PAGE PARTNERSHIP FOR ACTION ON GREEN ECONOMY

MODEL DOCUMENTATION:

Expanded Green Economy Model (GEM) for Circular Economy Assessments





ABOUT THIS DOCUMENT

This document is based on the model developed for the UNEP's report: Mapping Macroeconomic Impacts: A Modelling Framework for Circular Economy Pathways, and is published as part of the Partnership for Action on Green Economy (PAGE) – an initiative by the United Nations Environment Programme (UNEP), the International Labour Organization (ILO), the United Nations Development Programme (UNDP), the United Nations Industrial Development Organization (UNIDO) and the United Nations Institute for Training and Research (UNITAR).

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CITATION

PAGE (2026). Model Documentation: Expanded Green Economy Model (GEM) for Circular Economy Assessments – Technical Document.

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ACKNOWLEDGMENTS

The Partnership for Action on Green Economy (PAGE) gratefully acknowledges the generous support of its funding partners: the European Union, the German Federal Ministry for the Environment, Climate Action, Nature Conservation and Nuclear Safety, the Ministry for Foreign Affairs of Finland, the Norwegian Ministry of Climate and Environment, the Ministry of Climate, Energy and Environment of the Republic of Korea, the Swedish International Development Cooperation Agency (Sida), and the Swiss State Secretariat for Economic Affairs (SECO).

PAGE is a joint initiative of five United Nations agencies—UNEP, UNDP, ILO, UNIDO, and UNITAR—working together to support countries in advancing inclusive green economy policies and practices.

This model documentation was prepared by the United Nations Environment Programme (UNEP) in partnership with the Shamba Centre for Food and Climate, under the Partnership for Action on Green Economy (PAGE) Global Modelling Workstream.

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MODEL DOCUMENTATION

Model Settings

Units for time: Year
Initial time: 1970
Final time: 2050
Timestep: 0.125
Integration technique: Euler

Model Equations

"1 year delay time"= 1 Units: Year

"1st generation biofuel production"= (land for 1st generation biofuel*litre ge per hectare 1st generation biofuels (Time)) Units: lge

"2nd gen biofuel capital"= INTEG ("2nd gen biofuel investment"-"2nd gen biofuels capital decay", initial 2nd gen biofuel capital) Units: lge

"2nd gen biofuel investment"= biofuels investment/cost per litre ge 2nd generation(Time) Units: lge/Year

"2nd gen biofuels capital decay"= "2nd gen biofuel capital"*depreciation rate Units: lge/Year

"2nd generation biofuels production"= DELAY N(agricultural residue for 2nd generation biofuels dry matter*conversion efficiency of 2nd generation biofuels , 2, agricultural residue for 2nd generation biofuels dry matter*conversion efficiency of 2nd generation biofuels , 3) Units: lge

"2or3 wheel type": two wheel, three wheel

aa= distribution losses(Time)/total net electricity demand Units: dmnl

aaa= coal demand for power generation in mst*20*1e+006 Units: dmnl

access to health care weight= 0.3 Units: Dmnl

actual air travel= air travel volume-indicated air travel reduction Units: Km/Year

actual car travel= INDICATED CAR TRAVEL-indicated car travel reduction Units: Km/Year

actual crop diseases loss= crops disease loss-fraction of increase pesticide from new investment Units: Dmnl

actual fraction of private cars population reduction= if then else(indicated urban green investment fraction=0, 0, indicated fraction of private cars population reduction) Units: Dmnl

actual organic fertilizer increase= min(fertilizer consumption,organic fertilizer increase) Units: Ton/Year

actual total travel volume= total travel volume-total travel volume reduction due to efficiency Units: Km/Year

actual transportation emission abatement= DELAY N(indicated transportation emission abatement, 3, 0, 3) Units: Ton/Year

actual world oil fraction recoverable= World Oil Recoverable Reserves/World Oil Discovered Reserves Units: Dmnl

addition to share= ("non-recyclers convinced by campaign"+convinced by recyclers)/total population Units: Dmnl/Year

addition to world oil discovered reserves= DELAY N(indicated addition to world oil discovered reserve, 6, indicated addition to world oil discovered reserve , 3) Units: MB/Year

addition to world oil undiscovered resources= DELAY N(indicated addition to world oil undiscovered resource, 10, indicated addition to world oil undiscovered resource , 3) Units: MB/Year

additional agricultural land able to be reforested= if then else(Time>2026:AND:CE policy switch>0,(agricutlural land wasted in 2026 -agriculturland land wasted),0) Units: Ha/Year

Additional agricultural productivity= (additional agricultural land able to be reforested*Increase in yield per hectare reforested due to less food losses)/unit correction for year Units: Ton/Ha

additional agriculture electricity demand from electrification= indicated reduction in agriculture renewable resources demand from electrification +indicated reduction in agriculture coal demand from electrification +indicated reduction in agriculture petroleum demand from electrification +Indicated reduction in agriculture natural gas demand Units: qdbtu/Year

additional commericla electricity demand from electrification= indicated reduction in commercial renewable resources demand from electrification +indicated reduction in

commercial coal demand from electrification +indicated reduction in commercial petroleum demand from electrification +Indicated reduction in commercial natural gas demand Units: qdbtu/Year

additional electricity demand from electrification= indicated reduction in industrial renewable resources demand from electrification +indicated reduction in industrial coal demand from electrification +indicated reduction in industrial petroleum demand from electrification +Indicated reduction in industrial natural gas demand Units: qdbtu/Year

additional electricity demand from EVs CE in qdbtu= car stock oil demand reduction in mb/QDBTU to MB(Time) Units: qdbtu/Year

additional employment due to shift to organic farming= (agriculture employment from organic farming-BAU organic farming jobs)*fractional additional employment due to shift to organic farming Units: Person

additional fishing electricity demand from electrification= indicated reduction in fishing renewable resources demand from electrification +indicated reduction in fishing coal demand from electrification +indicated reduction in fishing petroleum demand from electrification +Indicated reduction in fishing natural gas demand Units: qdbtu/Year

additional land that can be restored to forests= if then else(Time>2026:AND:CE policy switch>0,BAU share of agricultural land in losses -share of agricultural land,0) Units: 1/Year

additional nonenergy electricity demand from electrification= indicated reduction in nonenergy renewable resources demand from electrification +indicated reduction in nonenergy coal demand from electrification +indicated reduction in nonenergy petroleum demand from electrification +Indicated reduction in nonenergy natural gas demand Units: qdbtu/Year

additional others electricity demand from electrification= indicated reduction in others renewable resources demand from electrification +indicated reduction in others coal demand from electrification +indicated reduction in others petroleum demand from electrification +Indicated reduction in others natural gas demand Units: qdbtu/Year

additional residential electricity demand from electrification= indicated reduction in residential renewable resources demand from electrification +indicated reduction in residential coal demand from electrification +indicated reduction in residential petroleum demand from electrification +Indicated reduction in residential natural gas demand Units: qdbtu/Year

additional transport electricity demand from electrification= indicated reduction in transport renewable resources demand from electrification +indicated reduction in transport coal demand from electrification +indicated reduction in transport petroleum

demand from electrification +Indicated reduction in transport natural gas demand Units: qdbtu/Year

adjustment time for average years of schooling= 30 Units: Year

adult age : (AGE 15-AGE 79), AGE 80 AND OVER

adult crude death rate= total adult deaths/SUM(Population[sex!,adult age!]) Units: Dmnl/Year

afforestation= (afforestation rate(Time))+AFFORESTATION FROM INVESTMENT Units: Ha/Year

afforestation employment= afforestation*afforestation employment factor Units: Person

afforestation employment factor= 0.0067 Units: Person/Ha

AFFORESTATION FROM INVESTMENT= if then else(FOREST POLICY SWITCH=0, 0, desired afforestation from investment (Time)) Units: Ha/Year

afforestation rate([(1970,0)-(2020,8e+006)],(1970,7.02e+006),(1982,7.46e+006),(1990,7.02e+006),(1996,6.36e+006),(2001,5.7e+006),(2009,4.82e+006),(2020.15,5.89474e+006)) Units: Ha/Year

AG CHILDBEARING : (AGE 15-AGE 49)

age : new born, AGE 0, (AGE 1-AGE 79),AGE 80 AND OVER

AGE 1 to 4 : (AGE 1-AGE 4)

AGE 10 to 14 : (AGE 10-AGE 14)

AGE 15 to 19 : (AGE 15-AGE 19)

AGE 20 to 24 : (AGE 20-AGE 24)

AGE 25 to 29 : (AGE 25-AGE 29)

AGE 30 to 34 : (AGE 30-AGE 34)

AGE 35 to 39 : (AGE 35-AGE 39)

AGE 40 to 44 : (AGE 40-AGE 44)

AGE 45 to 49 : (AGE 45-AGE 49)

AGE 5 to 9 : (AGE 5-AGE 9)

AGE 50 to 54 : (AGE 50-AGE 54)

AGE 55 to 59 : (AGE 55-AGE 59)

AGE 60 to 64 : (AGE 60-AGE 64)

AGE 65 to 69 : (AGE 65-AGE 69)

AGE 70 to 74 : (AGE 70-AGE 74)

AGE 75 to 79 : (AGE 75-AGE 79)

age group : AG UNDER 1,AG 1 TO 4,AG 5 to 9,AG 10 to 14,AG 15 TO 19,AG 20 to 24 ,AG 25 to 29, AG 30 to 34,AG 35 to 39,AG 40 to 44,AG 45 to 49,AG 50 to 54,AG 55 to 59 ,AG 60 to 64, AG 65 TO 69,AG 70 TO 74,AG 75 TO 79,AG 80 AND OVER -> (age : age under 1, AGE 1 to 4,AGE 5 to 9,AGE 10 to 14,AGE 15 to 19,AGE 20 to 24 ,AGE 25 to 29, AGE 30 to 34,AGE 35 to 39,AGE 40 to 44,AGE 45 to 49,AGE 50 to 54,AGE 55 to 59 ,AGE 60 to 64, AGE 65 to 69,AGE 70 to 74,AGE 75 to 79,AGE 80 AND OVER)

age group weight[sex, age group]= Population Group[sex,age group]/SUM(Population Group[sex,age group!]) Units: Dmnl

Age Over 0: (AGE 0- AGE 79), AGE 80 AND OVER

AGE SPECIFIC FERTILITY DISTRIBUTION[AG CHILDBEARING]= AGE SPECIFIC FERTILITY DISTRIBUTION TABLE(AG CHILDBEARING-2) Units: Dmnl/Year

AGE SPECIFIC FERTILITY DISTRIBUTION TABLE([(15,0)-(50,0.05)],(15,0),(16,0.00999131),(17,0.0199826),(18,0.0242424),(19,0.0285021),(20,0.0327618),(21,0.0370215),(22,0.0412813),(23,0.0422571),(24,0.043233),(25,0.0442088),(26,0.0451847),(27,0.0461605),(28,0.0456457),(29,0.0451309),(30,0.0446161),(31,0.0441013),(32,0.0435865),(33,0.0414401),(34,0.0392937),(35,0.0371473),(36,0.035001),(37,0.0328546),(38,0.029842),(39,0.0268294),(40,0.0238168),(41,0.0208042),(42,0.0177916),(43,0.0153177),(44,0.0128438),(45,0.0103699),(46,0.00789606),(47,0.00542217),(48,0.00361478),(49,0.00180739),(50,0)) Units: Dmnl/Year

age under 1: new born, AGE 0

agproduct: Cereals,FibreCrops,VegetablesandFruit,Oilcrops,Pulses,RootsandTubers,Treenuts,Meat,Milk, Egg

agric residue factor for biofuels= 0.6 Units: Dmnl

agric yield after harvest in volume= crops yield in volume*(1-harvest loss fraction) Units: Ton/Year

agric yield available for food= agric yield for food*(1-distribution losses fraction) Units: Ton/Year

agric yield for food= agric yield after harvest in volume*(1-animal feed fraction) Units: Ton/Year

Agricultural Land= Arable Land+Pasture Land Units: Ha

AGRICULTURAL LAND IN USE([(1980,0)-(2002,5e+008)],(1980,1.90624e+008),(1981,1.90624e+008),(1982,1.89799e+008),(1983,1.89799e+008),(1984,1.89799e+008),(1985,1.89799e+008),(1986,1.89799e+008),(1987,1.87776e+008),(1988,1.87776e+008),(1989,1.87776e+008),(1990,1.87776e+008),(1991,1.87776e+008),(1992,1.8618e+008),(1993,1.84948e+008),(1994,1.84139e+008),(1995,1.84139e+008),(1996,1.81306e+008),(1997,1.84139e+008),(1998,1.79282e+008),(1999,1.78473e+008),(2000,1.78877e+008),(2001,1.77259e+008),(2002,1.78068e+008)) Units: Ha

agricultural residue for 2nd generation biofuels dry matter= agricultural residue fresh matter for 2nd generation biofuels production*fresh matter to dry matter factor Units: Ton

agricultural residue fresh matter for 2nd generation biofuels production= min((biofuels feedstock cost/price of feedstock), agricultural yield for biofuels fresh matter) Units: Ton

agricultural waste= crops yield in volume*agriculture waste intensity time series Units: Ton/Year

AGRICULTURAL WATER DEMAND= indicated agric desired water demand rate*relative harvested area^elasticity of agric water demand to harvested area *(1-WATER EFFICIENCY FROM INVESTMENT) Units: Km3/Year

agricultural yield for biofuels fresh matter= crops yield in volume*agric residue factor for biofuels Units: Ton/Year

agricultural yield in volume by type[agproduct]= crops yield in volume*share of yield[agproduct](Time) Units: Ton/Year

agriculture biomass investments= biofuel from crops total investment+bioproduct from crops total investment Units: USD/Year

agriculture capital elasticity= 0.25 Units: Dmnl

agriculture capital life= 20 Units: Year

agriculture co2 emission from energy use= "Coal/peat co2 emisson"+electricity co2 emission+gas co2 emission+oil co2 emission +renewables and waste co2 emission Units: mtoe/Year

agriculture coal demand= DELAY N((indicated agriculture coal demand 0*Coal Price Substitutability^ agriculture elasticity of coal demand to coal price), time to adapt demand to price changes,(indicated agriculture coal demand 0 *Coal Price Substitutability^agriculture elasticity of coal demand to coal price), 3) Units: qdbtu/Year

agriculture desired capital labor ratio= initial agriculture capital labor ratio*relative average years of schooling ^elasticity of capital labour ration to average years of schooling agriculture *relative average life expectancy^elasticity of capital labour ratio to average life expectancy agric Units: usd15/Person

agriculture elasticity of coal demand to coal price= -0.1 Units: Dmnl

agriculture elasticity of coal demand to price= 1 Units: Dmnl

agriculture elasticity of electricity to gdp= 0.4 Units: Dmnl

agriculture elasticity of natural gas demand to natural gas price= -0.1 Units: Dmnl

agriculture Elasticity of natural gas demand to price= 0.1 Units: Dmnl

agriculture elasticity of oil demand to price= 0.6 Units: Dmnl

agriculture elasticity of petroleum demand to oil price= -0.01 Units: Dmnl

agriculture elasticity of renewable resources demand to price= 1 Units: Dmnl

agriculture elasticity of renewable resources demand to renewable resources price = -0.02 Units: Dmnl

agriculture electricity demand= DELAY N((indicated agricultureelectricity net demand 0*Electricity Price Substitutability ^agricultureelasticity of electricity demand to electricity price), time to adapt demand to price changes,(indicated agricultureelectricity net demand 0 *Electricity Price Substitutability ^agricultureelasticity of electricity demand to electricity price), 3) Units: qdbtu/Year

agriculture electricity GDP Intensity= normalized agriculture electricity net demand/real gross domestic product Units: qdbtu/usd15

agriculture employment= INTEG (net change in agriculture employment, initial agriculture employment) Units: Person

agriculture employment from organic farming= (agriculture employment-direct fisheries employment-forestry employment)*ratio of organic to chemical fertilizer use Units: Person

agriculture green investment= green economy investment*agriculture green investment fraction(Time) Units: usd15/Year

agriculture green investment fraction([(2011,0)-(2050,0.3)],(2011,0.26),(2050,0.26)) Units: Dmnl

agriculture labor demand= (capital agriculture/agriculture desired capital labor ratio) Units: Person

agriculture natural gas demand= DELAY N((indicated agriculture natural gas demand 0*Natural Gas Price Substitutability ^agriculture elasticity of natural gas demand to natural gas price), time to adapt demand to price changes,(indicated agriculture natural gas demand 0 *Natural Gas Price Substitutability^agriculture elasticity of natural gas demand to natural gas price), 3) Units: qdbtu/Year

agriculture natural gas GDP Intensity= normalized agriculture natural gas demand/real gross domestic product Units: qdbtu/usd15

agriculture petroleum demand= DELAY N((indicated agriculture petroleum demand 0*Oil Price Substitutability ^agriculture elasticity of petroleum demand to oil price), time to adapt demand to price changes ,(indicated agriculture petroleum demand 0 *Oil Price Substitutability^agriculture elasticity of petroleum demand to oil price), 3) Units: qdbtu/Year

agriculture petroleum gdp intensity= normalized agriculture petroleum demand/real gross domestic product Units: qdbtu/usd15

agriculture production= crop production+fish production+forestry production+livestock production Units: usd15/Year

agriculture renewable resources demand= DELAY N((indicated agriculture renewable resources demand 0*Renewable Resources Price Substitutability ^agriculture elasticity of renewable resources demand to renewable resources price), time to adapt demand to price changes, (indicated agriculture renewable resources demand 0 *Renewable Resources Price Substitutability ^ agriculture elasticity of renewable resources demand to renewable resources price), 3) Units: qdbtu/Year

agriculture renewable resources GDP intensity= normalized agriculture renewable resources demand/real gross domestic product Units: qdbtu/usd15

Agriculture share of GDP= agriculture production/SUM GDP Units: 1

agriculture waste intensity time series:= 0.2 Units: Dmnl

agriculturecoal gdp intensity= normalized agriculture coal demand/real gross domestic product Units: qdbtu/usd15

agricultureelasticity of electricity demand to electricity price= -0.05 Units: Dmnl

agriculturland land wasted= total food losses/BAU YIELD Units: Ha/Year

agricutlural land wasted in 2026= 8.963e+008 Units: Ha/Year

air average fuel efficiency= 0.075 Units: litre/Km

air CO2 emissions= air energy consumption*CO2 EMISSION FACTORS[jet fuel] Units: mtoe/Year

air energy consumption= air average fuel efficiency *actual air travel*convert LITRE to mtoe*(1-efficiency ratio transport from green investment) Units: mtoe/Year

air pollutants from buildings[Pollutants]= Pollutant coefficient per building[Pollutants](Time)*Sale of buildings Units: KILODALY/Year

air pollutants from clothing[Pollutants]= Pollutant coefficient per clothing[Pollutants](Time)*Sale of clothing Units: KILODALY/Year

air pollutants from plastic[Pollutants]= Pollutant coefficient per plastic[Pollutants](Time)*Sale of plastic Units: KILODALY/Year

air pollutants from vehicles[Pollutants]= Pollutant coefficient per vehicle[Pollutants](Time)*Sale of vehicle Units: KILODALY/Year

air pollution cost switch= 0 Units: Dmnl

air travel employment= air travel employment factor*air travel volume Units: Person

air travel employment factor= 1.70091e-006 Units: Person/Km

air travel reduction fraction= if then else(indicated green economy investment fraction=0, 0, indicated fraction of air travel reduction) Units: Dmnl

air travel volume= INITIAL AIR TRAVEL VOLUME*relative gdp ^elasticity of air travel volume to gdp growth Units: Km/Year

allowance price per ton= real base case allowance price per ton Units: USD/Ton

aluminium demand for buildings= Sale of buildings*kg of aluminium in a building Units: Kg/Year

aluminium demand for vehicles= Sale of vehicle*kg of aluminium in a vehicle Units: Kg/Year

Aluminum allowance share= 0 Units: Dmnl

Aluminum allowance share of EITE= Aluminum average two years emissions*total allowances share of eite/average two years emissions Units: Dmnl

Aluminum average two years emissions= (Aluminum emission one+Aluminum emission two)/2 Units: Ton/Year

Aluminum average two years production= (Aluminum production one+Aluminumproduction two)/2 Units: Ton/Year

Aluminum carbon intensity= Aluminum average two years emissions/Aluminum average two years production Units: Dmnl

Aluminum coal consumption= total Aluminum production*Aluminum energy Intensity[coal energy]*(1-energy efficiency ratio from green investment industry) Units: ktoe/Year

Aluminum coal consumption IN MBTU= Aluminum coal consumption*KTOE TO MBTU Units: Mbtu/Year

Aluminum coal emissions= Aluminum coal consumption IN MBTU*coal emission factor*MBTU TO TJ Units: Kg/Year

Aluminum coal intensity([(1985,0)-(2010,10)],(1985,3.41057e-005),(1986,3.32218e-005),(1987,2.72745e-005),(1988,2.6952e-005),(1989,2.65709e-005),(1990,2.63081e-005),(1991,2.56395e-005),(1992,2.56224e-005),(1993,2.39506e-005),(1994,2.40932e-005),(1995,2.34176e-005),(1996,2.29164e-005),(1997,2.14409e-005),(1998,2.34969e-005),(1999,2.31978e-005),(2000,1.98407e-005),(2001,1.99909e-005),(2002,1.79608e-005),(2003,1.44477e-005),(2004,1.83162e-005),(2005,1.52055e-005),(2006,1.52609e-005),(2007,1.01809e-005),(2008,1.43377e-005)) Units: Mbtu/Ton

Aluminum coal price= Coal Price per MBTU Units: USD/Mbtu

Aluminum demand over supply= total Aluminum demand/total Aluminum production Units: Dmnl

Aluminum demand per unit of GDP([(1973,3e-007)-(2024,7e-007)],(1973,4.45228e-007),(1974,4.94956e-007),(1975 ,4.27922e-007),(1976,4.25758e-007),(1977,4.58866e-007),(1978,4.57333e-007), (1979,4.57363e-007),(1980,4.72869e-007),(1981,4.51674e-007),(1982,3.9008e-007),(1983,3.93231e-007),(1984,4.35901e-007),(1985,4.08595e-007),(1986,3.96983e-007),(1987,4.08973e-007),(1988,4.50794e-007),(1989,4.48819e-007),(1990,4.45618e-007),(1991,4.42276e-007),(1992,4.26557e-007),(1993,4.24241e-

007),(1994,3.94144e-007),(1995,3.92115e-007),(1996,4.06786e-007),(1997,4.11552e-007),(1998,4.19073e-007),(1999,4.24655e-007),(2000,4.26198e-007),(2001,4.10847e-007),(2002,4.32809e-007),(2003,4.49565e-007),(2004,4.58724e-007),(2005,4.71501e-007),(2006,4.7971e-007),(2007,5.22306e-007),(2008,5.35372e-007),(2009,5.05399e-007),(2010,5.49189e-007),(2011,5.83985e-007),(2012,6.09054e-007),(2013,6.31074e-007),(2014,6.42923e-007),(2015,6.76329e-007),(2016,6.7503e-007),(2017,6.8419e-007),(2018,6.66496e-007),(2019,6.41661e-007),(2020,6.87563e-007),(2021,6.5535e-007),(2022,6.56078e-007),(2023,6.51133e-007),(2024,6.55328e-007)) Units: Ton/usd15

aluminum ELECTRICITY consumption= total Aluminum production*Aluminum energy Intensity[electricity]*(1-energy efficiency ratio from green investment industry) Units: ktoe/Year

aluminum ELECTRICITY consumption IN MBTU= aluminum ELECTRICITY consumption*KTOE TO MBTU Units: Mbtu/Year

Aluminum electricity emissions= aluminum ELECTRICITY consumption IN MBTU*electricity emission factor Units: Kg/Year

Aluminum ELECTRICITY intensity([(1985,0)-(2010,10)],(1985,0.000544583),(1986,0.000563703),(1987,0.000572535),(1988,0.000588034),(1989,0.00060023),(1990,0.000567867),(1991,0.000572245),(1992,0.000565432),(1993,0.000557815),(1994,0.000532634),(1995,0.000510657),(1996,0.000521132),(1997,0.00051751),(1998,0.000528076),(1999,0.000490928),(2000,0.000470746),(2001,0.000448363),(2002,0.000456568),(2003,0.000455862),(2004,0.000468446),(2005,0.000533975),(2006,0.000462082),(2007,0.000499155),(2008,0.000518835)) Units: Mbtu/Ton

Aluminum electricity price= reference electricity price Units: USD/kWh

Aluminum electricity price in mbtu= Aluminum electricity price*kwh to mbtu Units: USD/Mbtu

Aluminum emission one= DELAY FIXED (Aluminum emissions, 1 , Aluminum emissions) Units: Ton/Year

Aluminum emission two= DELAY FIXED (Aluminum emissions, 2 ,Aluminum emissions) Units: Ton/Year

Aluminum emissions= Aluminum total emissions in tons Units: Ton/Year

Aluminum employment per unit of output([(1990,0)-(2050,0.05)],(1990,0.0410088),(1991,0.0393417),(1992,0.0377464),(1993,0.0393487),(1994,0.0390488),(1995,0.0376354),(1996,0.0329656),(1997,0.0336814),(1998,0.0314418),(1999,0.0312132),(2000,0.0267421),(2001,0.0286219),(2002 ,0.0288236),(2003,0.0286524),(2004,0.0271647),(2005,0.0287812),(2006,0.0318713

),(2007,0.0229136),(2008,0.019492),(2009,0.0208137),(2010,0.0207252),(2011,
0.0184546),(2012,0.0174799),(2013,0.0159836),(2014,0.0155562),(2015,0.0152105
),(2016,0.0163034),(2017,0.0163469),(2018,0.0171376),(2019,0.0199926),(2020
,0.0183014),(2021,0.0178162),(2022,0.0169602),(2023,0.0169063),(2049.45,0.0109649
)) Units: Person/Ton

Aluminum energy cost= Aluminum coal consumption IN MBTU*Aluminum coal price+aluminum oil consumption IN MBTU *Aluminum oil price+Aluminum natural gas consumption IN MBTU *Aluminum natural gas price+Aluminum residual fuel consumption IN MBTU*Aluminum reNEWABLES price +aluminum ELECTRICITY consumption IN MBTU *Aluminum electricity price in mbtu Units: USD/Year

Aluminum energy cost over total cost= Aluminum energy cost/Aluminum total production cost Units: Dmnl

Aluminum energy intensity change[electricity]= Aluminum indicated energy intensity[electricity]-Aluminum energy Intensity[electricity] Aluminum energy intensity change[diesel]= Aluminum indicated energy intensity[diesel]-Aluminum energy Intensity[diesel] Aluminum energy intensity change[natural gas]= Aluminum indicated energy intensity[natural gas]-Aluminum energy Intensity [natural gas] Aluminum energy intensity change[ethanol]= Aluminum indicated energy intensity[ethanol]-Aluminum energy Intensity[ethanol] Aluminum energy intensity change[coal energy]= Aluminum indicated energy intensity[coal energy]-Aluminum energy Intensity [coal energy] Units: Mbtu/Ton

Aluminum energy Intensity[electricity]= INTEG (Aluminum energy intensity change[electricity], Aluminum ELECTRICITY intensity(Time)) Aluminum energy Intensity[diesel]= INTEG (Aluminum energy intensity change[diesel], Aluminum oil intensity(Time)) Aluminum energy Intensity[natural gas]= INTEG (Aluminum energy intensity change[natural gas], Aluminum natural gas intensity(Time)) Aluminum energy Intensity[ethanol]= INTEG (Aluminum energy intensity change[ethanol], Aluminum renewables intensity(Time)) Aluminum energy Intensity[coal energy]= INTEG (Aluminum energy intensity change[coal energy], Aluminum coal intensity(Time)) Units: Mbtu/Ton

Aluminum indicated energy intensity[electricity]= if then else(Time<2008, Aluminum ELECTRICITY intensity(Time), Aluminum energy Intensity [electricity]/percentage increase in efficiency) Aluminum indicated energy intensity[diesel]= if then else(Time<2008, Aluminum oil intensity(Time), Aluminum energy Intensity [diesel]/percentage increase in efficiency) Aluminum indicated energy intensity[natural gas]= if then else(Time<2008, Aluminum natural gas intensity(Time), Aluminum energy Intensity [natural gas]/percentage increase in efficiency) Aluminum indicated energy intensity[ethanol]= if then else(Time<2008, Aluminum renewables intensity(Time), Aluminum energy Intensity [ethanol]/percentage increase in efficiency) Aluminum indicated energy intensity[coal energy]= if then else(Time<2008, Aluminum coal

intensity(Time), Aluminum energy Intensity [coal energy]/percentage increase in efficiency) Units: Mbtu/Ton

Aluminum labor cost= total Aluminum employment*Aluminum labor cost table(Time) Units: USD/Year

Aluminum labor cost table([(1995,0)-(2010,100000)],(1995,36600),(1996,43100),(1997,36200),(1998,65400),(1999,28900),(2000,25400),(2001,19400),(2002,22800),(2003,31900),(2004,36500),(2005,37700),(2006,19900)) Units: USD/Person

Aluminum market price= Aluminum market price table(Time) Units: USD/Ton

Aluminum market price table([(1995,0)-(2010,10000)],(1995,3159),(1996,2117),(1997,2317),(1998,1499),(1999,1578),(2000,1455),(2001,1779),(2002,1297),(2003,1554),(2004,1751),(2005,1693),(2006,2312)) Units: USD/Ton

Aluminum material and capital production cost= total Aluminum production*Aluminum unit cost(Time) Units: USD/Year

Aluminum material cost= INTEG (Aluminum material cost change, Aluminum unit cost(Time)) Units: USD/Ton

Aluminum material cost change= indicated Aluminum material cost-Aluminum material cost Units: USD/Ton

Aluminum natural gas consumption= total Aluminum production*Aluminum energy Intensity[natural gas]*(1-energy efficiency ratio from green investment industry) Units: ktoe/Year

Aluminum natural gas consumption IN MBTU= Aluminum natural gas consumption*KTOE TO MBTU Units: Mbtu/Year

Aluminum natural gas emissions= Aluminum natural gas consumption IN MBTU*natural gas emission factor*MBTU TO TJ Units: Kg/Year

Aluminum natural gas intensity([(1985,0)-(2010,10)],(1985,2.72846e-007),(1986,1.56585e-006),(1987,8.57198e-007),(1988,4.35679e-007),(1989,1.82722e-007),(1990,1.31322e-007),(1991,1.97988e-007),(1992,1.41874e-007),(1993,1.23034e-007),(1994,4.97182e-007),(1995,3.73754e-007),(1996,3.66157e-007),(1997,3.4873e-007),(1998,6.40276e-007),(1999,3.43842e-007),(2000,2.64261e-007),(2001,2.07698e-007),(2002,2.34714e-007),(2003,6.22663e-007),(2004,3.69491e-007),(2005,2.67389e-007),(2006,3.17043e-007),(2007,1.99625e-007),(2008,5.43999e-007)) Units: Mbtu/Ton

Aluminum natural gas price= Natural Gas Price per MBTU Units: USD/Mbtu

Aluminum net allocations variable shares= min(Aluminum production based allocation,Aluminum upper limit allocation variable shares) Units: USD/Year

aluminum oil consumption= total Aluminum production*Aluminum energy Intensity[diesel]*(1-energy efficiency ratio from green investment industry) Units: ktoe/Year

aluminum oil consumption IN MBTU= aluminum oil consumption*KTOE TO MBTU Units: Mbtu/Year

Aluminum oil emissions= aluminum oil consumption IN MBTU*distillate fuel oil emission factor*MBTU TO TJ Units: Kg/Year

Aluminum oil intensity([(1985,0)-(2010,10)],(1985,7.4198e-005),(1986,6.9543e-005),(1987,6.78277e-005),(1988,6.54721e-005),(1989,7.26169e-005),(1990,6.91919e-005),(1991,6.48412e-005),(1992,6.66949e-005),(1993,6.34582e-005),(1994,6.1664e-005),(1995,5.953e-005),(1996,6.10725e-005),(1997,5.85386e-005),(1998,5.92316e-005),(1999,5.4751e-005),(2000,5.00617e-005),(2001,4.9536e-005),(2002,5.01472e-005),(2003,4.65344e-005),(2004,3.387e-005),(2005,3.83169e-005),(2006,3.65285e-005),(2007,3.07038e-005),(2008,2.79526e-005)) Units: Mbtu/Ton

Aluminum oil price= Oil Price per MBtu Units: USD/Mbtu

Aluminum operating margin= Aluminum operating surplus/Aluminum revenues Units: Dmnl

Aluminum operating surplus= Aluminum revenues-Aluminum total production cost Units: USD/Year

Aluminum price= INTEG (Aluminum price change, Aluminum market price table(Time)) Units: USD/Ton

Aluminum price change= indicated Aluminum price-Aluminum price Units: USD/Ton

Aluminum production based allocation= Aluminum average two years production*Aluminum carbon intensity*allowance price per ton Units: USD/Year

Aluminum production one= DELAY FIXED (total Aluminum production, 1 , total Aluminum production) Units: Ton/Year

Aluminum profit share([(1992,-0.8)-(2030,1)],(2000,0),(2001,-0.51),(2002,-0.1814),(2003,-0.2286) ,(2004,0.3487),(2005,0.3981),(2006,0.5337),(2007,0.6042)) Units: Dmnl

Aluminum profits over revenues= real Aluminum profit/real Aluminum revenues Units: Dmnl

Aluminum renewables intensity([(1985,0)-(2010,10)],(1985,7.95746e-005),(1986,7.81309e-005),(1987,8.10286e-005),(1988,7.81819e-005),(1989,7.89361e-005),(1990,7.69545e-005),(1991,7.71165e-005),(1992,7.49946e-005),(1993,6.83659e-005),(1994,6.54533e-005),(1995,6.73917e-005),(1996,6.49108e-005),(1997,5.75766e-005),(1998,5.66463e-005),(1999,5.31006e-005),(2000,4.89623e-005),(2001,4.61817e-005),(2002,4.40549e-005),(2003,4.13487e-005),(2004,3.81543e-005),(2005,3.87447e-005),(2006,4.14812e-005),(2007,3.73528e-005),(2008,3.34671e-005)) Units: Mbtu/Ton

Aluminum reNEWABLES price= Renewable Resource price per MBTU(Time) Units: USD/Mbtu

Aluminum residual fuel consumption= total Aluminum production*Aluminum energy Intensity[ethanol]*(1-energy efficiency ratio from green investment industry) Units: ktoe/Year

Aluminum residual fuel consumption IN MBTU= Aluminum residual fuel consumption*KTOE TO MBTU Units: Mbtu/Year

Aluminum residual fuel emissions= Aluminum residual fuel consumption IN MBTU*residual fuel oil emission factor *MBTU TO TJ Units: Kg/Year

Aluminum revenues= Aluminum market price*total Aluminum production Units: USD/Year

Aluminum total demand growth rate= ((total Aluminum demand-previous Aluminum total demand)/previous Aluminum total demand)/GROWTH RATE base period Units: Dmnl/Year

Aluminum total emissions in tons= (Aluminum coal emissions+Aluminum oil emissions+Aluminum electricity emissions + +Aluminum natural gas emissions+Aluminum residual fuel emissions)/1000 Units: Ton/Year

Aluminum total production cost= Aluminum labor cost+Aluminum material and capital production cost+Aluminum energy cost -Aluminum net allocations variable shares Units: USD/Year

Aluminum total production cost growth rate= ((Aluminum total production cost-previous Aluminum total production cost)/ previous Aluminum total production cost)/GROWTH RATE base period Units: Dmnl/Year

Aluminum total real unit cost= Aluminum total unit cost/gdp deflator Units: usd15/Ton

Aluminum total real unit cost growth rate= ((Aluminum total real unit cost-previous Aluminum total real unit cost)/previous Aluminum total real unit cost)/GROWTH RATE base period Units: Dmnl/Year

Aluminum total unit cost= Aluminum total production cost/total Aluminum production Units: USD/Ton

Aluminum unit cost([(1995,0)-(2010,10000)],(1995,1660),(1996,853),(1997,1100),(1998,274),(1999 ,648),(2000,612),(2001,760),(2002,345),(2003,516),(2004,540),(2005,520),(2006 ,1020)) Units: USD/Ton

Aluminum upper limit allocation variable shares= total allowance value*Aluminum allowance share of EITE Units: USD/Year

Aluminumproduction two= DELAY FIXED (total Aluminum production, 2 , total Aluminum production) Units: Ton/Year

ambition for decreasing plastics= (1-Ambition for transitioning to cotton CE) Units: Dmnl

Ambition for transitioning to cotton CE= if then else(CE policy switch=3:OR:S3 transitioning to cotton=3,transition to cotton HA ,if then else(CE policy switch=2:OR:S3 transitioning to cotton=2,transition to cotton CA ,if then else(CE policy switch=1:OR:S3 transitioning to cotton=1,transition to cotton LA ,0))) Units: 1

Ambition on electrification= WITH LOOKUP (Time, ([(2000,0)-(2049,1)],(2000,0),(2025,0),(2026,0.1297),(2045,1))) Units: Dmnl/Year

Ambition on less intensive use of floor space= if then else(CE policy switch=3:OR:S3 CE less intensive use of floor space =3,S3 less intensive use of floor space HA(Time),if then else(CE policy switch =2:OR:S3 CE less intensive use of floor space=2,S3 less intense use of floor space CA (Time),if then else(CE policy switch=1:OR:S3 CE less intensive use of floor space =1,S3 less intensive use of floor space LA(Time),0))) Units: Dmnl

ambition on reduction in building demand= if then else(CE policy switch=3:OR:S1 CE curtailing demand policy building =3,S1 reduction in building demand HA(Time),if then else(CE policy switch=2 :OR:S1 CE curtailing demand policy building=2,S1 reduction in building demand CA (Time),if then else(CE policy switch=1:OR:S1 CE curtailing demand policy building =1,S1 reduction in building demand LA(Time),0))) Units: Dmnl

ammonia emissions from power generation[power generation technology]= fuel use for power generation in TJ[power generation technology]*Ammonia emissions per TJ of fuel combusted [power generation technology]/KG PER TON Units: Ton/Year

Ammonia emissions per TJ of fuel combusted[power generation technology]= 0.101, 0.101, 1.829, 0.0117, 0, 0, 0, 0, 0, 0, 0, 0, 0.222, 0 Units: Kg/Tj

amount of carbon being sequestered by the forest= ((afforestation+forest regeneration)*maximum amount of carbon stored per heactare of forest land)/time needed to reach saturation Units: tons/Year

amount of carbon stored in forest lands= INTEG (amount of carbon being sequestered by the forest-amount of carbon stored lost , (natural forest area+planted forest area)*maximum amount of carbon stored per heactare of forest land) Units: tons

amount of carbon stored lost= (deforestation+harvested forest)*maximum amount of carbon stored per heactare of forest land Units: Ton/Year

animal consumption in tons= (meat production +fish catch)/2 Units: Ton/Year

animal feed fraction= 0.3 Units: Dmnl

annual cost of NH3 emissions= total annual ammonia emissions from power generation*average cost per ton of NH3 Units: USD/Year

annual cost of NOx emissions= total annual NOx emissions from power generation*average cost per ton of nox Units: USD/Year

"annual cost of pm2.5 emissions"= "change in cumulative pm2.5 emissions from power generation"*"average cost per ton of pm2.5 from electricity generating units" Units: USD/Year

"annual deaths from ambient air pollution (proxy)"= total population*death rate from ambient air pollution Units: Person/Year

"annual deaths from indoor air pollution (proxy)"= total population*death rate from indoor air pollution Units: Person/Year

annual fuel cost thermal power generation[FOSSIL FUEL AND NUCLEAR]= fuel use for power generation in TJ[FOSSIL FUEL AND NUCLEAR]*fuel cost per TJ [FOSSIL FUEL AND NUCLEAR] Units: USD/Year

annual number of batteries discarded= DELAY FIXED (annual number of batteries required, battery lifetime, 0) Units: Battery/Year

annual number of batteries required= (MAX(0,sale of EVs*unit correction for batteries-"Number of batteries required (60 kWh)" /time for units+annual number of batteries discarded)) Units: Battery/Year

annual social cost of carbon from fuel use for power generation= total GHG from power generation fuel use*social cost of carbon per ton of CO2e Units: USD/Year

annual waste investments= recycling investment+biofuel from waste investment+bioproduct from waste investment +electricity from biomass cofiring existing plant investment+electricity from biomass cofiring new plant investment +electricity from LFG investment+government investment for promoting waste management +natural gas generation from LFG investment Units: usd15/Year/Year

Arable Land= INTEG (forest to agricultural-arable to pasture-arable to settlement-change in forest , initial Arable Land) Units: Ha

arable land adjustment time= 2 Units: Year

arable land natural loss to pasture= 0.003 Units: Dmnl/Year

arable land per capita= WITH LOOKUP (Time, ([(1970,0)-(2050,0.4)],(1970,0.349917),(1971,0.341954),(1972,0.336598),(1973,0.330362),(1974,0.324549),(1975,0.318582),(1976,0.314267),(1977,0.310017),(1978,0.307026),(1979,0.302779),(1980,0.297882),(1981,0.293242),(1982,0.290027),(1983,0.285836),(1984,0.284019),(1985,0.281367),(1986,0.276504),(1987,0.271512),(1988,0.266127),(1989,0.261358),(1990,0.256747),(1991,0.25281),(1992,0.248033),(1993,0.243926),(1994,0.23977),(1995,0.236224),(1996,0.232687),(1997,0.23002),(1998,0.22671),(1999,0.223734),(2000,0.220118),(2001,0.217144),(2002,0.213796),(2003,0.211478),(2004,0.209062),(2005,0.206864),(2006,0.203791),(2007,0.200971),(2008,0.198345),(2009,0.196614),(2010,0.19421),(2011,0.192943),(2012,0.191208),(2013,0.189209),(2014,0.187166),(2015,0.185384),(2016,0.183381),(2017,0.181477),(2018,0.179449),(2019,0.177052),(2020,0.175525),(2021,0.174077),(2022,0.17232),(2023,0.170596),(2055,0.15))) Units: Ha/Person

arable to pasture= Arable Land*arable land natural loss to pasture Units: Ha/Year

arable to settlement= 0 Units: Ha/Year

area check= total area addressed+normalized area lost Units: Dmnl

area lost due to limited income classes= SUM(last income class[IncClass!])*missing income classes/2 Units: Dmnl

assumed annual change in ee for buildings([(2000,0)-(2025,0.02)],(2000,0),(2024,0),(2025,0.015)) Units: Dmnl/Year

assumed annual change in ee for clothing([(2000,0)-(2026,0.02)],(2000,0),(2024,0),(2025,0.002)) Units: Dmnl/Year

assumed annual change in ee for plastic([(2000,0)-(2026,0.02)],(2000,0),(2024,0),(2025,0.002)) Units: Dmnl/Year

assumed annual change in ee for vehicles([(2000,0)-(2026,0.02)],(2000,0),(2024,0),(2025,0.002)) Units: Dmnl/Year

assumed annual change in industry technology= WITH LOOKUP (Time, ([(2000,0)-(2030,0.02)],(2000,0.02),(2014,0.02),(2016,0.005),(2024,0.005) ,(2030,0.02))) Units: Dmnl/Year

Assumed change in material efficiency= WITH LOOKUP (Time, ([(2000,1)-(2026,2)],(2000,0),(2024,0),(2025,0.0015))) Units: Dmnl/Year

Assumed change in material efficiency for buildings= WITH LOOKUP (Time, ([(2000,1)-(2026,2)],(2000,0),(2024,0),(2025,0.0015))) Units: Dmnl/Year

Assumed change in material efficiency for clothing= WITH LOOKUP (Time, ([(2000,1)-(2026,2)],(2000,0),(2024,0),(2025,0.0015))) Units: Dmnl/Year

Assumed change in material efficiency for plastic= WITH LOOKUP (Time, ([(2000,1)-(2026,2)],(2000,0),(2024,0),(2025,0.0015))) Units: Dmnl/Year

average biomass electricity generation cost= initial biomas electricity generation cost*relative biomass price Units: usd15/kWh

average bus ownership([(1970,0)-(2050,0.01)],(1970,0.00232456),(1985,0.00232456),(2000,0.0022807),(2009,0.00219298),(2019,0.0020614),(2035,0.00201754),(2050,0.0020614)) Units: vehicle/Person

average car lifetime([(1970,0)-(2050,30)],(1970,17.3),(2000,17.3),(2005,17.3),(2010,17.4),(2015,17.5),(2020,17.6),(2025,17.7),(2030,17.7),(2035,17.8),(2040,17.8),(2045,17.8),(2050,17.8)) Units: Year

average car ownership rates= SMOOTH(average car ownership rates time series(Time), 2) Units: vehicle/Person

average car ownership rates time series([(1970,0)-(2050,1)],(1970,0.1135),(2000,0.113463),(2005,0.116317),(2010,0.122891),(2015,0.131579),(2020,0.140351),(2025,0.153509),(2030,0.166667),(2035,0.188596),(2040.21,0.219298),(2045,0.245614),(2050,0.285088)) Units: vehicle/Person

average coal electricity generation cost= initial coal electricity generation cost*(relative coal price^share of fuel cost for cogeneration power generation) Units: usd15/kWh

average cogeneration electricity generation cost= average biomass electricity generation cost*(SHARE OF Biomass ELECTRICITY GENERATION)+(average coal electricity generation cost*(1-SHARE OF Biomass ELECTRICITY GENERATION)) Units: usd15/kWh

average commercial power units per customer= effect of economic conditions on commercial electricity demand/(effect of electricity price ^commercial elasticity of units to price) Units: kWh/customers/Year

average cost of fuel per TJ of energy used[FOSSIL FUEL AND NUCLEAR]= 42.834, 42.834, 36.815, 26.43,0 Units: USD/(MW*hr)

average cost of vessel buyback= 7500 Units: usd15/vessel

average cost of worker relocation= 10000 Units: usd15/Person

average cost per ton of NH3= if then else (air pollution cost switch=1, average cost per ton of NH3 high cost, average cost per ton of NH3 low cost) Units: USD/Ton

average cost per ton of NH3 high cost= 51000 Units: USD/Ton

average cost per ton of NH3 low cost= 32000 Units: USD/Ton

average cost per ton of nox= if then else (air pollution cost switch=1, average cost per ton of nox high cost, average cost per ton of nox low cost) Units: USD/Ton

average cost per ton of nox high cost= 11000 Units: USD/Ton

average cost per ton of nox low cost= 6300 Units: USD/Ton

"average cost per ton of pm2.5 from electricity generating units"= if then else (air pollution cost switch=1, "average cost per ton of pm2.5 high cost", "average cost per ton of pm2.5 low cost") Units: USD/Ton

"average cost per ton of pm2.5 high cost"= 130000 Units: USD/Ton

"average cost per ton of pm2.5 low cost"= 29000 Units: USD/Ton

average cost per unit vessel= 7500 Units: USD/vessel

average depth of reservoirs= 3 Units: Km3/(Km*Km)

average depth of surface water= 1 Units: Km3/(Km*Km)

average diesel and fuel oil electricity generation cost= initial diesel and fuel oil electricity generation cost*(((relative fuel oil price *share of fuel over diesel oil for electricity generation)+(relative diesel oil price*(1-share of fuel over diesel oil for electricity generation)))^share of fuel cost for diesel and fuel oil power generation) Units: usd15/kWh

average distance traveled bus([(1970,0)-(2010,100000)],(1970,39220.3),(1971,40135.4),(1972,40896.2),(1973,41594.7),(1974,42283.4),(1975,42950.2),(1976,43587.4),(1977,44246.6),(1978,44979.4),(1979,45844.1),(1980,46852.8),(1981,47959),(1982,49071),(1983,50133.7),(1984,51187.2),(1985,52262.3),(1986,53392.9),(1987,54677.4),(1988,56166.2),(1989,57878.6),(1990,59779.2),(1991,61839.9),(1992,64000.9),(1993,66218.6),(1994,68484.9),(1995,70903.4),(1996,73446.7),(1997,75981.1),(1998,78433),

(1999,80778.2),(2000,83079),(2001,82670.3),(2002,82008.4),(2003,81239.9),(2004
,80566.6),(2005,80051.2),(2006,80024.6),(2007,80106.9),(2008,80112.6),(2009
,79989.1),(2010,79699.8)) Units: Km/vehicle

average distance traveled cars([(1970,0)-
(2010,100000)],(1970,9691.84),(1971,9700.6),(1972,9706.38),(1973
,9704.27),(1974,9703.15),(1975,9699.43),(1976,9691.07),(1977,9688.91),(1978
,9703.33),(1979,9745.71),(1980,9817.06),(1981,9906.46),(1982,9994.26),(1983
,10069.6),(1984,10141.1),(1985,10215.1),(1986,10298.1),(1987,10408.2),(1988
,10553.8),(1989,10737.5),(1990,10951.5),(1991,11190.4),(1992,11442.9),(1993
,11701.2),(1994,11964.5),(1995,12251),(1996,12555.9),(1997,12856.2),(1998,13140.2
),(1999,13404.9),(2000,13661.3),(2001,13791.8),(2002,13876.3),(2003,13936.7
),(2004,14012),(2005,14118.6),(2006,14318.9),(2007,14531.3),(2008,14723.3),
(2009,14892.2),(2010,15037.7)) Units: Km/vehicle/Year

average distance traveled passenger rail([(1970,0)-
(2100,1e+009)],(1971.59,3.693e+006),(1986.3,3.649e+006),(2001.41
,3.561e+006),(2009.88,3.868e+006)) Units: Km/vehicle

average electricity production cost= average diesel and fuel oil electricity generation cost*diesel and fuel oil share of power generation +average gas turbine electricity generation cost *gas turbine share of power generation+average hydro electricity generation cost *hydro share of power generation+average wind electricity generation cost *wind share of power generation+average coal electricity generation cost*coal share of power generation +average waste electricity generation cost *waste share of power generation+average cogeneration electricity generation cost *"co-generation share of power generation" +solar share of power generation*average solar electricity generation cost +average geothermal electricity generation cost *geothermal share of power generation+average landfill gas electricity generation cost *landfill gas share of power generation +average nuclear electricity generation cost*nuclear share of power generation +average tidal electricity generation cost*tidal share of power generation+ average wave electricity generation cost*wave share of power generation Units: usd15/kWh

average emissions per tj of electricity generation= ((emissions per GWh of gas power generation*(delayed share of gas*effect of CCS on emissions)+emissions per GWh of coal power generation*(delayed share of coal*effect of CCS on emissions) +emissions per GWh of liquid fuel power generation*(delayed share of oil*effect of CCS on emissions))/gwh per TJ) Units: Ton/Tj

average gas turbine electricity generation cost= initial gas turbine electricity generation cost*(relative kerosene price^share of fuel cost for gas turbine power generation) Units: Rs/kWh

average general industrial power units per customer= effect of economic conditions on industrial electricity demand/effect of electricity price ^general industrial elasticity of units to price Units: kWh/customers/Year

average geothermal electricity generation cost= initial geothermal electricity generation cost Units: usd15/kWh

Average global lifetime of a building= 95 Units: Year

Average global lifetime of a clothing= 4 Units: Year

Average global lifetime of a plastic= 15 Units: Year

Average global lifetime of a vehicle= 18 Units: Year

average hydro electricity generation cost= initial hydro electricity generation cost Units: usd15/kWh

average industrial units per customer= average general industrial power units per customer Units: kWh/customers/Year

average landfill gas electricity generation cost= initial landfill gas electricity generation cost Units: usd15/kWh

average life expectancy= life expectancy[FEMALE]*share of population per gender[FEMALE]+life expectancy [MALE]*share of population per gender [MALE] Units: Year

Average LITRES OF PETROL PER CAPITA= 484.34 Units: litre/Person/Year

average load per truck time series[medium truck]([(1970,0)-(2050,10)],(1970,1.764),(2000,0.745614),(2007,0.701754),(2013,0.614035),(2017,0.701754),(2023,0.921053),(2028,0.921053),(2032,0.964912),(2037,1.05263),(2045,1.09649),(2050,1.05263)) average load per truck time series[heavy truck]([(1970,0)-(2050,10)],(1969.51,8.37719),(2000,7.80939),(2005,7.74089),(2010,7.66915),(2015,7.59691),(2020,7.52473),(2025,7.46781),(2030,7.41328),(2035,7.35831),(2040,7.304),(2045,7.25036),(2050,7.19743)) Units: Ton/vehicle

average maturity of planted forest= 20 Units: Year

average natural death rate[FISH FEMALE, fish age]= 0.1,0.15,0.1,0.1, 0.01,0.01,0.01,0.01,0.01,0.01,0.01,0.01,0.01,0.01,0.01,0.01,0.01 ,0.01 average natural death rate[FISH MALE,fish age]= 0.1,0.15,0.1,0.1, 0.01,0.01,0.01,0.01,0.01,0.01,0.01,0.01,0.01,0.01,0.01,0.01, 0.01,0.01 Units: Dmnl/Year

average nuclear electricity generation cost= initial nuclear electricity generation cost Units: usd15/kWh

average oil price= SMOOTH(oil price, average year to smooth oil price) Units: usd15/bl/Year

average other power units per customer= Initial average other units per customer/effect of electricity price^others elasticity of units to price *relative gdp^others elasticity of units to gdp Units: kWh/customers/Year

"average pm2.5 emissions per TJ"= "total annual pm2.5 emissions from power generation"/(SUM(electricity generation rate [power generation technology!])*tj per mwh) Units: Ton/Tj

average population public transport ratio= 1000 Units: vehicle/Person

average precipitation= 1166.62/10^6 Units: Km/Year

average price per litre= 1.09 Units: usd15/litre

average residential power units per customer= effect of economic conditions on residential electricity demand/(effect of electricity price ^residential elasticity of units to price)*1.05 Units: kWh/(Year*customers)

average SO2 emissions per TJ by fuel grade table([(0,0)-(4,0.2)],(0,0.110777),(1,0.0197816),(2,0.0138471),(3,0.00276942),(4 ,0.000553883)) Units: Ton/Tj

average SO2 emissions per TJ of biomass= 0.102564 Units: Ton/Tj

average SO2 emissions per TJ of coal[sector]= 2.91 Units: Ton/Tj

average SO2 emissions per TJ of natural gas[sector]= 0.0179391 Units: Ton/Tj

average SO2 emissions per TJ of petroleum[transport]= average SO2 emissions per TJ by fuel grade table(current lookup value for fuel grade) average SO2 emissions per TJ of petroleum[INDUSTRY]= 1 average SO2 emissions per TJ of petroleum[other energy uses]= 1 average SO2 emissions per TJ of petroleum[NONENERGY USE]= 1 average SO2 emissions per TJ of petroleum[HOUSEHOLDS]= 1 Units: Ton/Tj

average solar electricity generation cost= initial solar electricity generation cost Units: usd15/kWh

average tidal electricity generation cost= initial tidal electricity generation cost Units: usd15/kWh

Average time for building waste to be incinerated= 50 Units: Years

Average time for waste from clothing to be incinerated= 50 Units: Years

Average time for waste from plastic to be incinerated= 50 Units: Years

Average time for waste to be incinerated= 50 Units: Years

average TJ per barrel of oil= 164 Units: Tj/Barrel

average TJ per ton of coal= 40 Units: Tj

average truck ownership heavy trucks([(1970,0)-(2050,0.1)],(1970,0.00219298),(1982,0.00263158),(2000,0.00307018),(2005,0.00350877),(2010,0.00394737),(2015,0.00438596),(2025,0.00486842),(2033,0.00614035),(2050,0.00789474)) Units: vehicle/Person

average truck ownership medium trucks([(1970,0)-(2050,0.1)],(1970,0.001),(2000,0.00438596),(2004,0.00570175),(2010,0.00657895),(2015,0.00789474),(2025,0.00877193),(2034,0.00929825),(2050,0.0136842)) Units: vehicle/Person

average two years emissions= (industries emissions one+industries emissions two)/2 Units: Ton/Year

average vehicle ownership three wheel([(1970,0)-(2050,0.1)],(1970,0.00570175),(1981,0.00482456),(1988,0.0045),(1998,0.0038),(2007,0.00394737),(2026,0.00482456),(2050,0.00614035)) Units: vehicle/Person

average vehicle ownership two wheel([(1970,0)-(2050,1)],(1970,0.0307018),(2000,0.0328947),(2010,0.0416667),(2020,0.0460526),(2030,0.0526316),(2050,0.0701754)) Units: vehicle/Person

average waste electricity generation cost= initial waste electricity generation cost Units: usd15/kWh

average water use per ha([(1980,0)-(2000,400000)],(1980,163000),(1992,165118),(2000,297313)) Units: gallon/Ha/Year

average wave electricity generation cost= initial wave electricity generation cost Units: usd15/kWh

average wind electricity generation cost= initial wind electricity generation cost Units: usd15/kWh

average year to smooth oil price= 2 Units: Year

average years of schooling= INTEG (change in average years of schooling, 3.6) Units: Year

average yeild per ha([(1980,100)-(2050,400)],(1980,179.349),(1981,176.64),(1982,174.593),(1983,

179.655),(1984,184.258),(1985,184.265),(1986,187.645),(1987,191.394),(1988,
192.315),(1989,193.418),(1990,192.104),(1991,183.452),(1992,179.035),(1993,
176.33),(1994,175.847),(1995,177.566),(1996,177.11),(1997,181.575),(1998,177.512
),(1999,184.069),(2000,188.157),(2001,183.758),(2002,186.627),(2003,190.899
),(2004,196.608),(2005,203.578),(2006,203.347),(2007,208.651),(2008,204.238
),(2009,198.306),(2010,214.01),(2011,223.648),(2012,229.833),(2013,238.718)
,(2014,246.581),(2015,246.185),(2016,252.08),(2017,254.461),(2018,260.761),
(2019,254.591),(2020,253.211),(2021,257.889),(2022,254.799),(2023,247.972),
(2050,301.754)) Units: m3/Ha

avoided deforestation cost= indicated deforestation reduction*opportunity cost of forest land Units: usd15/Year

AVRAGE LIFE bus[bus type]= 17, 17 Units: Year

AVRAGE LIFE trucks[truck type]= 17, 17 Units: Year

AVRAGE LIFE VEHICLE["2or3 wheel type"]= 17, 12 Units: Year

baseline share of agriculture land from fallow land([(2000,0.8)-
(2022,1)],(2000,0.9),(2015,0.8),(2016,0.8)) Units: Dmnl

battery lifetime= WITH LOOKUP (Time, ([(2020,10)-
(2100,20)],(2020,12),(2030,12),(2050,15),(2100,20))) Units: Year

battery recycling= if then else(CE policy switch=3,battery recycling HA(Time),if then else(CE policy switch =2,battery recycling CA(Time),if then else(CE policy switch=1,battery recycling LA (Time),battery recycling BAU(Time)))) Units: Dmnl

battery recycling BAU([(2022,0)-(2050,0.7)],(2022,0),(2026,0),(2050,0)) Units: Dmnl

battery recycling CA([(2022,0)-(2050,0.7)],(2022,0),(2026,0),(2050,0.4)) Units: Dmnl

battery recycling HA([(2022,0)-(2050,0.7)],(2022,0),(2026,0),(2050,0.6)) Units: Dmnl

battery recycling LA([(2022,0)-(2050,0.7)],(2022,0),(2026,0),(2050,0.2)) Units: Dmnl

BAU distribution losses fraction= 0.29 Units: Dmnl

BAU harvest loss fraction= 0.13 Units: Dmnl

BAU organic farming jobs= WITH LOOKUP (Time, ([(1970,0)-
(2050,6e+008)],(1970,1.65261e+008),(1971,1.70058e+008),(1972,1.75336e+008
),(1973,1.80928e+008),(1974,1.8718e+008),(1975,1.94376e+008),(1976,2.0183e+008
),(1977,2.09095e+008),(1978,2.16159e+008),(1979,2.23097e+008),(1980,2.30144e+008
),(1981,2.37321e+008),(1982,2.44425e+008),(1983,2.51006e+008),(1984,2.56604e+008
),(1985,2.61433e+008),(1986,2.6572e+008),(1987,2.69767e+008),(1988,2.73743e+008

),(1989,2.78175e+008),(1990,2.8289e+008),(1991,2.87623e+008),(1992,2.92358e+008
),(1993,2.96872e+008),(1994,3.01003e+008),(1995,3.04692e+008),(1996,3.08157e+008
),(1997,3.11392e+008),(1998,3.14387e+008),(1999,3.17084e+008),(2000,3.19273e+008
),(2001,3.21459e+008),(2002,3.23529e+008),(2003,3.25336e+008),(2004,3.26989e+008
),(2005,3.28847e+008),(2006,3.31033e+008),(2007,3.33633e+008),(2008,3.36663e+008
),(2009,3.40016e+008),(2010,3.43772e+008),(2011,3.4788e+008),(2012,3.52272e+008
),(2013,3.56904e+008),(2014,3.61726e+008),(2015,3.66521e+008),(2016,3.71422e+008
),(2017,3.76398e+008),(2018,3.81429e+008),(2019,3.865e+008),(2020,3.91599e+008
),(2021,3.96724e+008),(2022,4.01743e+008),(2023,4.06781e+008),(2024,4.11822e+008
),(2025,4.16847e+008),(2026,4.21846e+008),(2027,4.26819e+008),(2028,4.31778e+008
),(2029,4.36735e+008),(2030,4.41686e+008),(2031,4.46617e+008),(2032,4.51509e+008
),(2033,4.56338e+008),(2034,4.61091e+008),(2035,4.6576e+008),(2036,4.70346e+008
),(2037,4.74866e+008),(2038,4.79337e+008),(2039,4.83762e+008),(2040,4.88131e+008
),(2041,4.92456e+008),(2042,4.96682e+008),(2043,5.00771e+008),(2044,5.04652e+008
),(2045,5.08283e+008),(2046,5.11669e+008),(2047,5.14839e+008),(2048,5.17823e+008
),(2049,5.20636e+008),(2050,5.23296e+008))) Units: Person

BAU share of agricultural land in losses= 0.1932 Units: Dmnl/Year

BAU YIELD= (1-actual crop diseases loss)*natural crops yield per hectare Units: Ton/Ha

BCF to mmbtu= 1e+006 Units: mmbtu/BCF

bimass for cofiring existing plants= electricity from biomass cofiring existing plant*kwh per ton of waste Units: Ton/Year

biofuel EFFICIENCY= biofuel EFFICIENCY TABLE(Time) Units: gallon/Bushel

biofuel EFFICIENCY TABLE([(1970,0)-(2050,20)],(1970,1),(2010,1),(2049.51,1.5)) Units: gallon/Bushel

biofuel employment= "1st generation biofuel production"*first gen employment factor+"2nd generation biofuels production" *second gen employment factor Units: Person

biofuel from crops= crop for biofuel*crop to biofuel conversion Units: gallon/Year

biofuel from crops investment= biofuel from crops investment time series(Time) Units: USD/Year

biofuel from crops investment time series([(0,0)-(2100,10)],(1970,0),(2010,0)) Units: USD/Year

biofuel from crops total investment= INTEG (biofuel from crops investment, 0) Units: USD/Year

biofuel from organic waste= biofuel production from waste*biofuel production ratio*ton to gallon Units: gallon/Year

biofuel from waste capacity= biofuel from waste total investment*investment effect on biofuel from waste Units: gallon/Year

biofuel from waste investment= biofuel from waste investment time series(Time)/time delay for biofuel from waste investment Units: usd15/Year/Year

biofuel from waste investment time series([(0,0)-(2000,10)],(1970,0),(2000,0)) Units: usd15/Year

biofuel from waste total investment= INTEG (biofuel from waste investment, 0) Units: usd15/Year

Biofuel production facility from waste Investment time series 0([(1900,0)-(2025,8e+009)],(1992,0),(1994,0),(1994,0),(1995,0),(1995.63,0),(1996,0),(1997,0),(1998,0),(1999,0),(2000,0),(2001,0),(2002,0),(2003,0),(2005,0),(2006,0),(2007,0),(2008,0),(2009,0),(2010,0),(2010,7.11e+008),(2011,0),(2016,0),(2017,3.5e+008),(2018,0)) Units: USD/Year

biofuel production from waste= biofuel from waste capacity Units: Ton/Year

BIOFUEL PRODUCTION in QDBTU table([(1971,0)-(2010,50)],(1971,20.3804),(1972,20.7327),(1973,21.1327),(1974,21.5604),(1975,21.9796),(1976,22.3592),(1977,22.7882),(1978,23.2397),(1979,23.7555),(1980,24.2959),(1981,24.712),(1982,25.2845),(1983,26.111),(1984,26.7638),(1985,27.2863),(1986,27.959),(1987,28.4899),(1988,28.9164),(1989,29.6446),(1990,32.9396),(1991,33.4277),(1992,34.082),(1993,34.1453),(1994,34.6105),(1995,35.1151),(1996,35.6313),(1997,35.9911),(1998,36.0429),(1999,36.658),(2000,37.0163),(2001,37.0955),(2002,37.6898),(2003,38.6766),(2004,39.5418),(2005,40.2971),(2006,41.1395),(2007,42.1786)) Units: qdbtu/Year

biofuel production in TJ= ktoe to TJ*total biofuels production Units: Tj/Year

biofuel production ratio= 0.03 Units: Dmnl

biofuels capital cost= biofuels investment*biofuels capital cost fraction(Time) Units: usd15/Year

biofuels capital cost fraction([(2011,0)-(2050,1)],(2011,0.49),(2050,0.51)) Units: Dmnl

biofuels feedstock cost= biofuels investment*biofuels feedstock cost fraction(Time) Units: usd15/Year

biofuels feedstock cost fraction([(2011,0)-(2050,1)],(2011,0.35),(2050,0.33)) Units: Dmnl

biofuels investment= energy green investment*biofuels investment fraction(Time) Units: usd15/Year

biofuels investment fraction([(0,0)-(4000,10)],(2011,0),(2050,0)) Units: Dmnl

biofuels operation and management cost= (1-biofuels capital cost fraction(Time)-biofuels feedstock cost fraction(Time))*biofuels investment Units: usd15/Year

biogas production= biogas production time series(Time) Units: ktoe/Year

biogas production time series([(1900,0)-(2100,400000)],(1971,81.383),(1972,81.67),(1973,82.673),(1974,85.61),(1975,91.604),(1976,93.848),(1977,94.206),(1978,94.206),(1979,94.039),(1980,94.398),(1981,101.514),(1982,106.625),(1983,113.573),(1984,120.498),(1985,130.074),(1986,152.283),(1987,161.787),(1988,185.977),(1989,409.33),(1990,1559.53),(1991,1674.04),(1992,1754.06),(1993,1986.89),(1994,2900.82),(1995,3245.55),(1996,3614.74),(1997,4005.99),(1998,4207.04),(1999,6249.66),(2000,6998.08),(2001,8307.38),(2002,9766.23),(2003,10154.2),(2004,11246.2),(2005,12544.5),(2006,13314.1),(2007,16269.8),(2050,28070)) Units: ktoe/Year

biogasoline and biodiesel EROI= 1.2 Units: Dmnl

biomass and waste= world biofuel production in qdbtu+(waste energy electricity generation*GWH TO QDBTU) Units: qdbtu/Year

biomass and waste in TJ= (world renewable resources final consumption in mb/QDBTU to MB(Time))/TJ of coal to QDBTU Units: Tj/Year

biomass cofiring adjustment= 0.1 Units: Year

biomass conversion jobs= 0.13 Units: Person/GWh

Biomass demand for buildings= ((biomass demand per building*Sale of buildings)/Material efficiency for buildings)-building materials to be reused[biomass material] Units: Ton/Year

Biomass demand for clothing= (((biomass demand per clothing*(1+Ambition for transitioning to cotton CE) *Sale of clothing))/Material efficiency for clothing)-clothing materials to be reused [biomass material] Units: Ton/Year

Biomass demand for plastic= MAX(0,((biomass demand per plastic*Sale of plastic)/Material efficiency for plastic)-plastic materials to be reused[biomass material]) Units: Ton/Year

Biomass demand for vehicles= ((biomass demand per vehicle*Sale of vehicle)/Material efficiency for vehicles)-Vehicle materials to be reused[biomass material] Units: Ton/Year

biomass demand per building= WITH LOOKUP (Time, ([(2000,0)-(2050,0.9)],(2000,0.812659),(2001,0.801839),(2002,0.78825),(2003,0.778622),(2004,0.712752),(2005,0.655028),(2006,0.591193),(2007,0.505839),(2008,0.468379),(2009,0.488045),(2010,0.456305),(2011,0.416215),(2012,0.407595),(2013,0.405965),(2014,0.394209),(2015,0.418387),(2016,0.418595),(2017,0.426074),(2018,0.412236),(2019,0.411946),(2020,0.4311),(2021,0.384139),(2022,0.380035),(2023,0.371268),(2024,0.356304),(2050,0.3))) Units: Ton/building

biomass demand per clothing= WITH LOOKUP (Time, ([(2000,0)-(2050,6)],(2000,4.3297),(2001,4.77483),(2002,5.16116),(2003,5.10753),(2004,5.13231),(2005,4.93507),(2006,4.82994),(2007,4.56366),(2008,4.593),(2009,4.89177),(2010,4.5343),(2011,4.08851),(2012,3.86999),(2013,3.95964),(2014,3.85081) ,(2015,4.0132),(2016,3.88134),(2017,3.83146),(2018,3.68527),(2019,3.78371),(2020,3.80739),(2021,3.50514),(2022,3.14148), (2049.54 ,1.26316))) Units: Dmnl

biomass demand per plastic= WITH LOOKUP (Time, ([(2000,0)-(2050,0.1)],(2000,0.0784293),(2001,0.0746496),(2002,0.073),(2003,0.0786677),(2004,0.0787867),(2005,0.0825474),(2006,0.081088),(2007,0.0760802),(2008,0.0897821),(2009,0.0889924),(2010,0.0934959),(2011,0.0842593),(2012,0.0828472),(2013,0.0807232),(2014,0.0778824),(2015,0.0753218),(2016,0.0686211),(2017,0.0700309),(2018,0.0701494),(2019,0.0642488),(2020,0.0619566),(2021,0.0673731),(2022,0.0661897),(2023,0.0652287),(2024,0.0646152),(2050,0.03))) Units: Dmnl

biomass demand per vehicle= WITH LOOKUP (Time, ([(2000,1)-(2050,2)],(2000,1.07682),(2001,1.05131),(2002,1.1396),(2003,1.15317),(2004,1.09859),(2005,1.11035),(2006,1.09324),(2007,1.09869),(2008,1.08254),(2009,1.13163),(2010,1.12249),(2011,1.09567),(2012,1.1156),(2013,1.19168),(2014,1.16769),(2015,1.21611),(2016,1.21764),(2017,1.21856),(2018,1.20201),(2019,1.15525),(2020,1.32682),(2021,1.20507),(2022,1.28256),(2023,1.30503),(2024,1.29556),(2050,1.4556))) Units: Ton/vehicle

biomass energy production in QDBTU= BIOFUEL PRODUCTION in QDBTU table(Time) Units: qdbtu/Year

biomass waste= agricultural waste+total forestry waste Units: Ton/Year

biomass waste energy recovery and composting= biomass waste*fraction of biomass waste to uses[benergy recovery] Units: Ton/Year

biomass waste for landfill= biomass waste*fraction of biomass waste to uses[blandfill] Units: Ton/Year

biomass waste for material recovery[Bmaterial recovery]= biomass waste*fraction of biomass waste to uses[Bmaterial recovery] Units: Ton/Year

biomass waste upstream cost= biomass waste*total upstream cost Units: USD/Year

biomass waste upstream employment= biomass waste*total upstream employment factor per ton Units: Person/Year

bioproduct from crops investment= bioproduct from crops investment time series Units: USD/Year

bioproduct from crops investment time series:= 1 Units: USD/Year

bioproduct from crops total investment= INTEG (bioproduct from crops investment, 0) Units: USD/Year

bioproduct from waste capacity= bioproduct from waste total investment*investment effect on bioproduct from waste Units: Ton/Year

bioproduct from waste investment= bioproduct from waste investment time series(Time)/time delay for bioproduct from waste investment Units: usd15/Year/Year

bioproduct from waste investment time series([(0,0)-(2000,10)],(1970,0),(2000,0)) Units: usd15/Year

bioproduct from waste total investment= INTEG (bioproduct from waste investment, 0) Units: usd15/Year

bioproduct production from waste= bioproduct from waste capacity Units: Ton/Year

bioproduct production ratio= 0.6 Units: Dmnl

bioproducts from organic waste= bioproduct production from waste*bioproduct production ratio Units: Ton/Year

births[sex]= total fertility rate*SUM(sexually active women[AG CHILDBEARING!]*AGE SPECIFIC FERTILITY DISTRIBUTION [AG CHILDBEARING!])*proportion of babies per sex[sex] Units: Person/Year

BKWH to QDBTU= 0.0104863 Units: qdbtu/BKWH

black carbon emissions from biomass= biomass and waste in TJ*Black carbon emissions per tj of biomass by sector /KG PER TON Units: Ton/Year

black carbon emissions from coal[sector]= normalized coal demand[sector]*Black carbon emissions per tj of coal by sector [sector]/KG PER TON Units: Ton/Year

black carbon emissions from natural gas[sector]= normalized natural gas demand[sector]*Black carbon emissions per tj of natural gas by sector [sector]/KG PER TON Units: Ton/Year

black carbon emissions from petroleum[sector]= normalized petroleum demand[sector]*Black carbon emissions per tj of gasoline by sector [sector]/KG PER TON Units: Ton/Year

black carbon emissions from power generation[power generation technology]= fuel use for power generation in TJ[power generation technology]*black carbon emissions per TJ of fuel combusted [power generation technology]/KG PER TON*policy reduction in air pollution from thermal power generation Units: Ton/Year

Black carbon emissions per tj of biomass by sector= 51.235 Units: Kg/Tj

Black carbon emissions per tj of coal by sector[sector]= 6.9, 0, 6.9, 0, 72.85 Units: Kg/Tj

black carbon emissions per TJ of fuel combusted[power generation technology]= 0.957, 0.957, 0.0223, 0.083, 0, 0, 0, 0, 0, 0, 0, 0, 1.444, 0 Units: Kg/Tj

Black carbon emissions per tj of gasoline by sector[sector]= 11.2, 9.27, 40, 0, 10.1 Units: Kg/Tj

Black carbon emissions per tj of natural gas by sector[sector]= 0.03, 0.0362, 0.03, 0, 0.065 Units: Kg/Tj

brown agriculture capital= (1-fraction of agriculture capital to green agriculture(Time))*capital agriculture Units: usd15

brown agriculture desired capital labor ratio= initial brown agriculture capital labor ratio*relative average years of schooling ^elasticity of capital labour ration to average years of schooling agriculture brown *relative average life expectancy^elasticity of capital labour ratio to average life expectancy agric brown Units: usd15/Person

brown agriculture employment= INTEG (brown employment change, initial brown agriculture employment) Units: Person

brown agriculture labor demand= (brown agriculture capital/brown agriculture desired capital labor ratio) Units: Person

brown employment change= (indicated brown agriculture employment demand-brown agriculture employment)/time to adjust agriculture employment brown Units: Person/Year

btu gallon conversion factor= 115000/1e+015 Units: qdbtu/gallon

BTU to Tj = 1.055e-009 Units: Tj/BTU

building demand per population= WITH LOOKUP (Time, ([(1970,0)-(2050,50)],(1970,41.4301),(1971,40.5052),(1972,39.5723),(1973,38.6518),(1974,37.7582),(1975,36.8973),(1976,36.0665),(1977,35.257),(1978,34.4715),(1979,33.7089),(1980,32.9693),(1981,32.2551),(1982,31.5624),(1983,30.891),(1984,30.2337),(1985,29.5899),(1986,28.9669),(1987,28.3638),(1988,27.7794),(1989,27.2132),(1990,26.667),(1991,26.1422),(1992,25.6351),(1993,25.1436),(1994,24.6667),(1995,24.2038),(1996,23.7569),(1997,23.3251),(1998,22.9096),(1999,22.5107),(2000,22.1265),(2001,21.7572),(2002,21.4034),(2003,21.068),(2004,20.7542),(2005,20.4622),(2006,20.1936),(2007,19.9469),(2008,19.7219),(2009,19.5121),(2010,19.3145),(2011,19.1334),(2012,18.9631),(2013,18.8026),(2014,18.653),(2015,18.504),(2016,18.3546),(2017,18.2232),(2018,18.1182),(2019,18.0233),(2020,17.9277),(2021,17.8418),(2022,17.7711),(2023,17.7292),(2040,16.7),(2050,16.2))) Units: sqm/Person

building material waste to landfills[Materials]= MAX(0,Material waste collected from buildings[Materials]*share of material waste from buildings to be landfilled [Materials]) Units: Ton/Year

building materials to be reused[Materials]= DELAY FIXED (building waste from manufacturing[Materials]+building waste to be reused in building manufacturing [Materials],1,0) Units: Ton/Year

building waste collected[Materials]= if then else(CE policy switch=1,Material waste generated from buildings[Materials]*CE share of building waste collected[Materials](Time),Material waste generated from buildings [Materials]*share of building waste collected[Materials](Time)) Units: Ton/Year

building waste from manufacturing[Materials]= Material Consumption for building production[Materials]*material waste generated per material of building [Materials] Units: Ton/Year

building waste in landfills to be incinerated[Materials]= Material waste from buildings landfilled[Materials]/Average time for building waste to be incinerated Units: Ton/Year

building waste shares check[Materials]= share of material from buildings waste to be reused[Materials] +share of material waste from buildings to be landfilled[Materials] +share of material waste from buildings to be recycled[Materials] Units: Dmnl/Year

Building waste to be reused[Materials]= share of material from buildings waste to be reused[Materials]*Material waste collected from buildings [Materials] Units: Ton/Year

building waste to be reused in building manufacturing[Materials]= Building waste to be reused[Materials] Units: Ton/Year

buildings currently in use= INTEG (Refurbishing houses+Sale of buildings-Discard of building, initial buildings in use) Units: sqm

buildings green investment= green economy investment*buildings green investment fraction(Time) Units: usd15/Year

buildings green investment fraction([(2011,0)-(2050,0.3)],(2011,0),(2050,0)) Units: Dmnl

"built-up land footprint"= "initial built-up land footprint"*relativeSettlementland Units: Dmnl

bus disposal[bus type]= Bus stock[bus type]/AVRAGE LIFE bus[bus type] Units: vehicle/Year

bus emission abatement ton= bus emission change mtoe(Time)*ton to mtoe Units: Ton/Year

bus emission change mtoe([(1970,0)-(2050,1000)],(1970,0),(2010,0),(2011,53.4184),(2012,56.7321),(2013,60.1898),(2014,63.7987),(2015,67.561),(2016,72.5313),(2017,77.7058),(2018,83.0728),(2019,88.6154),(2020,94.3133),(2021,98.448),(2022,102.529),(2023,106.573),(2024,110.578),(2025,114.517),(2026,118.001),(2027,121.378),(2028,124.643),(2029,127.791),(2030,130.82),(2031,134.069),(2032,137.194),(2033,140.187),(2034,143.044),(2035,145.758),(2036,153.162),(2037,161.058),(2038,169.478),(2039,178.452),(2040,188.012),(2041,197.864),(2042,207.865),(2043,218.003),(2044,228.269),(2045,238.65),(2046,245.639),(2047,254.847),(2048,264.005),(2049,273.09),(2050,279.472)) Units: mtoe/Year

bus employment factor= 0.075 Units: Person/vehicle/Year

bus energy type[diesel]= (buses energy consumption[bus]*share of buses fuel consumption time series [diesel](Time))/100 bus energy type[gasoline power]= (buses energy consumption[bus]*share of buses fuel consumption time series [gasoline power](Time))/100 bus energy type[biodiesel]= (buses energy consumption[bus]*share of buses fuel consumption time series [biodiesel](Time))/100 bus energy type[ethanol]= (buses energy consumption[bus]*share of buses fuel consumption time series [ethanol](Time))/100 Units: mtoe/Year

bus production and maintenance employment= (car direct employment factor+car operations employment factor)*total buses Units: Person

bus sales[bus type]= (share of bus by type[bus type](Time)*total bus sales)/vehicle sales adjustment time Units: vehicle/Year

Bus stock[bus type]= INTEG (bus sales[bus type]-bus disposal[bus type], initial bus stock[bus type]) Units: vehicle

bus type: bus, minibus

buses average fuel efficiency time series[bus]([(1970,0)-(2050,1)],(1970,0.22807),(1997,0.22807),(2008,0.280702),(2014,0.263158),(2019,0.236842),(2024,0.245614),(2028,0.241228),(2030,0.22807),(2035,0.245614),(2041,0.245614),(2050,0.219298)) buses average fuel efficiency time series[minibus]([(1970,0)-(2050,1)],(1970,0.16),(1988,0.171053),(1998,0.192982),(2010,0.20614),(2016,0.188596),(2020,0.171053),(2025,0.171053),(2032,0.157895),(2036,0.166667),(2041,0.166667),(2050,0.140351)) Units: litre/Km

buses co2 emission urban[bus]= (buses energy consumption by type[diesel]*CO2 EMISSION FACTORS[diesel])+(buses energy consumption by type [gasoline power]*CO2 EMISSION FACTORS[gasoline power])+(buses energy consumption by type [biodiesel]*CO2 EMISSION FACTORS[biodiesel])+(buses energy consumption by type [ethanol]*CO2 EMISSION FACTORS[ethanol]) buses co2 emission urban[minibus]= (minibuses energy consumption by type[diesel]*CO2 EMISSION FACTORS[diesel])+(minibuses energy consumption by type[gasoline power]*CO2 EMISSION FACTORS [gasoline power])+(minibuses energy consumption by type[biodiesel]*CO2 EMISSION FACTORS [biodiesel])+(minibuses energy consumption by type[ethanol]*CO2 EMISSION FACTORS [ethanol]) Units: mtoe/Year

buses energy consumption[bus type]= (buses average fuel efficiency time series[bus type](Time)*buses travel volume [bus type])*convert LITRE to mtoe*(1-efficiency ratio transport from green investment) Units: mtoe/Year

buses energy consumption by type[diesel]= urban public transport energy consumption buses[bus]*(share of buses fuel consumption time series [diesel](Time)/100) buses energy consumption by type[gasoline power]= urban public transport energy consumption buses[bus]*(share of buses fuel consumption time series [gasoline power](Time)/100) buses energy consumption by type[biodiesel]= urban public transport energy consumption buses[bus]*(share of buses fuel consumption time series [biodiesel](Time)/100) buses energy consumption by type[ethanol]= urban public transport energy consumption buses[bus]*(share of buses fuel consumption time series [ethanol](Time)/100) Units: mtoe/Year

buses travel volume[bus type]= INDICATED BUS travel volume[bus type] Units: Km/Year

bwaste: benergy recovery, Bmaterial recovery, blandfill

"by-product recovery capacity"= "by-product recovery total investment"*"investment effect on by-product recovery" Units: kWh/Year

"by-product recovery investment time series"([(0,0)-(2100,10)],(1970,0),(2010,0)) Units: usd15/Year

"by-product recovery investment"= "by-product recovery investment time series"(Time+"time delay for by-product recovery investment") Units: usd15/Year/Year

"by-product recovery total investment"= INTEG ("by-product recovery investment", 0) Units: usd15/Year

C to CO2e= 44/12 Units: Dmnl

"c&d waste energy recovery"= "c&d waste"*"fraction of c&d waste to uses"[Cenergy recovery] Units: Ton/Year

"c&d waste material recovery"= "c&d waste"*"fraction of c&d waste to uses"[cmaterial recovery] Units: Ton/Year

"c&d waste per unit of production"([(1970,0)-(2010,0.0001)],(1970,1.43e-005),(2010,7.1e-005)) Units: Ton/usd15

"c&d waste to landfill"= "c&d waste"*"fraction of c&d waste to uses"[clandfill] Units: ton/year

"c&d waste upstream cost"= "c&d waste"*total upstream cost Units: USD/Year

"c&d waste upstream employment"= "c&d waste"*total upstream employment factor per ton Units: Person/Year

"c&d waste"= industry production*"c&d waste per unit of production"(Time) Units: Ton/Year

change in forest= (net forest increase due to policy*0.5) Units: Ha/Year

calories per person per day= DELAY N(total calories consumed/days in one year/total population,2,total calories consumed /days in one year/total population,1) Units: Kal/Person/day

calories per ton of food vegetables= 2.46308e+006 Units: Kal/Ton

calories per ton of meat= 3.4353e+006 Units: Kal/Ton

capital agriculture= INTEG (investment agriculture-capital depreciation agriculture, initial capital agriculture) Units: usd15

capital depreciation agriculture= capital agriculture/agriculture capital life Units: usd15/Year

capital depreciation industry= (capital industry/industry capital life)*covid effect on capital industry and service Units: usd15/Year

capital depreciation services= (capital services/services capital life)*covid effect on capital industry and service Units: usd15/Year

capital industry= INTEG (investment industry-capital depreciation industry, initial capital industry) Units: usd15

CAPITAL REQUIREMENT= (CHANGE IN EMPLOYMENT/total employment)*CAPITAL STOCK DELAYED Units: usd15

capital services= INTEG (investment services-capital depreciation services, initial capital services) Units: usd15

CAPITAL STOCK= capital agriculture+capital industry+capital services Units: usd15

CAPITAL STOCK DELAYED= DELAY FIXED(CAPITAL STOCK, 1, CAPITAL STOCK) Units: usd15

Captured energy demand for buildings= (Captured Energy intensity per building(Time)*Sale of buildings)/Energy efficiency in building construction Units: Tj/Year

Captured energy demand for clothing= (Captured Energy intensity per clothing(Time)*Sale of clothing)/Energy efficiency in clothing manufacturing Units: Tj/Year

Captured energy demand for plastic= (Captured Energy intensity per plastic(Time)*Sale of plastic)/Energy efficiency in plastic manufacturing Units: Tj/Year

Captured energy demand for vehicles= (Captured Energy intensity per vehicle(Time)*Sale of vehicle)/Energy efficiency in vehicle manufacturing Units: Tj/Year

Captured Energy intensity per building([(2000,0.0006)-(2024,0.002)],(2000,0.000960983),(2001,0.00101002),(2002,0.000973138),(2003,0.000899883),(2004,0.000873823),(2005,0.000833507),(2006,0.000791736),(2007,0.000719234),(2008,0.000699585),(2009,0.000835574),(2010,0.000825728),(2011,0.000785822),(2012,0.000853171),(2013,0.000903183),(2014,0.00100449),(2015,0.00114502),(2016,0.00117903),(2017,0.00131289),(2018,0.00125927),(2019,0.00127445),(2020,0.00138545),(2021,0.001177),(2022,0.00118842),(2023,0.00117914),(2024,0.00114641)) Units: Tj/building

Captured Energy intensity per clothing([(2000,0.002)-(2022,0.006)],(2000,0.00344959),(2001,0.00380737),(2002,0.00363491),(2003,0.00354164),(2004,0.00345456),(2005,0.0032509),(2006,0.00314861),(2007,0.00287398),(2008,0.00277333),(2009,0.00310755),(2010,0.00303044),(2011,0.00277062),(2012,0.00291718),(2013,0.00326376),(2014,0.00352329),(2015,0.00399009),(

2016,0.00432433),(2017,0.00431298),(2018,0.00439835),(2019,0.0046544),(2020,0.0051521),(2021,0.00459955),(2022,0.00418817)) Units: Tj/Ton

Captured Energy intensity per plastic([(2000,0.0001)-(2024,0.0002)],(2000,0.000160477),(2001,0.000153905),(2002,0.000144822),(2003,0.000138),(2004,0.000136394),(2005,0.000134354),(2006,0.000126246),(2007,0.00012211),(2008,0.000133034),(2009,0.00012784),(2010,0.000129036),(2011,0.000129897),(2012,0.000135007),(2013,0.000138091),(2014,0.00014156),(2015,0.00014007),(2016,0.000142124),(2017,0.000151664),(2018,0.000162672),(2019,0.00015919),(2020,0.000162035),(2021,0.000176982),(2022,0.000174849),(2023,0.000174294),(2024,0.000173577)) Units: Tj/Ton

Captured Energy intensity per vehicle([(2000,0.003)-(2024,0.006)],(2000,0.00300901),(2001,0.00302226),(2002,0.00317771),(2003,0.00318561),(2004,0.00323917),(2005,0.0033215),(2006,0.00334189),(2007,0.00352546),(2008,0.00344038),(2009,0.00359346),(2010,0.00373306),(2011,0.00370222),(2012,0.00379346),(2013,0.0040992),(2014,0.00423891),(2015,0.00440434),(2016,0.00462934),(2017,0.00470636),(2018,0.00484933),(2019,0.00477206),(2020,0.00568936),(2021,0.00531314),(2022,0.0057567),(2023,0.00591189),(2024,0.0059111)) Units: Tj/vehicle

car direct employment factor= 0.025 Units: Person/vehicle/Year

car disposal[vehicle tech type]= Car Stocks[vehicle tech type]/average car lifetime(Time) Units: vehicle/Year

car operations employment factor= WITH LOOKUP (Time, ([(2000,0)-(2050,2)],(2000,0),(2049.69,0))) Units: Person/vehicle/Year

car production and maintenance employment= (car direct employment factor+car operations employment factor)*total cars Units: Person

car sales[vehicle tech type]= (share of car sales by type time series[vehicle tech type](Time)*total car sales)/vehicle sales adjustment time Units: vehicle/Year

car stock oil demand reduction in mb= mtoe of oil demand reduction*MTOE to MB Units: MB/Year

Car Stocks[vehicle tech type]= INTEG (+car sales[vehicle tech type]-car disposal[vehicle tech type], INITIAL CAR STOCKS[vehicle tech type]) Units: vehicle

car travel reduction fraction= if then else(indicated green economy investment fraction=0, 0, indicated fraction of car travel reduction) Units: Dmnl

carbon factor arable land= 50 Units: Ton/Ha

carbon factor fallow= 30 Units: Ton/Ha

carbon factor forest= 150 Units: Ton/Ha

carbon factor pasture land= 36 Units: Ton/Ha

carbon factor settlement= 0 Units: Ton/Ha

carbon footprint= initial carbon footprint*relative carbon uptake land Units: Dmnl

carbon stock arable land= Arable Land*carbon factor arable land Units: Ton

carbon stock forest= Forest Land* carbon factor forest Units: Ton

carbon stock other land= Other Land * carbon factor fallow Units: Ton

carbon stock pasture land= Pasture Land * carbon factor pasture land Units: Ton

carbon stock settlement land= Settlement Land * carbon factor settlement Units: Ton

carbon uptake land= fossil fuel CO2 emission*(1-ocean carbon intake share)/delay amount of carbon being sequestered by the forest Units: tons/Year

carrying capacity= 1.3e+010 Units: Ton

cars average fuel efficiency time series[reg gasoline]([(1970,0)-(2050,10)],(1970,9.73684),(1998,8.85965),(2014,8.50877),(2026,7.19298),(2040,7.01754),(2050,6.49123)) cars average fuel efficiency time series[hybrid gasoline]([(2000,0)-(2050,10)],(2000,7.8),(2005,7.5),(2010,7.3),(2015,7.1),(2020,6.9),(2025,6.8),(2030,6.7),(2035,6.6),(2040,6.5),(2045,6.3),(2050,6.2)) cars average fuel efficiency time series[reg diesel]([(2000,0)-(2050,10)],(2000,9.3421),(2004,8.99123),(2009,9.03509),(2014,9.07895),(2020,8.99123),(2025,9.07895),(2030,9.12281),(2035,9.21053),(2040,9.29825),(2045,9.38597),(2050,9.16667)) cars average fuel efficiency time series[hybrid diesel]([(2000,0)-(2050,10)],(2000,6.6),(2005,6.7),(2010,6.7),(2015,6.6),(2020,6.5),(2025,6.4),(2030,6.3),(2035,6.1),(2040,6),(2045,5.8),(2050,5.7)) cars average fuel efficiency time series[V CNG]([(2000,0)-(2050,20)],(2000,10.7),(2005,10.5),(2010,10.1),(2015,9.7),(2020,9.4),(2025,9.2),(2030,9),(2035,8.8),(2040,8.7),(2045,8.5),(2050,8.4)) cars average fuel efficiency time series[V fuel cell]([(2000,0)-(2050,10)],(2000,5.8),(2005,5.7),(2010,5.5),(2015,5.5),(2020,5.4),(2025,5.4),(2030,5.3),(2035,5.2),(2040,5.1),(2045,5),(2050,4.8)) Units: litre/Km

cars energy consumption by car type[vehicle tech type]= (cars average fuel efficiency time series[vehicle tech type](Time)/100)*cars travel volume [vehicle tech type]*convert LITRE to mtoe*(1-efficiency ratio transport from green investment) Units: mtoe/Year

cars energy consumption by energy[gasoline power]= cars energy consumption by energy type[reg gasoline]+cars energy consumption by energy type [hybrid gasoline] cars energy consumption by energy[diesel]= cars energy consumption by energy type[reg diesel]+cars energy consumption by energy type [hybrid diesel] cars energy consumption by energy[CNG]= cars energy consumption by energy type[V CNG]+cars energy consumption by energy type [V fuel cell] Units: mtoe/Year

cars energy consumption by energy type[reg gasoline]= (cars energy consumption by car type[reg gasoline]*share of car energy type time series [reg gasoline](Time))/100 cars energy consumption by energy type[hybrid gasoline]= (cars energy consumption by car type[hybrid gasoline]*share of car energy type time series [hybrid gasoline](Time))/100 cars energy consumption by energy type[reg diesel]= (cars energy consumption by car type[reg diesel]*share of car energy type time series [reg diesel](Time))/100 cars energy consumption by energy type[hybrid diesel]= (cars energy consumption by car type[hybrid diesel]*share of car energy type time series [hybrid diesel](Time))/100 cars energy consumption by energy type[V CNG]= (cars energy consumption by car type[V CNG]*share of car energy type time series [V CNG](Time))/100 cars energy consumption by energy type[V fuel cell]= (cars energy consumption by car type[V fuel cell]*share of car energy type time series [V fuel cell](Time))/100 Units: mtoe/Year

cars travel volume[vehicle tech type]= INDICATED CAR travel volume[vehicle tech type] Units: Km/Year

CATCH PER UNIT vessel= initial catch per unit vessel*effect of fish stock on catch Units: Ton/vessel

catch sex ratio[FISHSEX]= 0.5 Units: Dmnl/Year

ccs coal energy electricity generation= coal energy electricity generation*ratio of coal ccs capacity to coal energyy capacity Units: GWh/Year

ccs construction employment= (COAL CCS CONSTRUCTION+GAS CCS CONSTRUCTION)*ccs construction employment factor Units: Person

ccs construction employment factor= WITH LOOKUP (Time, ([(2010,0)-(2050,30)],(2010,20.48),(2011,20.1933),(2012,19.9106),(2013,19.6318),(2014,19.357),(2015,19.086),(2016,18.8188),(2017,18.5553),(2018,18.2955), (2019,18.0394),(2020,17.7869),(2021,17.5378),(2022,17.2923),(2023,17.0502), (2024,16.8115),(2025,16.5762),(2026,16.3441),(2027,16.1153),(2028,15.8897), (2029,15.6672),(2030,15.4479))) Units: Person/MW

ccs employment= ccs construction employment+ccs operation employment Units: Person

ccs green investment= ccs green investment fraction(Time)*power generation investment Units: usd15/Year

ccs green investment fraction([(2011,0)-(2050,1)],(2011,0),(2050,0)) Units: Dmnl

ccs gs turbine energy electricity generation= gas turbine energy electricity generation*ratio of gas ccs capacity to gas energy capacity Units: GWh/Year

ccs investment fraction to coal= 0.7 Units: Dmnl

ccs operation employment= (COAL CCS CAPACITY+GAS CCS CAPACITY)*ccs operation employment factor Units: Person

ccs operation employment factor= WITH LOOKUP (Time, ([(2010,0)-(2050,2)],(2010,1.14),(2011,1.124),(2012,1.1083),(2013,1.0928),(2014,1.0775),(2015,1.0624),(2016,1.0475),(2017,1.0329),(2018,1.0184),(2019,1.0041),(2020,0.9901),(2021,0.9762),(2022,0.9626),(2023,0.9491),(2024,0.9358),(2025,0.9227),(2026,0.9098),(2027,0.897),(2028,0.8845),(2029,0.8721),(2030 ,0.8599))) Units: Person/MW

CE coal consumption in QDBTU= total coal consumption from CE sectors*TJ of coal to QDBTU Units: qdbtu/Year

CE electricity consumption in QDBTU= total electricity consumption from CE sectors*TJ of electricity to QDBTU Units: qdbtu/Year

CE impacted industry production= real value added from buildings +real value added from clothing manufacturing +real value added from plastic manufacturing +real value added from vehicle manufacturing +VA from aluminium +VA from chemicals +VA from textile Units: usd15/Year

CE lifetime extension switch= 0 Units: Dmnl

CE natural gas consumption in QDBTU= (share of oil consumption*total oil and natural gas consumption from CE sectors)*TJ of oil to QDBTU Units: qdbtu/Year

CE oil consumption in QDBTU= (total oil and natural gas consumption from CE sectors*share of oil consumption)*TJ of oil to QDBTU Units: qdbtu/Year

CE oil consumption industry in QDBTU= CE oil consumption in QDBTU*(1-share of oil considered for transport) Units: qdbtu/Year

CE oil consumption transport in QDBTU= CE oil consumption in QDBTU*share of oil considered for transport Units: qdbtu/Year

"CE policy fraction for c&D waste flows CA"[Cenergy recovery]= WITH LOOKUP (Time, ([(2000,0)-(2050,0.4)],(2000,0.2),(2026,0.2),(2050,0.2))) "CE policy fraction for c&D waste

flows CA"[cmaterial recovery]= WITH LOOKUP (Time, ([(2000,0)-(2050,0.4)],(2000,0.2),(2026,0.2),(2050,0.4))) "CE policy fraction for c&D waste flows CA"[clandfill]= WITH LOOKUP (Time, ([(2000,0)-(2050,0.4)],(2000,0.6),(2026,0.6),(2050,0.4))) Units: Dmnl/Year

"CE policy fraction for c&D waste flows HA"[Cenergy recovery]= WITH LOOKUP (Time, ([(2000,0)-(2050,0.4)],(2000,0.2),(2026,0.2),(2050,0.2))) "CE policy fraction for c&D waste flows HA"[cmaterial recovery]= WITH LOOKUP (Time, ([(2000,0)-(2050,0.4)],(2000,0.2),(2026,0.2),(2050,0.4))) "CE policy fraction for c&D waste flows HA"[clandfill]= WITH LOOKUP (Time, ([(2000,0)-(2050,0.4)],(2000,0.6),(2026,0.6),(2050,0.4))) Units: Dmnl/Year

"CE policy fraction for c&D waste flows LA"[Cenergy recovery]= WITH LOOKUP (Time, ([(2000,0)-(2050,0.4)],(2000,0.2),(2026,0.2),(2050,0.2))) "CE policy fraction for c&D waste flows LA"[cmaterial recovery]= WITH LOOKUP (Time, ([(2000,0)-(2050,0.4)],(2000,0.2),(2026,0.2),(2050,0.4))) "CE policy fraction for c&D waste flows LA"[clandfill]= WITH LOOKUP (Time, ([(2000,0)-(2050,0.4)],(2000,0.6),(2026,0.6),(2050,0.4))) Units: Dmnl/Year

CE policy fraction for ewaste flows HA[erecycle]= WITH LOOKUP (Time, ([(2000,0)-(2050,0.4)],(2000,0.15),(2026,0.15),(2050,0.6))) CE policy fraction for ewaste flows HA[elandfill]= WITH LOOKUP (Time, ([(2000,0)-(2050,0.4)],(2000,0.85),(2026,0.85),(2050,0.4))) Units: Dmnl/Year

CE policy fraction for ewaste waste flows CA[erecycle]= WITH LOOKUP (Time, ([(2000,0)-(2050,0.4)],(2000,0.115),(2026,0.15),(2050,0.4))) CE policy fraction for ewaste waste flows CA[elandfill]= WITH LOOKUP (Time, ([(2000,0)-(2050,0.4)],(2000,0.85),(2026,0.85),(2050,0.6))) Units: Dmnl/Year

CE policy fraction for ewaste waste flows LA[erecycle]= WITH LOOKUP (Time, ([(2000,0)-(2050,0.4)],(2000,0.115),(2026,0.15),(2050,0.2))) CE policy fraction for ewaste waste flows LA[elandfill]= WITH LOOKUP (Time, ([(2000,0)-(2050,0.4)],(2000,0.85),(2026,0.85),(2050,0.8))) Units: Dmnl/Year

CE policy fraction for industrial waste flows CA[irecycle]= WITH LOOKUP (Time, ([(2000,0)-(2050,0.7)],(2000,0.07),(2026,0.07),(2050,0.4))) CE policy fraction for industrial waste flows CA[ienergy recovery]= WITH LOOKUP (Time, ([(2000,0)-(2050,0.7)],(2000,0.118),(2026,0.118),(2050,0.118))) CE policy fraction for industrial waste flows CA[ilandfill]= WITH LOOKUP (Time, ([(2000,0)-(2050,0.4)],(2000,0.126),(2026,0.126),(2050,0.126))) CE policy fraction for industrial waste flows CA[iincineration]= WITH LOOKUP (Time, ([(2000,0)-(2050,0.4)],(2000,0.109),(2026,0.109),(2050,0.109))) CE policy fraction for industrial waste flows CA[iothers]= WITH LOOKUP (Time, ([(2000,0)-(2050,0.7)],(2000,0.577),(2026,0.577),(2050,0.277))) Units: Dmnl/Year

CE policy fraction for industrial waste flows HA[irecycle]= WITH LOOKUP (Time, ([(2000,0)-(2050,0.7)],(2000,0.07),(2026,0.07),(2050,0.6))) CE policy fraction for industrial waste flows HA[ienergy recovery]= WITH LOOKUP (Time, ([(2000,0)-(2050,0.7)],(2000,0.118),(2026,0.118),(2050,0.118))) CE policy fraction for industrial waste flows HA[ilandfill]= WITH LOOKUP (Time, ([(2000,0)-(2050,0.4)],(2000,0.126),(2026,0.126),(2050,0.126))) CE policy fraction for industrial waste flows HA[iincineration]= WITH LOOKUP (Time, ([(2000,0)-(2050,0.4)],(2000,0.109),(2026,0.109),(2050,0.109))) CE policy fraction for industrial waste flows HA[iothers]= WITH LOOKUP (Time, ([(2000,0)-(2050,0.7)],(2000,0.577),(2026,0.577),(2050,0.027))) Units: Dmnl/Year

CE policy fraction for industrial waste flows LA[irecycle]= WITH LOOKUP (Time, ([(2000,0)-(2050,0.7)],(2000,0.07),(2026,0.07),(2050,0.2))) CE policy fraction for industrial waste flows LA[ienergy recovery]= WITH LOOKUP (Time, ([(2000,0)-(2050,0.7)],(2000,0.118),(2026,0.118),(2050,0.118))) CE policy fraction for industrial waste flows LA[ilandfill]= WITH LOOKUP (Time, ([(2000,0)-(2050,0.4)],(2000,0.126),(2026,0.126),(2050,0.126))) CE policy fraction for industrial waste flows LA[iincineration]= WITH LOOKUP (Time, ([(2000,0)-(2050,0.4)],(2000,0.109),(2026,0.109),(2050,0.109))) CE policy fraction for industrial waste flows LA[iothers]= WITH LOOKUP (Time, ([(2000,0)-(2050,0.7)],(2000,0.577),(2026,0.577),(2050,0.447))) Units: Dmnl/Year

CE policy fraction for waste flows CA[mrecycle]= WITH LOOKUP (Time, ([(2000,0)-(2050,0.7)],(2000,0.1),(2026,0.1),(2050,0.4))) CE policy fraction for waste flows CA[mcompost]= WITH LOOKUP (Time, ([(2000,0)-(2050,0.4)],(2000,0.1),(2026,0.1),(2050,0.1))) CE policy fraction for waste flows CA[menergy recovery]= WITH LOOKUP (Time, ([(2000,0)-(2050,0.4)],(2000,0.106),(2026,0.106),(2050,0.106))) CE policy fraction for waste flows CA[mlandfill]= WITH LOOKUP (Time, ([(2000,0)-(2050,0.4)],(2000,0.604),(2026,0.604),(2050,0.304))) Units: Dmnl/Year

CE policy fraction for waste flows HA[mrecycle]= WITH LOOKUP (Time, ([(2000,0)-(2050,0.7)],(2000,0.1),(2026,0.1),(2050,0.6))) CE policy fraction for waste flows HA[mcompost]= WITH LOOKUP (Time, ([(2000,0)-(2050,0.4)],(2000,0.1),(2026,0.1),(2050,0.1))) CE policy fraction for waste flows HA[menergy recovery]= WITH LOOKUP (Time, ([(2000,0)-(2050,0.4)],(2000,0.106),(2026,0.106),(2050,0.106))) CE policy fraction for waste flows HA[mlandfill]= WITH LOOKUP (Time, ([(2000,0)-(2050,0.4)],(2000,0.604),(2026,0.604),(2050,0.104))) Units: Dmnl/Year

CE policy fraction for waste flows LA[mrecycle]= WITH LOOKUP (Time, ([(2000,0)-(2050,0.7)],(2000,0.1),(2026,0.1),(2050,0.2))) CE policy fraction for waste flows LA[mcompost]= WITH LOOKUP (Time, ([(2000,0)-(2050,0.4)],(2000,0.1),(2026,0.1),(2050,0.1))) CE policy fraction for waste flows

LA[menergy recovery]= WITH LOOKUP (Time, ([(2000,0)-(2050,0.4)],(2000,0.106),(2026,0.106),(2050,0.106))) CE policy fraction for waste flows LA[mlandfill]= WITH LOOKUP (Time, ([(2000,0)-(2050,0.4)],(2000,0.604),(2026,0.604),(2050,0.504))) Units: Dmnl/Year

CE policy switch= 0 Units: Dmnl

CE policy switch reusing and recycling= 0 Units: Dmnl

CE push for EV switch= 0 Units: Dmnl/Year

CE share of building waste collected[metallic minerals material]([(2000,0.6)-(2020,0.7)],(2000,0.35),(2026,0.35),(2060,1)) CE share of building waste collected[non metallic mineral material]([(2000,0.6)-(2020,0.7)],(2000,0.35),(2026,0.35),(2060,1)) CE share of building waste collected[fossil fuel material]([(2000,0.6)-(2020,0.7)],(2000,0.35),(2026,0.35),(2060,1)) CE share of building waste collected[biomass material]([(2000,0.6)-(2020,0.7)],(2000,0.35),(2026,0.35),(2060,1)) Units: Dmnl

CE share of clothing waste collected[metallic minerals material]([(2000,0.6)-(2020,0.7)],(2000,0.2),(2020,0.2)) CE share of clothing waste collected[non metallic mineral material]([(2000,0.6)-(2020,0.7)],(2000,0.2),(2020,0.2)) CE share of clothing waste collected[fossil fuel material]([(2000,0.6)-(2020,0.7)],(2000,0.2),(2020,0.2)) CE share of clothing waste collected[biomass material]([(2000,0.6)-(2020,0.7)],(2000,0.2),(2020,0.2)) Units: Dmnl

CE share of material waste collected[metallic minerals material]([(2000,0.6)-(2050,1)],(2000,0.6),(2024,0.6),(2050,1)) CE share of material waste collected[non metallic mineral material]([(2000,0.6)-(2050,1)],(2000,0.6),(2024,0.6),(2050,1)) CE share of material waste collected[fossil fuel material]([(2000,0.6)-(2050,1)],(2000,0.6),(2024,0.6),(2050,1)) CE share of material waste collected[biomass material]([(2000,0.6)-(2050,1)],(2000,0.6),(2024,0.6),(2050,1)) Units: Dmnl

CE share of material waste from plastic collected[metallic minerals material]([(2000,0.6)-(2020,0.7)],(2000,0.17),(2026,0.17),(2050,0.8)) CE share of material waste from plastic collected[non metallic mineral material]([(2000,0.6)-(2020,0.7)],(2000,0.17),(2026,0.17),(2050,0.8)) CE share of material waste from plastic collected[fossil fuel material]([(2000,0.6)-(2020,0.7)],(2000,0.17),(2026,0.17),(2050,0.8)) CE share of material waste from plastic collected[biomass material]([(2000,0.6)-(2020,0.7)],(2000,0.17),(2026,0.17),(2050,0.8)) Units: Dmnl

CE share of used land= Total land requirement from CE sectors/Total land Units: 1/Year

CE Share of vehicles that are electric POLICY CA= WITH LOOKUP (Time, ([(2000,0)-(2050,0.9)],(2000,0),(2010,0.000103641),(2011,0.000480633),(2012

,0.00076257),(2013,0.00132533),(2014,0.00230425),(2015,0.0044356),(2016,0.0064484),(2017,0.0103191),(2018,0.0160557),(2019,0.0163463),(2020,0.0245651),(2021,0.0500259),(2022,0.0826564),(2023,0.107933),(2024,0.123832),(2025,0.1268),(2026,0.1297),(2040,0.8))) Units: Dmnl

CE Share of vehicles that are electric POLICY HA= WITH LOOKUP (Time, ([(2000,0)-(2040,1)],(2000,0),(2010,0.000103641),(2011,0.000480633),(2012,0.00076257),(2013,0.00132533),(2014,0.00230425),(2015,0.0044356),(2016,0.0064484),(2017,0.0103191),(2018,0.0160557),(2019,0.0163463),(2020,0.0245651),(2021,0.0500259),(2022,0.0826564),(2023,0.107933),(2024,0.123832),(2025,0.1268),(2026,0.1297),(2040,1))) Units: Dmnl

CE Share of vehicles that are electric POLICY LA= WITH LOOKUP (Time, ([(2000,0)-(2050,0.9)],(2000,0),(2010,0.000103641),(2011,0.000480633),(2012,0.00076257),(2013,0.00132533),(2014,0.00230425),(2015,0.0044356),(2016,0.0064484),(2017,0.0103191),(2018,0.0160557),(2019,0.0163463),(2020,0.0245651),(2021,0.0500259),(2022,0.0826564),(2023,0.107933),(2024,0.123832),(2025,0.1268),(2026,0.1297),(2040,0.6))) Units: Dmnl

CE switch reduction in coal capacity= if then else(IEA NET ZERO SWITCH=1,3,0) Units: Dmnl

CE switch reduction in diesel and fuel oil capacity= if then else(IEA NET ZERO SWITCH=1,3,0) Units: Dmnl

CE switch reduction in gas turbine capacity= if then else(IEA NET ZERO SWITCH=1,3,0) Units: Dmnl

CH4 CO2 equivalent= fossil fuel CH4 emission * CH4 TO CO2 Units: Kg/Year

CH4 emissions from biomass= biomass and waste in TJ*CH4 emissions per tj of biomass by sector/KG PER TON Units: Ton/Year

CH4 emissions from coal[sector]= normalized coal demand[sector]*CH4 emissions per tj of coal by sector[sector]/KG PER TON Units: Ton/Year

CH4 emissions from natural gas[sector]= normalized natural gas demand[sector]*CH4 emissions per tj of natural gas by sector [sector]/KG PER TON Units: Ton/Year

CH4 emissions from petroleum[sector]= normalized petroleum demand[sector]*CH4 emissions per tj of gasoline by sector [sector]/KG PER TON Units: Ton/Year

CH4 emissions from power generation[power generation technology]= fuel use for power generation in TJ[power generation technology]*CH4 emissions per TJ of fuel combusted [power generation technology]/KG PER TON Units: Ton/Year

CH4 emissions per tj of biomass by sector= 300 Units: Kg/Tj

CH4 emissions per tj of coal by sector[sector]= 10, 0, 10, 0, 300 Units: Kg/Tj

CH4 emissions per TJ of fuel combusted[power generation technology]= 3, 3, 1, 1, 0, 0, 0, 0, 0, 0, 0, 0, 30, 0 Units: Kg/Tj

CH4 emissions per tj of gasoline by sector[sector]= 3, 33, 10, 0, 10 Units: Kg/Tj

CH4 emissions per tj of natural gas by sector[sector]= 1, 92, 5, 0, 5 Units: Kg/Tj

CH4 TO CO2= 23 Units: Dmnl

change in average years of schooling= (target years of schooling-average years of schooling)/adjustment time for average years of schooling Units: Dmnl

CHANGE IN CAPITAL= CHANGE IN CAPITAL AGRIC+CHANGE IN CAPITAL INDUSTRY+CHANGE IN CAPITAL SERVICES Units: usd15/Year

CHANGE IN CAPITAL AGRIC= investment agriculture-capital depreciation agriculture Units: usd15/Year

CHANGE IN CAPITAL INDUSTRY= investment industry-capital depreciation industry Units: usd15/Year

CHANGE IN CAPITAL SERVICES= investment services-capital depreciation services Units: usd15

change in carbon stock from arable land to forest= change in forest*carbon factor forest-change in forest*carbon factor arable land Units: Ton/Year

change in carbon stock from arable to pasture= arable to pasture*carbon factor arable land-arable to pasture*carbon factor pasture land Units: Ton/Year

change in carbon stock from arable to settlement= arable to settlement*carbon factor settlement-arable to settlement*carbon factor arable land Units: Ton/Year

change in carbon stock from fallow to pasture= other to pasture*carbon factor pasture land-other to pasture*carbon factor fallow Units: Ton/Year

change in carbon stock from fallow to settlement= others to settlement*carbon factor settlement-others to settlement*carbon factor fallow Units: Ton/Year

change in carbon stock from forest to arable= forest to agricultural*carbon factor arable land-forest to agricultural*carbon factor forest Units: Ton/Year

change in carbon stock from forest to pasture= forest to pasture*carbon factor forest-forest to pasture*carbon factor pasture land Units: Ton/Year

change in carbon stock from forest to settlement= Forest to settlement*carbon factor settlement-Forest to settlement*carbon factor forest Units: Ton/Year

change in carbon stock from pasture to forest= change in forest from pasture*carbon factor forest-change in forest from pasture *carbon factor pasture land Units: Ton/Year

change in carbon stock from pasture to others= pasture to others*carbon factor fallow-pasture to others*carbon factor pasture land Units: Ton/Year

change in carbon stock from pasture to settlement= pasture to settlement*carbon factor pasture land-pasture to settlement*carbon factor pasture land Units: Ton/Year

change in cumulative black carbon emissions from power generation= total annual black carbon emissions from power generation Units: Ton/Year

"change in cumulative cost of pm2.5 emissions from power generation"= "annual cost of pm2.5 emissions" Units: USD/Year

"change in cumulative deaths from ambient air pollution (proxy) indoor"= if then else (Time < 2026, 0, "annual deaths from indoor air pollution (proxy)") Units: Person/Year

"change in cumulative deaths from ambient air pollution (proxy)"= if then else (Time < 2026, 0, "annual deaths from ambient air pollution (proxy)") Units: Person/Year

"change in cumulative pm2.5 emissions from power generation"= "total annual pm2.5 emissions from power generation" Units: Ton/Year

change in cumulative social cost of carbon from fuel use for power generation = annual social cost of carbon from fuel use for power generation Units: USD/Year

change in ee for buildings= if then else(Time>2026,1,0)*(if then else(CE policy switch=3:OR:S3 CE energy efficiency building switch =3,S3 additional energy efficiency gains inconstruction HA,if then else(CE policy switch =2:OR:S3 CE energy efficiency building switch=2,S3 additional energy efficiency gains in construction CA ,if then else(CE policy switch=1:OR:S3 CE energy efficiency building switch =1,S3 additional energy efficiency gains in construction LA,assumed annual change in ee for buildings (Time)))))*Energy efficiency in building construction Units: Dmnl/Year

change in ee for clothing= if then else(Time>2026,1,0)*(if then else(CE policy switch=3:OR:S3 CE energy efficiency clothing switch =3,S3 additional energy efficiency gains in clothing production HA,if then else (CE policy switch=2:OR:S3 CE energy efficiency clothing switch=2,S3 additional energy efficiency gains in clothing production CA ,if then else(CE policy switch=1:OR:S3 CE energy efficiency clothing switch =1,S3 additional energy efficiency gains in clothing production LA,assumed annual change in ee for clothing (Time)))))*Energy efficiency in clothing manufacturing Units: Dmnl/Year

change in ee for plastic= if then else(Time>2026,1,0)*(if then else(CE policy switch=3:OR:S3 CE energy efficiency plastic switch =3,S3 additional energy efficiency gains in plastic production HA,if then else (CE policy switch=2:OR:S3 CE energy efficiency plastic switch=2,S3 additional energy efficiency gains in plastic production CA ,if then else(CE policy switch=1:OR:S3 CE energy efficiency plastic switch= 1,S3 additional energy efficiency gains in plastic production LA,assumed annual change in ee for plastic (Time)))))*Energy efficiency in plastic manufacturing Units: Dmnl/Year

change in ee for vehicles= if then else(Time>2026,1,0)*if then else(CE policy switch=3:OR:S3 CE energy efficiency vehicle switch =3,S3 additional energy efficiency gains in vehicle production HA,if then else (CE policy switch=2:OR:S3 CE energy efficiency vehicle switch=2,S3 additional energy efficiency gains in vehicle production CA ,if then else(CE policy switch=1:OR:S3 CE energy efficiency vehicle switch= 1,S3 additional energy efficiency gains in vehicle production LA,assumed annual change in ee for vehicles (Time))))*Energy efficiency in vehicle manufacturing Units: Dmnl/Year

CHANGE IN EMPLOYMENT= net change in agriculture employment+net change in industry employment+net change in services employment Units: Person/Year

change in forest from pasture= net forest increase due to policy*0.5 Units: ha/year

change in industries investment green= industrial abatement expenditure per year Units: usd15/Year

change in industry technology= industry technology*assumed annual change in industry technology Units: Dmnl/Year

"change in initial pm2.5 emissions for 2016"= if then else(Time<2016,("total pm2.5 emissions from energy and power"-"initial pm2.5 emissions for 2016")/TIME STEP,0) Units: Ton/(Year*Year)

"change in initial residential pm2.5 emissions for 2016"= if then else(Time<2016,("household pm2.5 emissions"-"initial residential pm2.5 emissions for 2016")/TIME STEP,0) Units: Ton/(Year*Year)

change in material efficiency for buildings= if then else(Time>2025,Material efficiency for buildings*(Assumed change in material efficiency for buildings +(if then else(S3 CE material efficiency building switch=3,S3 Additional material efficiency gains in building HA ,if then else(S3 CE material efficiency building switch=2,S3 Additional material efficiency gains in building CA ,if then else(S3 CE material efficiency building switch=1,S3 Additional material efficiency gains in building LA ,0))))),0) Units: Dmnl/Year

change in material efficiency for clothing= if then else(Time>2025,Material efficiency for clothing*(Assumed change in material efficiency for clothing +(if then else(S3 CE material efficiency clothing switch=3,S3 Additional material efficiency gains in clothing

production HA ,if then else(S3 CE material efficiency clothing switch=2,S3 Additional material efficiency gains in clothing production CA , if then else(S3 CE material efficiency clothing switch=1,S3 Additional material efficiency gains in clothing production LA ,0))))),0) Units: Dmnl/Year

change in material efficiency for plastic= if then else(Time>2025,Material efficiency for plastic*(Assumed change in material efficiency for plastic +(if then else(S3 CE material efficiency plastic switch=3,S3 Additional material efficiency gains in plastic production HA ,if then else(S3 CE material efficiency plastic switch=2,S3 Additional material efficiency gains in plastic production CA ,if then else(S3 CE material efficiency plastic switch=1,S3 Additional material efficiency gains in plastic production LA ,0))))),0) Units: Dmnl/Year

change in material efficiency for vehicles= if then else(Time>2025,Material efficiency for vehicles*(Assumed change in material efficiency +(if then else(S3 CE material efficiency vehicle switch=3,S3 Additional material efficiency gains HA ,if then else(S3 CE material efficiency vehicle switch=2, S3 Additional material efficiency gains CA ,if then else(S3 CE material efficiency vehicle switch=1,S3 Additional material efficiency gains LA ,0))))),0) Units: Dmnl/Year

change in relative GDP= if then else(Time<2024,(relative gdp-relative GDP in 2024)/0.1,0) Units: Dmnl

change in transport investment= MAX(0, transportation green investment after expansion of travel volume+transportation emission abatement cost +(energy green investment-power generation investment-biofuels investment)) Units: usd15/Year

check= real gross domestic product-(Normalized agriculture GDP+Normalized industry GDP +Normalized services GDP) Units: usd15/Year

Chemical and plastics allowance share of EITE= Chemical and plastics average two years emissions*total allowances share of eite /average two years emissions Units: Dmnl

Chemical and plastics average two years emissions= (Chemical and plastics emission one+Chemical and plastics emission two)/2 Units: Ton/Year

Chemical and plastics average two years production= (Chemical and plastics production one+Chemical and plastics production two)/2 Units: Ton/Year

Chemical and plastics carbon intensity= Chemical and plastics average two years emissions/Chemical and plastics average two years production Units: Dmnl

Chemical and plastics coal consumption= total Chemical and plastics production*Chemical and plastics energy Intensity [coal energy]*(1-energy efficiency ratio from green investment industry) Units: ktoe/Year

Chemical and plastics coal consumption IN MBTU= Chemical and plastics coal consumption*KTOE TO MBTU Units: Mbtu/Year

Chemical and plastics coal emissions= Chemical and plastics coal consumption IN MBTU*coal emission factor*MBTU TO TJ Units: Kg/Year

Chemical and plastics coal intensity([(1971,0)-(2010,1e-005)],(1971,1.58315e-006),(1972,1.38135e-006),(1973,1.35371e-006),(1974,1.30449e-006),(1975,1.25596e-006),(1976,1.20769e-006),(1977,1.0711e-006),(1978,9.44821e-007),(1979,9.47686e-007),(1980,2.29354e-006),(1981,2.20407e-006),(1982,2.20453e-006),(1983,2.23835e-006),(1984,2.32882e-006),(1985,1.89172e-006),(1986,1.8016e-006),(1987,1.82598e-006),(1988,1.89086e-006),(1989,1.86567e-006),(1990,1.47485e-006),(1991,1.52001e-006),(1992,1.3512e-006),(1993,1.34423e-006),(1994,1.45228e-006),(1995,1.72787e-006),(1996,1.61488e-006),(1997,1.36932e-006),(1998,1.32697e-006),(1999,1.20032e-006),(2000,1.04914e-006),(2001,9.89929e-007),(2002,6.63889e-007),(2003,5.43491e-007),(2004,3.71257e-007),(2005,4.76795e-007),(2006,4.6654e-007),(2007,4.85666e-007)) Units: Mbtu/Ton

Chemical and plastics coal price= Coal Price per MBTU Units: usd15/Mbtu

Chemical and plastics demand over supply= total Chemical and plastics demand/total Chemical and plastics production Units: Dmnl

Chemical and plastics demand per unit of GDP([(1995,0)-(2006,0.002)],(1995,0.000720965),(1996,0.000758334),(1997,0.000760065),(1998,0.000808725),(1999,0.000726562),(2000,0.000762525),(2001,0.000736539),(2002,0.00103051),(2003,0.00129592),(2004,0.00167438),(2005,0.0013415),(2006,0.00142012)) Units: Ton/usd15

Chemical and plastics ELECTRICITY consumption= total Chemical and plastics production*Chemical and plastics energy Intensity [electricity]*(1-energy efficiency ratio from green investment industry) Units: ktoe/Year

Chemical and plastics ELECTRICITY consumption IN MBTU= Chemical and plastics ELECTRICITY consumption*KTOE TO MBTU Units: Mbtu/Year

Chemical and plastics electricity emissions= Chemical and plastics ELECTRICITY consumption IN MBTU*electricity emission factor Units: Kg/Year

Chemical and plastics ELECTRICITY intensity([(1971,0)-(2010,10)],(1971,2.23866e-006),(1972,2.39021e-006),(1973,2.57257e-006),(1974,2.63831e-006),(1975,2.56325e-006),(1976,2.6704e-006),(1977,2.63029e-006),(1978,2.56471e-006),(1979,2.511e-006),(1980,2.34028e-006),(1981,2.2051e-006),(1982,2.14451e-006),(1983,2.16781e-006),(1984,2.20958e-006),(1985,2.19896e-006),(1986,2.15545e-006),(1987,2.19472e-006),(1988,2.1978e-006),(1989,2.22488e-006),(1990,2.07527e-006),(1991,2.01856e-

006),(1992,1.97804e-006),(1993,1.90844e-006),(1994,1.89997e-006),(1995,1.94074e-006),(1996,1.84381e-006),(1997,1.78031e-006),(1998,1.56183e-006),(1999,1.70328e-006),(2000,1.6539e-006),(2001,1.68812e-006),(2002,1.19373e-006),(2003,9.7444e-007),(2004,7.49184e-007),(2005,9.31861e-007),(2006,8.71459e-007),(2007,9.02797e-007)) Units: Mbtu/Ton

Chemical and plastics electricity price= reference electricity price Units: usd15/kWh

Chemical and plastics electricity price in mbtu= Chemical and plastics electricity price*kwh to mbtu Units: USD/Mbtu

Chemical and plastics emission one= DELAY FIXED (Chemical and plastics emissions, 1 , Chemical and plastics emissions) Units: Ton/Year

Chemical and plastics emission two= DELAY FIXED (Chemical and plastics emissions, 2 ,Chemical and plastics emissions) Units: Ton/Year

Chemical and plastics emissions= Chemical and plastics total emissions in tons Units: Ton/Year

Chemical and plastics employment per unit of output([(1990,0)-(2024,0.002)],(1990,0.00192432),(1991,0.00186089),(1992,0.00181929),(1993,0.00173912),(1994,0.00169554),(1995,0.00168434),(1996,0.0016032),(1997 ,0.001564),(1998,0.0014157),(1999,0.00155367),(2000,0.0014472),(2001,0.00147615),(2002,0.00103188),(2003,0.000775675),(2004,0.000590994),(2005,0.000724124),(2006,0.000695317),(2007,0.000696059),(2008,0.000694748),(2009,0.000679875),(2010,0.000678129),(2011,0.000668904),(2012,0.000647773),(2013,0.000625006),(2014,0.000594267),(2015,0.000576841),(2016,0.000565271),(2017,0.00054692),(2018,0.000529587),(2019,0.000537323),(2020,0.000538036),(2021,0.000509259),(2022,0.000483824),(2023,0.000483409),(2024,0.000484621)) Units: Person/Ton

Chemical and plastics energy cost= Chemical and plastics coal consumption IN MBTU*Chemical and plastics coal price +Chemical and plastics ELECTRICITY consumption IN MBTU *Chemical and plastics electricity price in mbtu +Chemical and plastics natural gas consumption IN MBTU*Chemical and plastics natural gas price +Chemical and plastics oil consumption IN MBTU *Chemical and plastics oil price +Chemical and plastics residual fuel consumption IN MBTU*Chemical and plastics reNEWABLES price Units: usd15/Year

Chemical and plastics energy cost over total cost= Chemical and plastics energy cost/Chemical and plastics total production cost Units: Dmnl

Chemical and plastics energy intensity change[electricity]= Chemical and plastics indicated energy intensity[electricity]-Chemical and plastics energy Intensity [electricity] Chemical and plastics energy intensity change[diesel]= Chemical and plastics indicated

energy intensity[diesel]-Chemical and plastics energy Intensity [diesel] Chemical and plastics energy intensity change[natural gas]= Chemical and plastics indicated energy intensity[natural gas]-Chemical and plastics energy Intensity [natural gas] Chemical and plastics energy intensity change[ethanol]= Chemical and plastics indicated energy intensity[ethanol]-Chemical and plastics energy Intensity [ethanol] Chemical and plastics energy intensity change[coal energy]= Chemical and plastics indicated energy intensity[coal energy]-Chemical and plastics energy Intensity [coal energy] Units: Mbtu/Ton

Chemical and plastics energy Intensity[electricity]= INTEG (Chemical and plastics energy intensity change[electricity], Chemical and plastics ELECTRICITY intensity(Time)) Chemical and plastics energy Intensity[diesel]= INTEG (Chemical and plastics energy intensity change[diesel], Chemical and plastics oil intensity(Time)) Chemical and plastics energy Intensity[natural gas]= INTEG (Chemical and plastics energy intensity change[natural gas], Chemical and plastics natural gas intensity(Time)) Chemical and plastics energy Intensity[ethanol]= INTEG (Chemical and plastics energy intensity change[ethanol], Chemical and plastics renewables intensity(Time)) Chemical and plastics energy Intensity[coal energy]= INTEG (Chemical and plastics energy intensity change[coal energy], Chemical and plastics coal intensity(Time)) Units: Mbtu/Ton

Chemical and plastics indicated energy intensity[electricity]= if then else(Time<2008, Chemical and plastics ELECTRICITY intensity(Time), Chemical and plastics energy Intensity[electricity]/percentage increase in efficiency) Chemical and plastics indicated energy intensity[diesel]= if then else(Time<2008, Chemical and plastics oil intensity(Time), Chemical and plastics energy Intensity [diesel]/percentage increase in efficiency) Chemical and plastics indicated energy intensity[natural gas]= if then else(Time<2008, Chemical and plastics natural gas intensity(Time) , Chemical and plastics energy Intensity[natural gas]/percentage increase in efficiency) Chemical and plastics indicated energy intensity[ethanol]= if then else(Time<2008, Chemical and plastics renewables intensity(Time), Chemical and plastics energy Intensity[ethanol]/percentage increase in efficiency) Chemical and plastics indicated energy intensity[coal energy]= if then else(Time<2008, Chemical and plastics coal intensity(Time), Chemical and plastics energy Intensity [coal energy]/percentage increase in efficiency) Units: Mbtu/Ton

Chemical and plastics labor cost= total Chemical and plastics employment*Chemical and plastics labor cost table (Time) Units: usd15/Year

Chemical and plastics labor cost table([(1995,0)-(2010,100000)],(1995,17000),(1996,15900),(1997,16100),(1998,15100),(1999,14100),(2000,13200),(2001,13000),(2002,12900),(2003,16200),(2004,19200),(2005,19300),(2006,9750)) Units: usd15/Person

Chemical and plastics market price= Chemical and plastics market price table(Time) Units: USD/Ton

Chemical and plastics market price table([(1995,0)-(2010,100)],(1995,31.36),(1996,26.68),(1997,33.37),(1998,26.3),(1999,26.24),(2000,20.83),(2001,18.74),(2002,15.03),(2003,14.46),(2004,12.42),(2005,19.5),(2006,21.81)) Units: usd15/Ton

Chemical and plastics material and capital production cost= total Chemical and plastics production*Chemical and plastics unit cost(Time) Units: usd15/Year

Chemical and plastics material cost= INTEG (Chemical and plastics material cost change, Chemical and plastics unit cost(Time)) Units: usd15/Ton

Chemical and plastics material cost change= (indicated Chemical and plastics material cost-Chemical and plastics material cost)/price adjustment Units: usd15/Ton/Year

Chemical and plastics natural gas consumption= total Chemical and plastics production*Chemical and plastics energy Intensity [natural gas]*(1-energy efficiency ratio from green investment industry) Units: ktoe/Year

Chemical and plastics natural gas consumption IN MBTU= Chemical and plastics natural gas consumption*KTOE TO MBTU Units: Mbtu/Year

Chemical and plastics natural gas emissions= Chemical and plastics natural gas consumption IN MBTU*natural gas emission factor *MBTU TO TJ Units: Kg/Year

Chemical and plastics natural gas intensity([(1971,0)-(2010,10)],(1971,1.48901e-006),(1972,1.64319e-006),(1973,1.81956e-006),(1974,1.93312e-006),(1975,1.88333e-006),(1976,1.91526e-006),(1977,2.01084e-006),(1978,1.99211e-006),(1979,2.11323e-006),(1980,2.20791e-006),(1981,2.20577e-006),(1982,2.1117e-006),(1983,2.00557e-006),(1984,2.04843e-006),(1985,2.16834e-006),(1986,2.07875e-006),(1987,2.04239e-006),(1988,1.97337e-006),(1989,1.99681e-006),(1990,3.13511e-006),(1991,3.0706e-006),(1992,2.79403e-006),(1993,2.76785e-006),(1994,2.80051e-006),(1995,2.88111e-006),(1996,2.80408e-006),(1997,2.42068e-006),(1998,2.10808e-006),(1999,2.30155e-006),(2000,2.66891e-006),(2001,2.50579e-006),(2002,1.81735e-006),(2003,1.41561e-006),(2004,1.02679e-006),(2005,1.20035e-006),(2006,1.12378e-006),(2007,1.17499e-006)) Units: Mbtu/Ton

Chemical and plastics natural gas price= Natural Gas Price per MBTU Units: usd15/Mbtu

Chemical and plastics net allocations variable shares= min(Chemical and plastics production based allocation,Chemical and plastics upper limit allocation variable shares) Units: usd15/Year

Chemical and plastics oil consumption= total Chemical and plastics production*Chemical and plastics energy Intensity [diesel]*(1-energy efficiency ratio from green investment industry) Units: ktoe/Year

Chemical and plastics oil consumption IN MBTU= Chemical and plastics oil consumption*KTOE TO MBTU Units: Mbtu/Year

Chemical and plastics oil emissions= Chemical and plastics oil consumption IN MBTU*distillate fuel oil emission factor *MBTU TO TJ Units: Kg/Year

Chemical and plastics oil intensity([(1971,0)-(2010,10)],(1971,2.31966e-006),(1972,2.38034e-006),(1973,2.44349e-006),(1974,2.33701e-006),(1975,2.19605e-006),(1976,2.38797e-006),(1977,2.41981e-006),(1978,2.21836e-006),(1979,2.17741e-006),(1980,2.09682e-006),(1981,1.85148e-006),(1982,1.76517e-006),(1983,1.38617e-006),(1984,1.23209e-006),(1985,1.13328e-006),(1986,1.12689e-006),(1987,1.11533e-006),(1988,1.02188e-006),(1989,9.98676e-007),(1990,1.36991e-006),(1991,1.38967e-006),(1992,1.25807e-006),(1993,1.22135e-006),(1994,1.27611e-006),(1995,1.41785e-006),(1996,1.39384e-006),(1997,1.33075e-006),(1998,1.17819e-006),(1999,1.26456e-006),(2000,1.39789e-006),(2001,1.41281e-006),(2002,9.43003e-007),(2003,6.98015e-007),(2004,5.31202e-007),(2005,6.29477e-007),(2006,5.726e-007),(2007,5.53782e-007)) Units: Mbtu/Ton

Chemical and plastics oil price= Oil Price per MBtu Units: usd15/Mbtu

Chemical and plastics operating margin= Chemical and plastics operating surplus/Chemical and plastics revenues Units: Dmnl

Chemical and plastics operating surplus= Chemical and plastics revenues-Chemical and plastics total production cost Units: USD/Year

Chemical and plastics price= INTEG (Chemical and plastics price change, Chemical and plastics market price table(Time)) Units: usd15/Ton

Chemical and plastics price change= (indicated Chemical and plastics price-Chemical and plastics price)/price adjustment Units: usd15/Ton/Year

Chemical and plastics production based allocation= Chemical and plastics average two years production*Chemical and plastics carbon intensity *allowance price per ton Units: usd15/Year

Chemical and plastics production one= DELAY FIXED (total Chemical and plastics production, 1 , total Chemical and plastics production) Units: Ton/Year

Chemical and plastics production two= DELAY FIXED (total Chemical and plastics production, 2 , total Chemical and plastics production) Units: Ton/Year

Chemical and plastics profit share([(1992,-0.8)-(2030,1)],(2000,0),(2001,-0.51),(2002,-0.1814),(2003,-0.2286) ,(2004,0.3487),(2005,0.3981),(2006,0.5337),(2007,0.6042)) Units: Dmnl

Chemical and plastics profits over revenues= real Chemical and plastics profit/real Chemical and plastics revenues Units: Dmnl

Chemical and plastics renewables intensity([(1971,0)-(2010,10)],(1971,1.13224e-006),(1972,1.24359e-006),(1973,1.35161e-006),(1974,1.45288e-006),(1975,1.28276e-006),(1976,1.50257e-006),(1977,1.45549e-006),(1978,1.42964e-006),(1979,1.3956e-006),(1980,1.00922e-006),(1981,9.95024e-007),(1982,9.68848e-007),(1983,9.17662e-007),(1984,9.15396e-007),(1985,8.84751e-007),(1986,1.31764e-006),(1987,8.27975e-007),(1988,7.98091e-007),(1989,7.78531e-007),(1990,4.15839e-007),(1991,4.03157e-007),(1992,5.42168e-007),(1993,1.15924e-006),(1994,1.00656e-006),(1995,9.30159e-007),(1996,7.4784e-007),(1997,6.89413e-007),(1998,5.92319e-007),(1999,7.67612e-007),(2000,7.44444e-007),(2001,7.48729e-007),(2002,5.30862e-007),(2003,4.36277e-007),(2004,3.21828e-007),(2005,4.06027e-007),(2006,3.99073e-007),(2007,3.99599e-007)) Units: Mbtu/Ton

Chemical and plastics reNEWABLES price= Renewable Resource price per MBTU(Time) Units: usd15/Mbtu

Chemical and plastics residual fuel consumption= total Chemical and plastics production*Chemical and plastics energy Intensity [ethanol]*(1-energy efficiency ratio from green investment industry) Units: ktoe/Year

Chemical and plastics residual fuel consumption IN MBTU= Chemical and plastics residual fuel consumption*KTOE TO MBTU Units: Mbtu/Year

Chemical and plastics residual fuel emissions= Chemical and plastics residual fuel consumption IN MBTU*residual fuel oil emission factor *MBTU TO TJ Units: Kg/Year

Chemical and plastics revenues= Chemical and plastics market price*total Chemical and plastics production Units: USD/Year

Chemical and plastics total demand growth rate= ((total Chemical and plastics demand-previous Chemical and plastics total demand)/previous Chemical and plastics total demand)/GROWTH RATE base period Units: Dmnl/Year

Chemical and plastics total emissions in tons= (Chemical and plastics coal emissions+Chemical and plastics oil emissions+ Chemical and plastics electricity emissions+ +Chemical and plastics natural gas emissions+Chemical and plastics residual fuel emissions)/1000 Units: Ton/Year

Chemical and plastics total production cost= Chemical and plastics labor cost+Chemical and plastics material and capital production cost +Chemical and plastics energy cost-Chemical and plastics net allocations variable shares Units: usd15/Year

Chemical and plastics total production cost growth rate= ((Chemical and plastics total production cost-previous Chemical and plastics total production cost)/previous Chemical and plastics total production cost)/GROWTH RATE base period Units: Dmnl/Year

Chemical and plastics total real unit cost= Chemical and plastics total unit cost/gdp deflator Units: usd15/Ton

Chemical and plastics total real unit cost growth rate= ((Chemical and plastics total real unit cost-previous Chemical and plastics total real unit cost)/previous Chemical and plastics total real unit cost)/GROWTH RATE base period Units: Dmnl/Year

Chemical and plastics total unit cost= Chemical and plastics total production cost/total Chemical and plastics production Units: USD/Ton

Chemical and plastics unit cost([(1995,0)-(2010,100)],(1995,14.5),(1996,12.4),(1997,16.2),(1998,12.7),(1999,12.7),(2000,10.3),(2001,9.03),(2002,7.04),(2003,7.17),(2004,6.28),(2005,10.3),(2006,11.8)) Units: usd15/Ton

Chemical and plastics upper limit allocation variable shares= total allowance value*Chemical and plastics allowance share of EITE Units: usd15/Year

chemical fertilizer cost per tonne= 7320 Units: usd15/Ton

chemical fertilizer use= fertilizer use by type[chemical] Units: Ton/Year

clothing currently in use= INTEG (reusing of used clothing+Sale of clothing-Discard of clothing, initial clothing in use) Units: Ton

clothing demand per population= WITH LOOKUP (Time, ([(2000,0.01)-(2025,0.03)],(2000,0.0150679),(2001,0.0149725),(2002,0.0147921),(2003,0.0146861),(2004,0.0147284),(2005,0.014962),(2006,0.0153714),(2007,0.0160116),(2008,0.0167772),(2009,0.0172742),(2010,0.0175868),(2011,0.018171),(2012,0.0188894),(2013,0.0195152),(2014,0.0199538),(2015,0.0200955),(2016,0.0200323),(2017,0.0199751),(2018,0.0199738),(2019,0.0199826),(2020,0.0197315),(2021,0.0196999),(2022,0.02055),(2025,0.023))) Units: Ton/Person/Year

clothing material waste to landfills[Materials]= MAX(0,Material waste collected from clothing[Materials]*share of material waste from clothing to be landfilled [Materials]) Units: Ton/Year

clothing materials to be reused[Materials]= DELAY FIXED (clothing waste from manufacturing[Materials]+clothing waste to be reused in clothing manufacturing [Materials],1,0) Units: Ton/Year

clothing waste collected[Materials]= if then else(CE policy switch=1,Material waste generated from clothing[Materials]*CE share of clothing waste collected[Materials](Time), Material waste generated from clothing [Materials]*share of clothing waste collected[Materials](Time)) Units: Ton/Year

clothing waste from manufacturing[Materials]= Material Consumption for clothing production[Materials]*material waste generated per material of clothing [Materials] Units: Ton/Year

clothing waste in landfills to be incinerated[Materials]= Material waste from clothing landfilled[Materials]/Average time for waste from clothing to be incinerated Units: Ton/Year

clothing waste shares check[Materials]= if then else(CE policy switch=3:OR:S9 S10 recycling and reuse rates=3,S9 CE share of material waste from clothing to be recycled HA [Materials](Time)+S9 S10 CE share of material from clothing waste to be reused HA [Materials](Time),if then else(CE policy switch=2:OR:S9 S10 recycling and reuse rates =2,S9 S10 CE share of material from clothing waste to be reused CA[Materials](Time)+S9 CE share of material waste from clothing to be recycled CA[Materials](Time), if then else(CE policy switch=1:OR:S9 S10 recycling and reuse rates=1,S9 S10 CE share of material from clothing waste to be reused LA [Materials](Time)+S9 CE share of material waste from clothing to be recycled LA [Materials](Time),share of material from clothing waste to be reused[Materials](Time) +share of material waste from clothing to be recycled[Materials](Time))))+ share of material waste from clothing to be landfilled[Materials] Units: Dmnl/Year

Clothing waste to be reused[Materials]= if then else(CE policy switch=3:OR:S9 S10 recycling and reuse rates=3,MAX(0,Material waste collected from clothing[Materials]*S9 S10 CE share of material from clothing waste to be reused HA [Materials](Time)),if then else(CE policy switch=2:OR:S9 S10 recycling and reuse rates =2,MAX(0,Material waste collected from clothing[Materials]*S9 S10 CE share of material from clothing waste to be reused CA [Materials](Time)),if then else(CE policy switch=1:OR:S9 S10 recycling and reuse rates =1,MAX(0,Material waste collected from clothing[Materials]*S9 S10 CE share of material from clothing waste to be reused LA [Materials](Time)),MAX(0,Material waste collected from clothing[Materials]* share of material from clothing waste to be reused[Materials](Time))))) Units: Ton/Year

clothing waste to be reused in clothing manufacturing[Materials]= Clothing waste to be reused[Materials] Units: Ton/Year

CO emissions from biomass= biomass and waste in TJ*CO emissions per tj of biomass by sector/KG PER TON Units: Ton/Year

CO emissions from coal[sector]= normalized coal demand[sector]*Co emissions per tj of coal by sector[sector]/KG PER TON Units: Ton/Year

CO emissions from natural gas[sector]= normalized natural gas demand[sector]*CO emissions per tj of natural gas by sector [sector]/KG PER TON Units: Ton/Year

CO emissions from petroleum[sector]= normalized petroleum demand[sector]*CO emissions per tj of gasoline by sector [sector]*effect of fuel grade on transport CO emissions [sector]/KG PER TON Units: Ton/Year

CO emissions from power generation[power generation technology]= fuel use for power generation in TJ[power generation technology]*CO emissions per TJ of fuel combusted [power generation technology]/KG PER TON Units: Ton/Year

CO emissions per tj of biomass by sector= 4753 Units: Kg/Tj

Co emissions per tj of coal by sector[sector]= 931, 0, 931, 0, 2610 Units: Kg/Tj

CO emissions per TJ of fuel combusted[power generation technology]= 15.1, 15.1, 39, 8.7, 0, 0, 0, 0, 0, 0, 0, 0, 0, 90, 0 Units: Kg/Tj

CO emissions per tj of gasoline by sector[sector]= 66, 5808.2, 130, 0, 93 Units: Kg/Tj

CO emissions per tj of natural gas by sector[sector]= 29, 271.7, 29, 0, 26 Units: Kg/Tj

"co-generation capacity from green investment"= "co-generation green investment"/"co-generation energy cost per mw"(Time)/ "co-generation energy construction time" Units: MW

"co-generation capital life time"= 30 Units: Year

"Co-generation energy capacity"= INTEG ("Co-generation energy construction"-"co-generation energy discard", 0) Units: MW

"co-generation energy construction employment factor"([(2010,0)-(2030,20)],(2010,8.2668),(2011,8.0818),(2012,7.8997),(2013,7.7205),(2014,7.544),(2015,7.3703),(2016,7.1993),(2017,7.031),(2018,6.8653),(2019,6.7023),(2020,6.5418),(2021,6.4161),(2022,6.2915),(2023,6.168),(2024,6.0455),(2025,5.9242),(2026,5.8039),(2027,5.6846),(2028,5.5664),(2029,5.4492),(2030,5.3331)) Units: Person/MW

"co-generation energy construction employment"= "Co-generation energy construction"*("co-generation energy construction employment factor" (Time)+"co-generation energy manufacturing employment factor"(Time)) Units: Person/Year

"co-generation energy construction time"= 1 Units: Year

"Co-generation energy construction"= if then else(Time<2010, "co-generation energy investment"/"co-generation energy cost per mw" (Time)/"co-generation energy construction time" , ("future co-generation energy investment"/"co-generation energy cost per mw" (Time)/"co-generation energy construction time")+"co-generation capacity from green investment") Units: MW/Year

"co-generation energy cost per mw"([(2015,0)-(2030,6e+006)],(2015,2.57e+006),(2030,2.46e+006)) Units: usd15/MW

"co-generation energy discard"= "Co-generation energy capacity"/"co-generation capital life time" Units: MW/Year

"co-generation energy electricity generation"= min((TOTAL electricity demand accounting for distribution losses-hydro electricity generation -wind electricity generation-solar electricity generation-geothermal electricity generation -tidal energy electricity generation-wave energy electricity generation-landfill gas electricity generation -nuclear energy electricity generation-waste energy electricity generation) , "co-generation energy power capacity use"/mwh to gwh) Units: GWh/Year

"co-generation energy investment" Units: usd15

"co-generation energy load factor"= 0.2 Units: Dmnl

"co-generation energy manufacturing employment factor"([(2010,0)-(2030,1)],(2010,0.8479),(2011,0.8289),(2012,0.8102),(2013,0.7918),(2014,0.7737),(2015,0.7559),(2016,0.7384),(2017,0.7211),(2018,0.7041),(2019,0.6874),(2020,0.671),(2021,0.6581),(2022,0.6453),(2023,0.6326),(2024,0.6201),(2025,0.6076),(2026,0.5953),(2027,0.583),(2028,0.5709),(2029,0.5589),(2030 ,0.547)) Units: Person/MW

"co-generation energy operation and maintenance employment factor"([(2010,0)-(2030,10)],(2010,3.2907),(2011,3.217),(2012,3.1446),(2013,3.0732),(2014,3.003),(2015,2.9338),(2016,2.8657),(2017,2.7987),(2018,2.7328),(2019,2.6679),(2020,2.604),(2021,2.554),(2022,2.5044),(2023,2.4552),(2024,2.4065),(2025,2.3582),(2026,2.3103),(2027,2.2628),(2028,2.2158),(2029,2.1691),(2030,2.1229)) Units: Person/MW

"co-generation energy operation and maintenance employment"= "Co-generation energy capacity"*"co-generation energy operation and maintenance employment factor" (Time) Units: Person/Year

"co-generation energy power capacity use"= "co-generation energy load factor"*"potential electricity generation co-generation energy" Units: MWh/Year

"co-generation green investment fraction"([(2011,0)-(2050,0.3)],(2011,0.01),(2050,0.01)) Units: Dmnl

"co-generation green investment"= "co-generation green investment fraction"(Time)*power generation investment Units: usd15/Year

"co-generation share of power generation"= "co-generation energy electricity generation"/total electricity generation Units: Dmnl

CO2 EMISSION FACTORS [energy type]= 2.1, 2.15, 3.21128, 2.98519, 0, 2.07487, 2.50297, 0, 2.25, 3.5, 0, 0, 0, 0 Units: mtoe/mtoe

co2 emission from agriculture= agriculture co2 emission from energy use+DEFORESTATION CO2 EMISSION+fertilizer co2 emission +HARVESTED LAND C02 EMISSION+livestock c02 emission Units: mtoe/Year

co2 emission from coal demand for power generation in ton= co2 emission per ton coal*(coal demand for power generation in barrels/7)* (1-efficiency factor power generation)*(1-(EXOGENOUS CCS CAPACITY*IEA NET ZERO SWITCH)) Units: Ton/Year

co2 emission from gas demand for power generation in ton= co2 emission per ton gas*(gas turbine demand for power generation in barrels /7) Units: Ton/Year

co2 emission from oil demand for power generation in ton= co2 emission per ton oil*(oil demand for power generation in barrels/7) Units: Ton/Year

CO2 emission in kg= fossil fuel CO2 emission * TON to KG Units: Kg/Year

co2 emission per ton coal= 3.81105 Units: Ton/Ton

co2 emission per ton gas= 2.25526 Units: Ton/Ton

co2 emission per ton oil= 2.69708 Units: Ton/Ton

CO2 emissions by bus type[bus]= ((bus energy type[diesel]*CO2 EMISSION FACTORS[diesel])+(bus energy type[gasoline power]*CO2 EMISSION FACTORS[gasoline power])+(bus energy type[biodiesel]*CO2 EMISSION FACTORS [biodiesel])+(bus energy type[ethanol]*CO2 EMISSION FACTORS[ethanol])) CO2 emissions by bus type[minibus]= ((minibus energy type[diesel]*CO2 EMISSION FACTORS[diesel])+(minibus energy type [gasoline power]*CO2 EMISSION FACTORS[gasoline power])+(minibus energy type [biodiesel]*CO2 EMISSION FACTORS[biodiesel])+(minibus energy type[ethanol] *CO2 EMISSION FACTORS[ethanol])) Units: mtoe/Year

CO2 emissions by trucks type[medium truck]= ((medium truck energy consumed by energy type[gasoline power]*CO2 EMISSION FACTORS [gasoline power])+(medium truck energy consumed by energy type[ethanol]*CO2 EMISSION FACTORS [ethanol])+(medium truck energy consumed by energy type[diesel]*CO2 EMISSION FACTORS

[diesel])+(medium truck energy consumed by energy type[biodiesel]*CO2 EMISSION FACTORS [biodiesel])+(medium truck energy consumed by energy type[hydrogen]*CO2 EMISSION FACTORS [hydrogen])) CO2 emissions by trucks type[heavy truck]= ((heavy truck energy consumed by energy type[gasoline power]*CO2 EMISSION FACTORS [gasoline power])+(heavy truck energy consumed by energy type[ethanol]*CO2 EMISSION FACTORS [ethanol])+(heavy truck energy consumed by energy type[diesel]*CO2 EMISSION FACTORS [diesel])+(heavy truck energy consumed by energy type[biodiesel]*CO2 EMISSION FACTORS [biodiesel])+(heavy truck energy consumed by energy type[hydrogen]*CO2 EMISSION FACTORS [hydrogen])) Units: mtoe/Year

co2 emissions from biomass= biomass and waste in TJ*CO2 emissions per tj of biomass by sector/KG PER TON Units: Ton/Year

co2 emissions from coal 0[sector]= normalized coal demand[sector]*co2 emissions per tj of coal by sector[sector]/KG PER TON Units: Ton/Year

co2 emissions from natural gas[sector]= normalized natural gas demand[sector]*CO2 emissions per tj of natural gas by sector [sector]/KG PER TON Units: Ton/Year

co2 emissions from petroleum[sector]= normalized petroleum demand[sector]*CO2 emissions per tj of gasoline by sector [sector]/KG PER TON Units: Ton/Year

co2 emissions from power generation[power generation technology]= fuel use for power generation in TJ[power generation technology]*CO2 emissions per TJ of fuel combusted [power generation technology] Units: Ton/Year

co2 emissions per hectare= (total emissions from energy*1000)/total land area Units: Kg/Year/Ha

CO2 emissions per tj of biomass by sector= 95600 Units: Kg/Tj

co2 emissions per tj of coal by sector[sector]= 94600, 0, 94600, 0, 94600 Units: Kg/Tj

CO2 emissions per TJ of fuel combusted[power generation technology]= 77.4, 77.4, 56.1, 96.1, 0, 0, 0, 0, 0, 0, 0, 0, 91.7, 0 Units: Ton/Tj

CO2 emissions per tj of gasoline by sector[sector]= 74100, 69300, 74100, 0, 67460 Units: Kg/Tj

CO2 emissions per tj of natural gas by sector[sector]= 56100, 56100, 56100, 0, 56100 Units: Kg/Tj

co2 equivalents per short ton land filled waste= 0.26 Units: Ton/short ton

co2e emissions per hectare of agricultural land= WITH LOOKUP (Time, ([(1970,1)-(2050,2)],(1970,1.03147),(1971,1.04519),(1972,1.04805),(1973,1.05946),(1974,1.07143),(1975,1.09004),(1976,1.09832),(1977,1.10461),(1978,1.10792

),(1979,1.11033),(1980,1.12309),(1981,1.12451),(1982,1.12999),(1983,1.13776
),(1984,1.14823),(1985,1.14215),(1986,1.1506),(1987,1.14957),(1988,1.16259)
,(1989,1.17723),(1990,1.17874),(1991,1.16831),(1992,1.161),(1993,1.14962),(
1994,1.15516),(1995,1.16455),(1996,1.17181),(1997,1.15037),(1998,1.15029),(
1999,1.15842),(2000,1.15011),(2001,1.14857),(2002,1.15848),(2003,1.1694),(2004
,1.19421),(2005,1.20595),(2006,1.2243),(2007,1.24076),(2008,1.25592),(2009,
1.27052),(2010,1.28017),(2011,1.29679),(2012,1.30398),(2013,1.31658),(2014,
1.31778),(2015,1.32786),(2016,1.34221),(2017,1.34735),(2018,1.34945),(2019,
1.35799),(2020,1.38198),(2021,1.38902),(2022,1.39851),(2023,1.40452),(2049.76
,1.5614))) Units: Ton/Ha/Year

Coal and peat demand for buildings= (Coal and peat intensity per building(Time)*Sale of buildings)/Energy efficiency in building construction Units: Tj/Year

Coal and peat demand for clothing= (Coal and peat intensity per clothing(Time)*Sale of clothing)/Energy efficiency in clothing manufacturing Units: Tj/Year

Coal and peat demand for plastic= (Coal and peat intensity per plastic(Time)*Sale of plastic)/Energy efficiency in plastic manufacturing Units: Tj/Year

Coal and peat demand for vehicles= (Coal and peat intensity per vehicle(Time)*Sale of vehicle)/Energy efficiency in vehicle manufacturing Units: Tj/Year

Coal and peat intensity per building([(2000,0)-
(2050,0.02)],(2000,0.0115),(2001,0.0120339),(2002,0.0118037),(2003
,0.0117233),(2004,0.0119554),(2005,0.0117624),(2006,0.0122029),(2007,0.0114484
),(2008,0.0102748),(2009,0.0123037),(2010,0.0122472),(2011,0.0161244),(2012
,0.0137474),(2013,0.01139),(2014,0.0114832),(2015,0.0119532),(2016,0.0141797
),(2017,0.0165988),(2018,0.0156356),(2019,0.0155567),(2020,0.0167381),(2021
,0.0140209),(2022,0.0140887),(2023,0.0139215),(2024,0.0134862),(2049.39,0.0121053
)) Units: Tj/building

Coal and peat intensity per clothing([(2000,0)-
(2050,0.04)],(2000,0.029521),(2001,0.0329603),(2002,0.0332931),(
2003,0.0368852),(2004,0.0374792),(2005,0.0383262),(2006,0.0381816),(2007,0.035815
),(2008,0.0346961),(2009,0.0388392),(2010,0.0380347),(2011,0.0342454),(2012
,0.0333746),(2013,0.0349568),(2014,0.0360647),(2015,0.0386324),(2016,0.0368646
),(2017,0.0352857),(2018,0.0348442),(2019,0.0362754),(2020,0.0396484),(2021
,0.0355188),(2022,0.0321375),(2049.39,0.0252632)) Units: Tj/Ton

Coal and peat intensity per plastic([(2000,0)-
(2050,0.002)],(2000,0.00116633),(2001,0.00117347),(2002,0.00108266
),(2003,0.00113516),(2004,0.00121653),(2005,0.00122663),(2006,0.00109962),(
2007,0.00109334),(2008,0.00127046),(2009,0.00117248),(2010,0.0012276),(2011
,0.00111621),(2012,0.00105131),(2013,0.00109751),(2014,0.0011127),(2015,0.0010312

),(2016,0.000822668),(2017,0.000826504),(2018,0.000876637),(2019,0.000817604
),(2020,0.000827943),(2021,0.000940285),(2022,0.000914341),(2023,0.00091128
),(2024,0.000903945),(2050,0.00054386)) Units: Tj/Ton

Coal and peat intensity per vehicle([(2000,0.02)-
(2050,0.04)],(2000,0.0224053),(2001,0.0235934),(2002,0.0251674
),(2003,0.0259229),(2004,0.0257899),(2005,0.0264796),(2006,0.0272606),(2007
,0.0299045),(2008,0.0286571),(2009,0.0283772),(2010,0.03033),(2011,0.0332673
),(2012,0.0342031),(2013,0.0348696),(2014,0.0343284),(2015,0.0347181),(2016
,0.0352223),(2017,0.0362779),(2018,0.0381949),(2019,0.0386331),(2020,0.0283943
),(2021,0.0264375),(2022,0.0285807),(2023,0.029427),(2024,0.0293134),(2050,
0.0224561)) Units: Tj/vehicle

coal capital life time= 30 Units: Year

COAL CCS CAPACITY= INTEG (COAL CCS CONSTRUCTION-COAL CCS DECAY, 0) Units: MW

COAL CCS CONSTRUCTION= (coal ccs investment/coal ccs construction cost(Time))/consstruction time Units: MW/Year

coal ccs construction cost([(2007,0)-(2030,800000)],(2007,800000),(2030,600000)) Units: usd15/MW

COAL CCS DECAY= COAL CCS CAPACITY/coal capital life time Units: MW/Year

coal ccs investment= coal ccs investment total-"coal ccs o&m cost" Units: usd15/Year

coal ccs investment total= ccs green investment*ccs investment fraction to coal Units: usd15/Year

"coal ccs o&m cost"= COAL CCS CAPACITY*coal energy maintenance cost per mw Units: usd15/Year

coal consumption from building= Coal and peat demand for buildings Units: Tj/Year

coal consumption from clothing= Coal and peat demand for clothing Units: Tj/Year

coal consumption from plastic= Coal and peat demand for plastic Units: Tj/Year

coal consumption from vehicles= Coal and peat demand for vehicles Units: Tj/Year

coal demand= coal final use+coal inventory and losses(Time) Units: MST/Year

coal demand for power generation in barrels= coal demand per gwh of power generation(Time)*(coal energy electricity generation) Units: Ton/Year

coal demand for power generation in mb= coal demand for power generation in barrels/1e+006 Units: MB/Year

coal demand for power generation in mst= coal energy electricity generation*coal mst per gwh Units: MST/Year

coal demand for power generation in qdbtu= coal demand for power generation in mb/QDBTU to MB(Time) Units: qdbtu/Year

Coal demand function([(1980,0)-(2010,10000)],(1980,4245.93),(1981,4220.02),(1982,4286.4),(1983,4278.56),(1984,4438.57),(1985,4566.57),(1986,4777.66),(1987,4918.56),(1988,5015.92),(1989,5126.84),(1990,5191),(1991,5100.01),(1992,4919.91),(1993,4730.99),(1994,4813.16),(1995,4819.31),(1996,4876.69),(1997,5000.63),(1998,5118.65),(1999,5162.84),(2000,5213.56),(2001,5457.94),(2002,5504.22),(2003,5556.26),(2004,5702.74),(2005,5866.04),(2006,6166.77),(2007,6340.63),(2008,6520.92),(2009,6735.96),(2010,6959.62),(2011,7200.86),(2012,7085.65),(2013,6974.56),(2014,7192.59),(2015,7450.62),(2016,7717.19),(2017,7841.46),(2018,8055.22),(2019,8342.71),(2020,8610.83),(2021,8806.27),(2022,9036.5),(2023,9323.39),(2024,9598.33),(2025,9841.76),(2026,10092),(2027,10359.9),(2028,10617.9),(2029,10866.3),(2030,11127.7),(2031,11364.6),(2032,11591.3),(2033,11821.5),(2034,12058.7),(2035,12315.7),(2036,12589.3),(2037,12845.4),(2038,13093.4)) Units: MST/Year

coal demand per gwh of power generation([(1990,0)-(2050,2000)],(1990,1940),(2007,1850),(2015,1760),(2020,1710),(2025,1650),(2030,1600)) Units: Ton/GWh

coal efficiency loss from ccs= 0 Units: Dmnl

coal electricity production share= min(1,(coal energy electricity generation)/nonhydro electricity production) Units: Dmnl

coal emission factor= 94600 Units: Kg/Tj

coal employment factor([(1990,0)-(2050,2000)],(1990,1400),(2010,770),(2030,400),(2050,200)) Units: Person/MST

coal energy capacity= INTEG (coal energy construction-coal energy discard, 350000) Units: MW

coal energy construction= if then else(Time<2010, coal energy investment(Time)/coal energy cost per mw (Time)/coal energy construction time, future coal energy investment /coal energy cost per mw(Time)/coal energy construction time)*(if then else (CE switch reduction in coal capacity=3,Reduction in coal capacity HA,if then else (CE switch

reduction in coal capacity=2,Reduction in coal capacity CA,if then else (CE switch reduction in coal capacity=1,Reduction in coal capacity LA,1)))) Units: MW/Year

coal energy construction employment= coal energy construction*(coal energy construction employment factor(Time) +coal energy manufacturing employment factor(Time)) Units: Person/Year

coal energy construction employment factor([(2010,0)-(2030,20)],(2010,18.3162),(2011,17.9244),(2012,17.5383),(2013,17.1576),(2014,16.7824),(2015,16.4125),(2016,16.0479),(2017,15.6886),(2018,15.3344),(2019,14.9853),(2020,14.6413),(2021,14.3888),(2022,14.1378),(2023,13.8881),(2024,13.6397),(2025,13.3928),(2026,13.1472),(2027,12.9029),(2028,12.66),(2029,12.4185),(2030,12.1782)) Units: Person/MW

coal energy construction time= 1 Units: Year

coal energy cost per mw([(2015,0)-(2030,4e+006)],(2015,1.22e+006),(2030,1.23e+006)) Units: usd15/MW

coal energy discard= (coal energy capacity/coal capital life time)*if then else(CE switch reduction in coal capacity =3,Phasing out coal capacity HA,if then else(CE switch reduction in coal capacity =2,Phasing out coal capacity CA,if then else(CE switch reduction in coal capacity =1,Phasing out coal capacity LA,1))) Units: MW/Year

coal energy electricity generation= min((TOTAL electricity demand accounting for distribution losses-hydro electricity generation -wind electricity generation-solar electricity generation-geothermal electricity generation -tidal energy electricity generation-wave energy electricity generation-landfill gas electricity generation -nuclear energy electricity generation-waste energy electricity generation- gas turbine energy electricity generation-diseal and fuel oil energy electricity generation), coal energy power capacity use/mwh to gwh) Units: GWh/Year

coal energy electricity generation in bkwh= coal energy electricity generation*gwh to bkwh Units: BKWH/Year

coal energy investment([(1970,0)-(2010,2e+011)],(1970,2.84e+010),(2009.76,1.29123e+011)) Units: usd15

coal energy load factor([(2010,0.3)-(2050,0.7)],(2010,0.613814),(2022,0.541318),(2023,0.541843)) Units: Dmnl

coal energy maintenance cost= coal energy capacity*coal energy maintenance cost per mw Units: usd15/Year

coal energy maintenance cost per mw= 29187.5 Units: usd15/MW/Year

coal energy manufacturing employment factor([(2010,0)-(2030,0.01)],(2010,0.0038),(2011,0.0037),(2012,0.0037),(2013,0.0036),(2014,0.0035),(2015,0.0034),(2016,0.0033),(2017,0.0033),(2018,0.0032),(2019,0.0031),(2020,0.0031),(2021,0.003),(2022,0.0029),(2023,0.0029),(2024,0.0028),(2025,0.0028),(2026,0.0027),(2027,0.0027),(2028,0.0026),(2029,0.0026),(2030,0.0025)) Units: Person/MW

Coal Energy Market Share= World Coal Production in qdbtu/total energy production Units: Dmnl

coal energy operation and maintenance employment= coal energy capacity*coal energy operation and maintenance employment factor (Time) Units: Person/Year

coal energy operation and maintenance employment factor([(2010,0)-(2030,1)],(2010,0.344),(2011,0.3366),(2012,0.3294),(2013,0.3222),(2014,0.3152),(2015,0.3082),(2016,0.3014),(2017,0.2947),(2018,0.288),(2019,0.2814),(2020,0.275),(2021,0.2702),(2022,0.2655),(2023,0.2608),(2024,0.2562),(2025,0.2515),(2026,0.2469),(2027,0.2423),(2028,0.2378),(2029,0.2332),(2030,0.2287)) Units: Person/MW

coal energy power capacity use= coal energy load factor(Time)*potential electricity generation coal energy Units: MWh/Year

coal expenditure for power generation= coal demand for power generation in mst*real coal price per MBTU*1e+006 Units: usd15/Year

coal export table([(1980,-50)-(2006,200)],(1980,126.97),(1981,91.15),(1982,131.2),(1983,45.42),(1984,104.63),(1985,65.59),(1986,86.08),(1987,81.82),(1988,66.62),(1989,85.73),(1990,124.58),(1991,96.76),(1992,89.89),(1993,1.34),(1994,82.22),(1995,70.87),(1996,57.53),(1997,60.39),(1998,80.43),(1999,61.78),(2000,-10.48),(2001,67.54),(2002,27.93),(2003,-23.11),(2004,4.84),(2005,0)) Units: MST/Year

coal extraction and conversion jobs factor= 0.06 Units: Person/GWh

coal extraction employment= coal employment factor(Time)*World Coal Production Rate Units: Person

coal final use= (normalized agriculture coal demand+normalized commercial coal demand+normalized Fishing coal demand +normalized industrial coal demand+"normalized non-energy use coal demand" +normalized Others coal demand+normalized residential coal demand+normalized transportation coal demand)*QDBTU to MST+coal demand for power generation in mst Units: MST/Year

Coal Fraction Developable([(1980,0)-(2050,0.3)],(1980,0.08),(1981,0.08),(1982,0.08),(1983,0.08),(1984

,0.08),(1985,0.08),(1986,0.08),(1987,0.08),(1988,0.08),(1989,0.08),(1990,0.08
),(1991,0.0800078),(1992,0.0800315),(1993,0.0800694),(1994,0.0801203),(1995
,0.0801835),(1996,0.0802585),(1997,0.0803454),(1998,0.0804433),(1999,0.0805523
),(2000,0.0806726),(2001,0.0808),(2002,0.0809305),(2003,0.0810628),(2004,0.0811968
),(2005,0.0813332),(2006,0.0814685),(2007,0.0815997),(2008,0.0817287),(2009
,0.0818564),(2010,0.0819835),(2011,0.082114),(2012,0.0822473),(2013,0.0823751
),(2014,0.0824934),(2015,0.0826022),(2016,0.0827058),(2017,0.0828069),(2018
,0.0829086),(2019,0.0830125),(2020,0.0831185),(2021,0.0832241),(2022,0.0833278
),(2023,0.08343),(2024,0.0835304),(2025,0.0836289),(2026,0.0837256),(2027,0.083820
3),(2028,0.0839129),(2029,0.0840033),(2030,0.0840918),(2031,0.0841783),(2032
,0.0842628),(2033,0.0843454),(2034,0.0844263),(2035,0.0845053),(2036,0.0845824
),(2037,0.0846574),(2038,0.0847303)) Units: Dmnl

Coal Fraction Developable Table([(0,0)-
(1.6,0.1)],(0,0),(0.2,0.02),(0.45,0.044),(0.7,0.064),(1,0.08),(1.25 ,0.092),(1.5,0.1)) Units:
Dmnl

Coal fraction discoverable([(1980,0)-
(2050,10)],(1980,0.75),(1981,0.75),(1982,0.75),(1983,0.75),(1984
,0.75),(1985,0.75),(1986,0.75),(1987,0.75),(1988,0.75),(1989,0.75),(1990,0.75
),(1991,0.750033),(1992,0.750131),(1993,0.750289),(1994,0.750501),(1995,0.750764
),(1996,0.751077),(1997,0.751439),(1998,0.751847),(1999,0.752301),(2000,0.752803
),(2001,0.753333),(2002,0.753877),(2003,0.754428),(2004,0.754987),(2005,0.755555
),(2006,0.756119),(2007,0.756666),(2008,0.757203),(2009,0.757735),(2010,0.758265
),(2011,0.758808),(2012,0.759364),(2013,0.759896),(2014,0.760389),(2015,0.760842
),(2016,0.761274),(2017,0.761695),(2018,0.762119),(2019,0.762552),(2020,0.762994
),(2021,0.763434),(2022,0.763866),(2023,0.764292),(2024,0.76471),(2025,0.76512
),(2026,0.765523),(2027,0.765918),(2028,0.766304),(2029,0.76668),(2030,0.767049
),(2031,0.76741),(2032,0.767762),(2033,0.768106),(2034,0.768443),(2035,0.768772
),(2036,0.769093),(2037,0.769406),(2038,0.76971)) Units: Dmnl

Coal Fraction Discoverable Table([(0,0)-
(6,1)],(0,0),(0.2,0.2),(0.45,0.44),(0.7,0.64),(1,0.75),(1.25,0.8),(3,0.9),(5,1)) Units: Dmnl

Coal Fraction Recoverable([(1980,0)-
(2050,10)],(1980,0.8),(1981,0.8),(1982,0.8),(1983,0.8),(1984,0.8
),(1985,0.8),(1986,0.8),(1987,0.8),(1988,0.8),(1989,0.8),(1990,0.8),(1991,0.800033
),(1992,0.800131),(1993,0.800289),(1994,0.800501),(1995,0.800764),(1996,0.801077
),(1997,0.801439),(1998,0.801847),(1999,0.802301),(2000,0.802803),(2001,0.803333
),(2002,0.803877),(2003,0.804428),(2004,0.804987),(2005,0.805555),(2006,0.806119
),(2007,0.806666),(2008,0.807203),(2009,0.807735),(2010,0.808265),(2011,0.808808
),(2012,0.809364),(2013,0.809896),(2014,0.810389),(2015,0.810842),(2016,0.811274
),(2017,0.811695),(2018,0.812119),(2019,0.812552),(2020,0.812994),(2021,0.813434
),(2022,0.813866),(2023,0.814292),(2024,0.81471),(2025,0.81512),(2026,0.815523

),(2027,0.815918),(2028,0.816304),(2029,0.81668),(2030,0.817049),(2031,0.81741
),(2032,0.817762),(2033,0.818106),(2034,0.818443),(2035,0.818772),(2036,0.819093
),(2037,0.819406),(2038,0.81971)) Units: Dmnl

Coal Fraction Recoverable Table([(0,0)-
(6,1)],(0,0),(0.2,0.2),(0.45,0.5),(0.7,0.7),(1,0.8),(1.25,0.85),(1.5 ,0.89),(2,0.92),(5,1)) Units:
Dmnl

coal generation efficiency table([(1980,0)-
(2100,1)],(1980,0.32),(1990,0.325),(2000,0.332),(2030,0.45),(2050 ,0.5)) Units: Dmnl

coal GHG emission coefficient= 88.5 Units: Ton/Tj

Coal Initial Cumulative Production= 530900 Units: MST

Coal initial discovered resources= 480000 Units: MST

coal inventory and losses([(1990,0)-
(2030,800)],(1990,411.522),(2007,514.402),(2015,622.604),(2020,666.949
),(2025,762.734),(2030,789.341)) Units: MST/Year

Coal land use per mb of demand= WITH LOOKUP (Time, ([(1990,0)-
(2024,900)],(1990,293.33),(1991,284.546),(1992,307.734),(1993,
359.567),(1994,391.046),(1995,476.532),(1996,439.736),(1997,472.544),(1998,
497.584),(1999,577.914),(2000,589.758),(2001,678.025),(2002,856.006),(2003,
805.035),(2004,717.735),(2005,629.864),(2006,532.079),(2007,493.443),(2008,
353.277),(2009,335.188),(2010,313.398),(2011,286.637),(2012,261.008),(2013,
233.758),(2014,244.554),(2015,227.863),(2016,251.397),(2017,264.644),(2018,
287.719),(2019,274.059),(2020,241.421),(2021,284.423),(2022,318.57),(2023,307.732
),(2024,300.45))) Units: Ha/MB

coal mst per gwh= WITH LOOKUP (Time, ([(1990,0)-
(2030,0.001)],(1990,0.00055515),(2007,0.00052751),(2015,0.00050301
),(2020,0.00048893),(2025,0.00047172),(2030,0.00045626))) Units: MST/GWh

Coal price over cost= (Coal Price per MBTU/Coal production cost per MBTU)-1 Units:
Dmnl

Coal Price per MBTU= real coal price per MBTU*gdp deflator Units: usd15/Mbtu

Coal Price Substitutability= DELAY N((Relative real Coal Price/Relative Weighted
Average Energy Price), 1,1, 1) Units: Dmnl

Coal production cost from data= 2.4 Units: usd15/Mbtu

Coal production cost per MBTU= real coal production cost per MBTU*gdp deflator Units:
USD/Mbtu

Coal Production in QDBTU= World Coal Production Rate/QDBTU to MST Units: qdbtu/Year

coal recoverable reserve= (World Coal Discovered Reserves+World Coal Cumulative Production)*Coal Fraction Recoverable (Time)-World Coal Cumulative Production Units: MST

Coal Recoverable Reserves= (World Coal Discovered Reserves+World Coal Cumulative Production)* Coal Fraction Recoverable (Time)-World Coal Cumulative Production Units: MST

coal recoverable reserves demand ratio= coal recoverable reserve/world Coal demand Units: Dmnl

Coal reference Demand Supply Balance on cost= INITIAL(World Coal Demand Supply Balance) Units: Dmnl

coal reference reserve production ratio= 1 Units: Year

coal share of power generation= coal energy electricity generation/total electricity generation Units: Dmnl

Coal US Effect of Demand Supply Balance on Cost= World Coal Demand Supply Balance/Coal reference Demand Supply Balance on cost Units: Dmnl

Coal World A= (world Coal demand-Coal World Perceived precent condition)/Time to Perceive Perceived Present condition Units: MST/(Year*Year)

Coal World Adjustment for Expected Growth in Demand= MAX(0,Coal World Trend*World Coal Recoverable Reserves) Units: MST/Year

Coal World Adjustment of Total Recoverable Resources Remaining= MAX(0,(Coal World Required Total Recoverable Resources for Production-World Coal Recoverable Reserves)/Time to Adjust Reserves) Units: MST/Year

Coal World available production years= World Coal Recoverable Reserves/World Desired Recoverable Coal Units: Year

Coal World B= (Coal World Reference Trend-Coal World Trend)/Time to Perceive Trend Units: 1/(Year*Year)

Coal World C= (Coal World Perceived precent condition-Coal World Reference Condition)/TERC Units: MST/(Year*Year)

Coal World desired available ratio effect on price= Coal World reference year of production/Coal World available production years Units: Dmnl

Coal World Effect of Demand Supply Balance on Price= World Coal Demand Supply Balance/Coal World reference demand supply balance Units: Dmnl

Coal World Elasticity of price to availability of resource= 0.1 Units: Dmnl

Coal World Initial Trend Demand= 0.03 Units: 1/Year

Coal World Perceived precent condition= INTEG (Coal World A, world Coal demand/(1+Time to Perceive Perceived Present condition*Coal World Initial Trend Demand)) Units: MST/Year

Coal World Reference Condition= INTEG (Coal World C, Coal World Perceived precent condition/(1+TERC*Coal World Initial Trend Demand)) Units: MST/Year

Coal World reference demand supply balance= INITIAL(World Coal Demand Supply Balance) Units: Dmnl

Coal World Reference Trend= (Coal World Perceived precent condition-Coal World Reference Condition)/(Coal World Reference Condition *TERC) Units: 1/Year

Coal World reference year of production= INITIAL(Coal World available production years) Units: Year

Coal World Required Total Recoverable Resources for Production= world Coal demand*coal reference reserve production ratio Units: MST

Coal World Trend= INTEG (Coal World B, Coal World Initial Trend Demand) Units: 1/Year

"Coal/peat co2 emisson"= "Coal/peat energy consumption ag"*CO2 EMISSION FACTORS[coal energy]*ktoe to mtoe Units: mtoe/Year

"Coal/peat energy consumption ag"= (agriculture coal demand*QDBTU to MB(Time))/ktoe to MB Units: ktoe/Year

cobalt annual demand rate of change= 0.01 Units: 1/Year

cobalt baseline demand= INTEG (cobalt demand change, 146) Units: Ton/Year

cobalt CO2e emissions= cobalt energy consumption*energy carbon intensity Units: TonCO2e/Year

cobalt demand= MAX(0,annual number of batteries required*cobalt required per battery/KG PER TON -cobalt recycled) Units: Ton/Year

cobalt demand change= cobalt annual demand rate of change*cobalt baseline demand Units: Ton/(Year*Year)

cobalt demand supply balance= if then else(mining for EV switch=1, (cobalt baseline demand+cobalt demand)/cobalt production, cobalt baseline demand/cobalt production) Units: 1

cobalt energy consumption= cobalt production*"energy consumption per unit (extraction and processing)" Units: Tj/Year

cobalt exploration= cobalt resource*cobalt resource development rate Units: Ton/Year

cobalt extracted= INTEG (cobalt production, 0) Units: Ton

cobalt import cost= cobalt demand*cobalt price per ton-cobalt revenues Units: USD/Year

cobalt land use= cobalt demand*Cobalt land user per ton of demand Units: Ha/Year

Cobalt land user per ton of demand= 0.02 Units: Ha/Ton

cobalt price per ton= 29000 Units: USD/Ton

cobalt production= if then else(mining for EV switch=0, min(cobalt baseline demand,cobalt reserve), min(cobalt baseline demand+cobalt demand, cobalt reserve)) Units: Ton/Year

cobalt recycled= annual number of batteries discarded*cobalt required per battery/KG PER TON *battery recycling Units: Ton/Year

cobalt required per battery= 8 Units: Kg/Battery

cobalt reserve= INTEG (cobalt exploration-cobalt production, 985) Units: Ton

cobalt resource= INTEG (-cobalt exploration, 5150*100) Units: Ton

cobalt resource development rate= 0.05 Units: 1/Year

cobalt revenues= cobalt production*cobalt price per ton Units: USD/Year

cobalt water consumption= cobalt production*water consumption per unit Units: liter/Year

coefficient for biomass growth= 0.0015 Units: Dmnl

collection cost per ton([(1970,0)-(2010,100)],(1970,22.5),(1990,50),(2010,95)) Units: USD/Ton

collection employment factor per ton= 0.00028 Units: Person/Ton

Collection rate CA= WITH LOOKUP (Time, ([(2000,0.7)-(2050,1)],(2000,0.75),(2026,0.75),(2050,1))) Units: Dmnl

Collection rate HA= WITH LOOKUP (Time, ([(2000,0.7)-(2050,1)],(2000,0.75),(2026,0.75),(2050,1))) Units: Dmnl

Collection rate LA= WITH LOOKUP (Time, ([(2000,0.7)-(2050,1)],(2000,0.75),(2026,0.75),(2050,1))) Units: Dmnl

Combustible investment([(1970,0)-(2030,2e+010)],(1970,9e+009),(1972.75,8.07018e+009),(1978.62,6.49123e+009),(1994,4e+009)) Units: usd15

commercial coal demand= DELAY N((indicated commercial coal demand 0*Coal Price Substitutability^commercial elasticity of coal demand to coal price), time to adapt demand to price changes,(indicated commercial coal demand 0 *Coal Price Substitutability^commercial elasticity of coal demand to coal price), 3) Units: qdbtu/Year

commercial coal gdp intensity= normalized commercial coal demand/real gross domestic product Units: qdbtu/usd15

commercial elasticity of coal demand to coal price= -0.025 Units: Dmnl

commercial elasticity of coal demand to price= 1 Units: Dmnl

commercial elasticity of customers to GDP= 0.5 Units: Dmnl

commercial elasticity of electricity demand to electricity price= -0.05 Units: Dmnl

commercial elasticity of electricity to gdp= 0.4 Units: Dmnl

commercial elasticity of natural gas demand to natural gas price= -0.004 Units: Dmnl

Commercial Elasticity of natural gas demand to price= 0.1 Units: Dmnl

Commercial elasticity of oil demand to price= 0.6 Units: Dmnl

commercial elasticity of petroleum demand to oil price= -0.004 Units: Dmnl

Commercial elasticity of renewable resources demand to price= 1 Units: Dmnl

commercial elasticity of renewable resources demand to renewable resources price = -0.05 Units: Dmnl

commercial elasticity of units to price= 0 Units: Dmnl

commercial electricity customers= initial commercial electricity customers*relative services production ^commercial elasticity of customers to GDP Units: customers

commercial electricity demand= DELAY N((indicated commercial electricity net demand 0*Electricity Price Substitutability ^commercial elasticity of electricity demand to electricity price), time to adapt demand to price changes,(indicated commercial electricity net demand 0 *Electricity Price Substitutability ^commercial elasticity of electricity demand to electricity price), 3) Units: qdbtu/Year

commercial electricity GDP Intensity= normalized commercial electricity net demand/real gross domestic product Units: qdbtu/usd15

commercial natural gas demand= DELAY N((indicated commercial natural gas demand 0*Natural Gas Price Substitutability ^commercial elasticity of natural gas demand to natural gas price), time to adapt demand to price changes,(indicated commercial natural gas demand 0 *Natural Gas Price Substitutability^commercial elasticity of natural gas demand to natural gas price), 3) Units: qdbtu/Year

commercial natural gas GDP Intensity= normalized commercial natural gas demand/real gross domestic product Units: qdbtu/usd15

commercial petroleum demand= DELAY N((indicated commercial petroleum demand 0*Oil Price Substitutability ^commercial elasticity of petroleum demand to oil price), time to adapt demand to price changes ,(indicated commercial petroleum demand 0*Oil Price Substitutability^commercial elasticity of petroleum demand to oil price), 3) Units: qdbtu/Year

commercial petroleum gdp intensity= normalized commercial petroleum demand/real gross domestic product Units: qdbtu/usd15

commercial power demand= (commercial electricity customers*average commercial power units per customer)/KWH to gwh*(1-efficiency factor power generation) Units: GWh/Year

commercial renewable resources demand= DELAY N((indicated commercial renewable resources demand 0*Renewable Resources Price Substitutability ^commercial elasticity of renewable resources demand to renewable resources price), time to adapt demand to price changes, (indicated commercial renewable resources demand 0 *Renewable Resources Price Substitutability ^ commercial elasticity of renewable resources demand to renewable resources price), 3) Units: qdbtu/Year

Commercial renewable resources GDP intensity= normalized commercial renewable resources demand/real gross domestic product Units: qdbtu/usd15

compost manufacture= compost waste/time to manufacture compost Units: Ton/Year

compost waste= INTEG (waste for compost-compost manufacture, 1.69e+009) Units: Ton

consciously controlled fertility rate= (desired number of children per woman*(1+perceived under five mortality rate /1000)) Units: Dmnl

consstruction time= 1 Units: Year

CONSTANT fraction of planted forest for production= 0.2 Units: Dmnl

Construction employment= total employment*sectoral distribution of employment[con] Units: Person

construction time= 1 Units: Year

consumption= private consumption+public consumption Units: usd15/Year

contact rate= 5 Units: 1/Year

contraceptive prevalence rate= min(1, initial contraceptive prevalence rate*effect of education on contraceptive prevalence rate) Units: Dmnl

CONVENTIONAL WATER SUPPLY= CONVENTIONAL WATER SUPPLY INVESTMENT/(COST OF CONVENTIONAL WATER SUPPLY PER M3 *m3 to km3) Units: Km3/Year

CONVENTIONAL WATER SUPPLY INVESTMENT= water supply management investment*(1-FRACTION OF INVESTMENT FOR DESALINATION (Time)) Units: usd15/Year

conversion efficiency of 2nd generation biofuels= 214 Units: lge/Ton

conversion factor= initial conversion factor*biofuel EFFICIENCY Units: gallon/Bushel

CONVERT KG TO MTON= 1e+009 Units: mton/Kg

convert LITRE to mtoe= 1.13636e-009 Units: litre/mtoe

convertor to MB= 185 Units: MB/qdbtu

convinced by recyclers= ("non-seperators contacted by recyclers per time period"*probability to become recyclers due to pollution) Units: Person/Year

copper annual demand rate of change= -0.08 Units: 1/Year

copper baseline demand= INTEG (copper demand change, 23026) Units: Ton/Year

copper CO2e emissions= copper energy consumption*energy carbon intensity Units: TonCO2e/Year

copper demand= MAX(0,annual number of batteries required*copper required per battery/KG PER TON -copper recycled) Units: Ton/Year

copper demand change= copper annual demand rate of change*copper baseline demand Units: Ton/(Year*Year)

copper demand supply balance= if then else(mining for EV switch=1, (copper baseline demand+copper demand)/copper production, copper baseline demand/copper production) Units: 1

copper energy consumption= copper production*"energy consumption per unit (extraction and processing)" Units: Tj/Year

copper exploration= copper resource*copper resource development rate Units: Ton/Year

copper extracted= INTEG (copper production, 0) Units: Ton

copper import cost= copper demand*copper price per ton-copper revenues Units: USD/Year

copper land use= copper demand*Copper land use per ton of demand Units: Ha/Year

Copper land use per ton of demand= 0.01 Units: Ha/Ton

copper price per ton= 8300 Units: USD/Ton

copper production= if then else(mining for EV switch=0, min(copper baseline demand,copper reserve), min(copper baseline demand+copper demand, copper reserve)) Units: Ton/Year

copper recycled= annual number of batteries discarded*copper required per battery/KG PER TON *battery recycling Units: Ton/Year

copper required per battery= 20 Units: Kg/Battery

copper reserve= INTEG (copper exploration-copper production, 44645) Units: Ton

copper resource= INTEG (-copper exploration, 680223) Units: Ton

copper resource development rate= 0.03 Units: 1/Year

copper revenues= copper production*copper price per ton Units: USD/Year

copper water consumption= copper production*water consumption per unit Units: liter/Year

CORRECTION FACTOR coal industrial use= WITH LOOKUP (Time, ([(2000,1)-(2020,2)],(2000,1.16),(2020,1.16))) Units: Dmnl

CORRECTION FACTOR natural gas industrial use= WITH LOOKUP (Time, ([(2000,1)-(2020,2)],(2000,1.95),(2020,1.95))) Units: Dmnl

CORRECTION FACTOR OIL CONSUMPTION= 1.1 Units: Dmnl

CORRECTION FACTOR petroleum industrial use= WITH LOOKUP (Time, ([(2000,1)-(2020,2)],(2000,1.25),(2020,1.25))) Units: Dmnl

CORRECTION FACTOR renewable resources industrial use= WITH LOOKUP (Time, ([(2000,1)-(2020,2)],(2000,1.05),(2020,1.05))) Units: Dmnl

cost difference= organic fertilizer cost per tonne-chemical fertilizer cost per tonne Units: usd15/Ton

cost of abatement of co2 power generation([(2011,0)-(2050,2000)],(2011,846),(2030,1142),(2050,1700)) Units: usd15/Ton/Year

cost of afforestation investment= AFFORESTATION FROM INVESTMENT*cost of afforestation per hectare Units: usd15/Year

cost of afforestation per hectare= 1630 Units: usd15/Ha

cost of avoided deforestation= avoided deforestation cost*opportunity cost of forest land Units: usd15/Year

cost of buses expansion due to shift in travel volume= bus emission abatement ton*cost per ton of transport end use abatement(Time) Units: usd15/Year

cost of coal= (coal final use*MST to tonnes)*exogenous coal price Units: USD/Year

cost of compost= compost waste*treatment and disposal cost per ton of compost(Time) Units: USD

COST OF CONVENTIONAL WATER SUPPLY PER M3= 0.08 Units: usd15/m3

cost of disposal= disposed waste*disposal cost per ton of other disposed waste(Time) Units: USD/Year

cost of electricity= ((world electricity final consumption in mb*mb to GWH)*GWH to KWH)*exogenous electricity price Units: USD/Year

cost of fishing= fish catch*per ton cost of fishing Units: usd15/Year

cost of incinerator= waste for incinerator*treatment and disposal cost per ton of incinerator(Time) Units: USD/Year

cost of industrial emission abatement= industrial emission abatement*industries cost of co2 emission abatement per ton of co2 (Time) Units: usd15/Year

cost of industrial emission abatement delayed= DELAY FIXED(cost of industrial emission abatement, 1, cost of industrial emission abatement) Units: usd15/Year

cost of landfilling green investment= waste landfilled from green investment*treatment and disposal land filling cost per ton (Time) Units: USD/Year

cost of natural gas= (natural gas final use*BCF to mmbtu)*exogenous natural gas price Units: USD/Year

cost of oil= (world oil final consumption in mb*mb to barrel)*exogenous oil price Units: USD/Year

cost of passenger train expansion due to shift in travel volume= passenger train emission abatement ton*cost per ton of transport end use abatement (Time) Units: usd15/Year

cost of recyclying= treatment cost of recycle per ton*waste to recycle Units: USD/Year

cost of recyclying green investment= total waste recycled from green investment*treatment cost of recycle per ton Units: USD/Year

cost of urban buses expansion due to investment= cost per ton of transport end use abatement(Time)*urban buses emission change due to investment in ton Units: usd15/Year

cost of urban passenger train expansion due to investment= cost per ton of transport end use abatement(Time)*urban passenger train change due to investment in ton Units: usd15/Year

cost of water demand management= cost of water demand management per m3*water demand reduction from management *m3 to km3 Units: usd15/Year

cost of water demand management per m3= 0.08 Units: usd15/m3

cost of water supply BY DESALINATION per m3= 0.8 Units: usd15/m3

cost per litre ge 2nd generation([(2011,0)-(2050,10)],(2011,2.5),(2050,1.66667)) Units: lge/used

cost per ton of transport end use abatement([(2011,0)-(2050,4000)],(2011,885),(2030,1946),(2050,3000)) Units: usd15/Ton

country: Bangladesh, Morocco, Egypt, Ethiopia, Ghana, Myanmar, Nigeria, Pakistan, Sri Lanka , Tunisia, Viet nam, Algeria, China, India, Indonesia, Iran, Iraq, Russia, Saudi Arabia, UAE, Venezuela, USA, BRAZIL, GERMANY, MEXICO, SOUTH AFRICA, ZAMBIA , ARGENTINA, AUSTRALIA, CANADA, JAPAN, NETHERLANDS

covid effect on capital industry and service= if then else (COVID19 switch=1, if then else (duration of covid impacts table(Time)>0, (1+((sinus for covid impacts+magnitude of

impact)*duration of covid impacts table (Time)))^elasticity of capital to COVID impacts , 1),1) Units: 1

COVID shock on capital industry and services= COVID shock on capital industry and services table(Time) Units: Dmnl

COVID shock on capital industry and services table([(2000,0.4)-(2028,1)],(2000,1),(2018,1),(2019.8,0.7),(2021,1)) Units: Dmnl

COVID19 switch= 1 Units: Dmnl

critical mineral land divided compared to coal land use= Land use for critical minerals/land used for coal mining Units: 1

crop for biofuel= crops yield in volume*fraction of crops for biofuels Units: Ton/Year

crop for food= crops yield in volume-crop for biofuel Units: Ton/Year

crop production= crops yield in volume*(crops value added(Time)*0.93) Units: usd15/Year

crop to biofuel conversion= 0.2 Units: gallon/Ton

cropland footprint= initial cropland footprint*relative harvested area Units: Dmnl

crops: MAIZE, rest

crops disease loss= 0.3 Units: Dmnl/Year

crops value added([(1970,40)-(2050,100)],(1970,61.2444),(1971,59.397),(1972,57.0844),(1973,55.6671),(1974,55.7476),(1975,56.1819),(1976,53.2321),(1977,51.7754),(1978,50.4674),(1979,49.1702),(1980,48.7541),(1981,49.4342),(1982,50.4903),(1983,49.569),(1984,51.467),(1985,51.6804),(1986,51.463),(1987,51.7184),(1988,51.7955),(1989,52.0098),(1990,52.5096),(1991,51.2801),(1992,51.7223),(1993,51.0568),(1994,51.1869),(1995,50.5076),(1996,52.2551),(1997,52.6267),(1998,53.3394),(1999,54.7083),(2000,55.6503),(2001,55.6522),(2002,55.7644),(2003,56.5005),(2004,58.3264),(2005,59.8533),(2006,60.5081),(2007,62.2836),(2008,62.7028),(2009,61.0444),(2010,62.9789),(2011,64.2825),(2012,65.1715),(2013,66.2043),(2014,67.4356),(2015,68.7094),(2016,69.8173),(2017,71.389),(2018,72.9164),(2019,74.0651),(2020,71.1577),(2021,74.882),(2022,76.7288),(2023,78.3658),(2024,79.8942),(2050,95)) Units: usd15/Ton

crops yield in volume= effective crops yield per hectare*Harvested area Units: Ton/Year

crude oil to refined oil factor= 0.75 Units: Dmnl

cubic feet of LFG per ton of waste= 0.432 Units: Cubic Feet/Ton

cummulative cost of avoided deforestation= INTEG (cost of avoided deforestation, 0) Units: usd15

cummulative industries green investment= INTEG (change in industries investment green, 0) Units: usd15

cummulative transportation efficiency green investment= INTEG (change in transport investment, 0) Units: usd15

cumulative black carbon emissions from power generation= INTEG (change in cumulative black carbon emissions from power generation, 0) Units: Ton

cumulative cost of NH3 emissions= INTEG (annual cost of NH3 emissions, 0) Units: USD

cumulative cost of NOX emissions= INTEG (annual cost of NOx emissions, 0) Units: USD

"cumulative cost of pm2.5 emissions from power generation"= INTEG ("change in cumulative cost of pm2.5 emissions from power generation", 0) Units: USD

"cumulative deaths from ambient air pollution (proxy)"= INTEG ("change in cumulative deaths from ambient air pollution (proxy)", 0) Units: Person

"cumulative deaths from indoor air pollution (proxy)"= INTEG ("change in cumulative deaths from ambient air pollution (proxy) indoor", 0) Units: Person

Cumulative energy spending= INTEG (energy bill in USD, 0) Units: USD

cumulative forest production= INTEG (forest production, initial cumulative forest production) Units: m3

cumulative fuel cost power generation= INTEG (SUM(annual fuel cost thermal power generation[FOSSIL FUEL AND NUCLEAR!]), 0) Units: LCU

cumulative investment for power efficiency= INTEG (investment for power efficiency, 0) Units: usd15

"cumulative pm2.5 emissions from power generation"= INTEG ("change in cumulative pm2.5 emissions from power generation", 0) Units: Ton

cumulative social cost of carbon from fuel use for power generation= INTEG (change in cumulative social cost of carbon from fuel use for power generation , 0) Units: LCU

current lookup value for fuel grade= if then else (LOW IMPACT DEVELOPMENT POLICY SWITCH=1, Lookup for change in fuel quality ambitious(Time), 1) Units: 1

current pesticide use= 1.2e+010 Units: Ton

cwaste: Cenergy recovery,cmaterial recovery, clandfill

cycle time= 2 Units: Year

data initial death rate from ambient air pollution= WITH LOOKUP (Time, ([(2010,0.0006)-(2018,0.0008)],(2010,0.0007068),(2011,0.0006999),(2012,0.000693),(2013,0.0007018),(2014,0.0006718),(2015,0.0006567),(2016,0.0006385),(2017,0.0006245),(2018,0.0006171))) Units: Dmnl/Year

data initial death rate from indoor air pollution= WITH LOOKUP (Time, ([(2013,0.0005)-(2018,0.0008)],(2013,0.0007335),(2014,0.0007034),(2015,0.0006725),(2016,0.0006458),(2017,0.0006204),(2018,0.0005959))) Units: Dmnl/Year

days in one year= 365 Units: day/Year

days per year= 365 Units: day/Year

death rate from ambient air pollution= data initial death rate from ambient air pollution*"pm2.5 emissions Index" Units: 1/Year

death rate from indoor air pollution= data initial death rate from indoor air pollution*"residential pm2.5 emissions Index" Units: 1/Year

death rates per age[sex,age]= min(1,MAX(0,death rates table[sex, age group](life expectancy at birth[sex]))) Units: Dmnl/Year

death rates table[FEMALE, AG UNDER 1]([(0,0)-(80,0.4)],(0,1),(20,0.31),(22.5,0.28),(25,0.26),(27.5,0.25),(30,0.23),(32.5,0.21),(35,0.2),(37.5,0.19),(40,0.17),(42.5,0.16),(45,0.15),(47.5,0.14),(50,0.13),(52.5,0.12),(55,0.11),(57.5,0.1),(60,0.09),(62.5,0.09),(65,0.08),(67.5,0.07),(70,0.06),(72.5,0.05),(75,0.04),(77.5,0.03),(80,0.02)) death rates table[FEMALE, AG 1 TO 4]([(0,0)-(80,0.2)],(0,1),(20,0.107747),(22.5,0.096214),(25,0.086166),(27.5,0.077297),(30,0.069386),(32.5,0.062265),(35,0.055811),(37.5,0.04992),(40,0.044518),(42.5,0.03942),(45,0.034525),(47.5,0.030069),(50,0.026002),(52.5,0.022273),(55,0.018843),(57.5,0.015675),(60,0.012736),(62.5,0.009978),(65,0.007747),(67.5,0.005892),(70,0.004318),(72.5,0.003019),(75,0.001988),(77.5,0.00121),(80,0.000663)) death rates table[FEMALE, AG 5 to 9]([(0,0)-(80,0.02)],(0,1),(20,0.018731),(22.5,0.016906),(25,0.015271),(27.5,0.013789),(30,0.01244),(32.5,0.011202),(35,0.01006),(37.5,0.009003),(40,0.00802),(42.5,0.006989),(45,0.006082),(47.5,0.005257),(50,0.004502),(52.5,0.003809),(55,0.003168),(57.5,0.002575),(60,0.00202),(62.5,0.001515),(65,0.001183),(67.5,0.000876),(70,0.000621),(72.5,0.000418),(75,0.000264),(77.5,0.000152),(80,7.8e-005)) death rates table[FEMALE, AG 10 to 14]([(0,0)-

(80,0.01)],(0,1),(20,0.009836),(22.5,0.00892),(25,0.008096),(27.5,
0.007347),(30,0.006662),(32.5,0.006034),(35,0.005453),(37.5,0.004914),(40,
0.004411),(42.5,0.003941),(45,0.003472),(47.5,0.00304),(50,0.002642),(52.5
,0.002272),(55,0.001927),(57.5,0.001609),(60,0.001309),(62.5,0.001026),(65
,0.000809),(67.5,0.000617),(70,0.000452),(72.5,0.000316),(75,0.000208),(77.5
,0.000128),(80,7e-005)) death rates table[FEMALE, AG 15 TO 19]([(0,0)-
(80,0.02)],(0,1),(20,0.013531),(22.5,0.012284),(25,0.011165),(27.5
,0.01015),(30,0.009223),(32.5,0.008369),(35,0.007584),(37.5,0.006853),(40,
0.006174),(42.5,0.005598),(45,0.004943),(47.5,0.004339),(50,0.003783),(52.5
,0.003269),(55,0.002794),(57.5,0.002351),(60,0.001937),(62.5,0.001549),(65
,0.001173),(67.5,0.000896),(70,0.000659),(72.5,0.000462),(75,0.000306),(77.5
,0.000186),(80,0.000102)) death rates table[FEMALE, AG 20 to 24]([(0,0)-
(80,0.02)],(0,1),(20,0.01693),(22.5,0.015376),(25,0.013979),(27.5,
0.012715),(30,0.011562),(32.5,0.010504),(35,0.009528),(37.5,0.008621),(40,
0.00778),(42.5,0.00704),(45,0.00625),(47.5,0.005517),(50,0.004839),(52.5,0.004207
),(55,0.00362),(57.5,0.003071),(60,0.002559),(62.5,0.002075),(65,0.001607)
,(67.5,0.001247),(70,0.000934),(72.5,0.000669),(75,0.000452),(77.5,0.000286
),(80,0.000162)) death rates table[FEMALE, AG 25 to 29]([(0,0)-
(80,0.02)],(0,1),(20,0.01819),(22.5,0.016536),(25,0.015052),(27.5,
0.013709),(30,0.012484),(32.5,0.011361),(35,0.010323),(37.5,0.009362),(40,
0.008468),(42.5,0.0077),(45,0.006864),(47.5,0.006088),(50,0.005365),(52.5,
0.004692),(55,0.004063),(57.5,0.003476),(60,0.002925),(62.5,0.002404),(65,
0.001875),(67.5,0.00147),(70,0.001114),(72.5,0.000811),(75,0.000559),(77.5
,0.000358),(80,0.00021)) death rates table[FEMALE, AG 30 to 34]([(0,0)-
(80,0.02)],(0,1),(20,0.018977),(22.5,0.017253),(25,0.015708),(27.5
,0.01431),(30,0.013033),(32.5,0.011864),(35,0.010784),(37.5,0.009786),(40,
0.008855),(42.5,0.008013),(45,0.007182),(47.5,0.006403),(50,0.005674),(52.5
,0.00499),(55,0.004346),(57.5,0.003738),(60,0.003168),(62.5,0.002626),(65,
0.002147),(67.5,0.001714),(70,0.001326),(72.5,0.000986),(75,0.000697),(77.5
,0.000462),(80,0.00028)) death rates table[FEMALE, AG 35 to 39]([(0,0)-
(80,0.02)],(0,1),(20,0.019955),(22.5,0.018173),(25,0.016574),(27.5
,0.015127),(30,0.013806),(32.5,0.012597),(35,0.011481),(37.5,0.010448),(40
,0.009486),(42.5,0.008628),(45,0.00778),(47.5,0.006981),(50,0.006227),(52.5
,0.005519),(55,0.004847),(57.5,0.004215),(60,0.003616),(62.5,0.003047),(65
,0.002527),(67.5,0.002046),(70,0.001611),(72.5,0.001223),(75,0.000886),(77.5
,0.000603),(80,0.000378)) death rates table[FEMALE, AG 40 to 44]([(0,0)-
(80,0.04)],(0,1),(20,0.020193),(22.5,0.018461),(25,0.01691),(27.5,
0.015505),(30,0.014225),(32.5,0.013048),(35,0.011965),(37.5,0.01096),(40,0.010027
),(42.5,0.009187),(45,0.008396),(47.5,0.00764),(50,0.006917),(52.5,0.006229
),(55,0.005574),(57.5,0.004949),(60,0.004356),(62.5,0.003785),(65,0.003247
),(67.5,0.002717),(70,0.002218),(72.5,0.001756),(75,0.001338),(77.5,0.000966
),(80,0.000653)) death rates table[FEMALE, AG 45 to 49]([(0,0)-

(80,0.04)],(0,1),(20,0.021268),(22.5,0.019524),(25,0.01796),(27.5,
0.016544),(30,0.015252),(32.5,0.014068),(35,0.012976),(37.5,0.011965),(40,
0.011022),(42.5,0.010177),(45,0.009401),(47.5,0.008657),(50,0.007937),(52.5
,0.007244),(55,0.00658),(57.5,0.005944),(60,0.005333),(62.5,0.004745),(65,
0.004171),(67.5,0.003582),(70,0.00301),(72.5,0.002464),(75,0.001952),(77.5
,0.001478),(80,0.001056)) death rates table[FEMALE, AG 50 to 54]([(0,0)-
(80,0.04)],(0,1),(20,0.027763),(22.5,0.025529),(25,0.023525),(27.5
,0.021717),(30,0.020072),(32.5,0.018562),(35,0.017174),(37.5,0.015889),(40
,0.014693),(42.5,0.013557),(45,0.012614),(47.5,0.011701),(50,0.010815),(52.5
,0.009956),(55,0.009127),(57.5,0.00833),(60,0.007561),(62.5,0.006851),(65,
0.006135),(67.5,0.005361),(70,0.004602),(72.5,0.003858),(75,0.00314),(77.5
,0.002458),(80,0.001829)) death rates table[FEMALE, AG 55 to 59]([(0,0)-
(80,1)],(0,1),(20,0.038124),(22.5,0.03506),(25,0.032325),(27.5,0.029863
),(30,0.027627),(32.5,0.025582),(35,0.023703),(37.5,0.021968),(40,0.02036)
,(42.5,0.018867),(45,0.017601),(47.5,0.016369),(50,0.015178),(52.5,0.014022
),(55,0.012907),(57.5,0.011831),(60,0.010795),(62.5,0.009813),(65,0.008829
),(67.5,0.007759),(70,0.006703),(72.5,0.005664),(75,0.004653),(77.5,0.003683
),(80,0.002777)) death rates table[FEMALE, AG 60 to 64]([(0,0)-
(80,0.08)],(0,1),(20,0.063586),(22.5,0.058245),(25,0.05352),(27.5,
0.049301),(30,0.045498),(32.5,0.042044),(35,0.038887),(37.5,0.035987),(40,
0.033308),(42.5,0.030763),(45,0.028708),(47.5,0.026711),(50,0.024778),(52.5
,0.022906),(55,0.021102),(57.5,0.019361),(60,0.017689),(62.5,0.016171),(65
,0.014587),(67.5,0.012867),(70,0.01116),(72.5,0.009478),(75,0.007832),(77.5
,0.006246),(80,0.004753)) death rates table[FEMALE, AG 65 TO 69]([(0,0)-
(80,0.1)],(0,1),(20,0.098693),(22.5,0.090243),(25,0.082871),(27.5,
0.076358),(30,0.070546),(32.5,0.065312),(35,0.060565),(37.5,0.056235),(40,
0.05226),(42.5,0.048607),(45,0.045604),(47.5,0.042686),(50,0.039859),(52.5
,0.037122),(55,0.034479),(57.5,0.031933),(60,0.029484),(62.5,0.027191),(65
,0.024787),(67.5,0.022148),(70,0.019498),(72.5,0.016848),(75,0.014214),(77.5
,0.011621),(80,0.009119)) death rates table[FEMALE, AG 70 TO 74]([(0,0)-
(80,0.2)],(0,1),(20,0.159395),(22.5,0.145124),(25,0.133009),(27.5,
0.12254),(30,0.113358),(32.5,0.105221),(35,0.097937),(37.5,0.091361),(40,0.08539
),(42.5,0.080084),(45,0.075702),(47.5,0.071445),(50,0.067315),(52.5,0.063316
),(55,0.059453),(57.5,0.055731),(60,0.052151),(62.5,0.048695),(65,0.045019
),(67.5,0.040933),(70,0.036768),(72.5,0.032528),(75,0.028216),(77.5,0.023862
),(80,0.019513)) death rates table[FEMALE, AG 75 TO 79]([(0,0)-
(80,0.4)],(0,1),(20,0.252331),(22.5,0.227439),(25,0.207422),(27.5,
0.190805),(30,0.176687),(32.5,0.164479),(35,0.153767),(37.5,0.144268),(40,
0.135763),(42.5,0.128251),(45,0.122317),(47.5,0.116549),(50,0.110954),(52.5
,0.105536),(55,0.100302),(57.5,0.095255),(60,0.090401),(62.5,0.085765),(65
,0.08059),(67.5,0.074756),(70,0.068712),(72.5,0.062434),(75,0.055897),(77.5
,0.049101),(80,0.042068)) death rates table[FEMALE, AG 80 AND OVER]([(0,0)-

(80,0.6)],(0,1),(20,0.410881),(22.5,0.389394),(25,0.370157),(27.5,
0.352756),(30,0.336902),(32.5,0.322367),(35,0.308965),(37.5,0.296544),(40,
0.284989),(42.5,0.274432),(45,0.265855),(47.5,0.257306),(50,0.248818),(52.5
,0.240404),(55,0.232093),(57.5,0.223906),(60,0.215861),(62.5,0.208031),(65
,0.199094),(67.5,0.188776),(70,0.1778),(72.5,0.166073),(75,0.15349),(77.5,
0.139955),(80,0.125409)) death rates table[MALE, AG UNDER 1]([(0,0)-
(80,0.4)],(0,1),(19.92,0.34),(22.299,0.311),(24.661,0.289),(27.007
,0.269),(29.321,0.251),(31.636,0.234),(33.95,0.218),(36.233,0.204),(38.501
,0.19),(40.634,0.178),(42.861,0.167),(45.118,0.156),(47.372,0.145),(49.623
,0.135),(51.869,0.125),(54.108,0.115),(56.341,0.106),(58.58,0.097),(61.252
,0.086),(63.659,0.076),(66.08,0.066),(68.524,0.056),(70.993,0.047),(73.486
,0.037),(76.002,0.028)) death rates table[MALE, AG 1 TO 4]([(0,0)-
(80,0.2)],(0,1),(19.92,0.101096),(22.299,0.090657),(24.661,0.08153
),(27.007,0.073448),(29.321,0.066219),(31.636,0.059702),(33.95,0.053783),(
36.233,0.048373),(38.501,0.043402),(40.634,0.039138),(42.861,0.034408),(45.118
,0.030108),(47.372,0.026188),(49.623,0.0226),(51.869,0.019304),(54.108,0.016268
),(56.341,0.013454),(58.58,0.010822),(61.252,0.007944),(63.659,0.00606),(66.08
,0.00446),(68.524,0.003132),(70.993,0.002074),(73.486,0.00127),(76.002,0.000701))
death rates table[MALE, AG 5 to 9]([(0,0)-
(80,0.02)],(0,1),(19.92,0.01657),(22.3,0.015023),(24.66,0.013635),
(27.01,0.012379),(29.32,0.011231),(31.64,0.010177),(33.95,0.009206),(36.23
,0.008305),(38.5,0.007467),(40.63,0.006619),(42.86,0.005848),(45.12,0.005134
),(47.37,0.004476),(49.62,0.003864),(51.87,0.003296),(54.11,0.002767),(56.34
,0.00227),(58.58,0.001802),(61.25,0.001382),(63.66,0.001058),(66.08,0.000783
),(68.52,0.000553),(70.99,0.000366),(73.49,0.000226),(76,0.000126)) death rates
table[MALE, AG 10 to 14]([(0,0)-
(80,0.008)],(0,1),(19.92,0.007768),(22.3,0.007094),(24.66,0.006486
),(27.01,0.005934),(29.32,0.005429),(31.64,0.004963),(33.95,0.004533),(36.23
,0.004134),(38.5,0.003762),(40.63,0.003411),(42.86,0.003081),(45.12,0.002771
),(47.37,0.002478),(49.62,0.0022),(51.87,0.001937),(54.11,0.00169),(56.34,
0.001454),(58.58,0.001231),(61.25,0.001008),(63.66,0.000819),(66.08,0.000645
),(68.52,0.00049),(70.99,0.000356),(73.49,0.000244),(76,0.000154)) death rates
table[MALE, AG 15 TO 19]([(0,0)-
(80,0.02)],(0,1),(19.92,0.011745),(22.3,0.010717),(24.66,0.009792)
,(27.01,0.008955),(29.32,0.008187),(31.64,0.007483),(33.95,0.006833),(36.23
,0.006229),(38.5,0.005666),(40.63,0.005183),(42.86,0.004671),(45.12,0.004191
),(47.37,0.003738),(49.62,0.003312),(51.87,0.002911),(54.11,0.002533),(56.34
,0.002175),(58.58,0.001835),(61.25,0.001484),(63.66,0.001197),(66.08,0.000936
),(68.52,0.000705),(70.99,0.000507),(73.49,0.000342),(76,0.000212)) death rates
table[MALE, AG 20 to 24]([(0,0)-
(80,0.02)],(0,1),(19.92,0.017833),(22.3,0.016267),(24.66,0.014861)
,(27.01,0.013588),(29.32,0.012429),(31.64,0.011363),(33.95,0.010379),(36.23

,0.00947),(38.5,0.008621),(40.63,0.007904),(42.86,0.007154),(45.12,0.006397
),(47.37,0.00569),(49.62,0.00503),(51.87,0.004413),(54.11,0.003833),(56.34
,0.00329),(58.58,0.002775),(61.25,0.002155),(63.66,0.001702),(66.08,0.001313
),(68.52,0.000974),(70.99,0.000687),(73.49,0.000454),(76,0.000274)) death rates
table[MALE, AG 25 to 29]([(0,0)-
(80,0.02)],(0,1),(19.92,0.017861),(22.3,0.016286),(24.66,0.014872)
,(27.01,0.01359),(29.32,0.012423),(31.64,0.011351),(33.95,0.01036),(36.23,
0.009445),(38.5,0.00859),(40.63,0.007869),(42.86,0.007098),(45.12,0.006369
),(47.37,0.005682),(49.62,0.005036),(51.87,0.004429),(54.11,0.003856),(56.34
,0.003316),(58.58,0.002804),(61.25,0.00226),(63.66,0.001823),(66.08,0.001428
),(68.52,0.001076),(70.99,0.000775),(73.49,0.000523),(76,0.000326)) death rates
table[MALE, AG 30 to 34]([(0,0)-
(80,0.02)],(0,1),(19.92,0.017569),(22.3,0.016098),(24.66,0.014776)
,(27.01,0.013578),(29.32,0.012486),(31.64,0.011483),(33.95,0.010557),(36.23
,0.009698),(38.5,0.008899),(40.63,0.008222),(42.86,0.007568),(45.12,0.006872
),(47.37,0.006215),(49.62,0.005592),(51.87,0.005002),(54.11,0.004443),(56.34
,0.003915),(58.58,0.003409),(61.25,0.002798),(63.66,0.002297),(66.08,0.001851
),(68.52,0.001442),(70.99,0.001078),(73.49,0.000763),(76,0.000503)) death rates
table[MALE, AG 35 to 39]([(0,0)-
(80,0.02)],(0,1),(19.92,0.019279),(22.3,0.017682),(24.66,0.016247)
,(27.01,0.014948),(29.32,0.013764),(31.64,0.012675),(33.95,0.011671),(36.23
,0.010742),(38.5,0.009877),(40.63,0.009146),(42.86,0.00845),(45.12,0.007706
),(47.37,0.006999),(49.62,0.006328),(51.87,0.00569),(54.11,0.005083),(56.34
,0.004508),(58.58,0.003959),(61.25,0.00329),(63.66,0.002741),(66.08,0.002236
),(68.52,0.001766),(70.99,0.001342),(73.49,0.000968),(76,0.000651)) death rates
table[MALE, AG 40 to 44]([(0,0)-
(80,0.04)],(0,1),(19.92,0.022776),(22.3,0.02095),(24.66,0.019312),
(27.01,0.017831),(29.32,0.01648),(31.64,0.015242),(33.95,0.014098),(36.23,
0.013042),(38.5,0.012057),(40.63,0.011225),(42.86,0.010446),(45.12,0.009623
),(47.37,0.008833),(49.62,0.008075),(51.87,0.007349),(54.11,0.006656),(56.34
,0.005995),(58.58,0.005361),(61.25,0.004582),(63.66,0.00391),(66.08,0.003273
),(68.52,0.002666),(70.99,0.002097),(73.49,0.001577),(76,0.001116)) death rates
table[MALE, AG 45 to 49]([(0,0)-
(80,0.04)],(0,1),(19.92,0.026511),(22.3,0.024484),(24.66,0.022667)
,(27.01,0.021024),(29.32,0.019528),(31.64,0.018155),(33.95,0.016891),(36.23
,0.015723),(38.5,0.014634),(40.63,0.013715),(42.86,0.012852),(45.12,0.011973
),(47.37,0.011121),(49.62,0.010298),(51.87,0.009503),(54.11,0.008737),(56.34
,0.008001),(58.58,0.00729),(61.25,0.006434),(63.66,0.005643),(66.08,0.004861
),(68.52,0.004095),(70.99,0.00335),(73.49,0.00264),(76,0.00198)) death rates
table[MALE, AG 50 to 54]([(0,0)-
(80,0.04)],(0,1),(19.92,0.033434),(22.3,0.031013),(24.66,0.028845)
,(27.01,0.026888),(29.32,0.025108),(31.64,0.023477),(33.95,0.021977),(36.23

,0.020588),(38.5,0.019299),(40.63,0.018179),(42.86,0.017155),(45.12,0.016154
),(47.37,0.015174),(49.62,0.014219),(51.87,0.013291),(54.11,0.012391),(56.34
,0.01152),(58.58,0.010673),(61.25,0.009678),(63.66,0.008686),(66.08,0.007685
),(68.52,0.006675),(70.99,0.00566),(73.49,0.004655),(76,0.003675)) death rates
table[MALE, AG 55 to 59]([(0,0)-
(80,0.06)],(0,1),(19.92,0.044138),(22.3,0.04106),(24.66,0.038314),
(27.01,0.035841),(29.32,0.033597),(31.64,0.031544),(33.95,0.02966),(36.23,
0.027918),(38.5,0.026304),(40.63,0.024908),(42.86,0.023655),(45.12,0.022423
),(47.37,0.021217),(49.62,0.020035),(51.87,0.018882),(54.11,0.017758),(56.34
,0.016668),(58.58,0.015606),(61.25,0.014384),(63.66,0.013094),(66.08,0.011774
),(68.52,0.010417),(70.99,0.00903),(73.49,0.007621),(76,0.006211)) death rates
table[MALE, AG 60 to 64]([(0,0)-
(80,0.08)],(0,1),(19.92,0.065496),(22.3,0.060868),(24.66,0.056767)
,(27.01,0.053092),(29.32,0.049774),(31.64,0.046754),(33.95,0.04399),(36.23
,0.041446),(38.5,0.039096),(40.63,0.037084),(42.86,0.035279),(45.12,0.033503
),(47.37,0.031763),(49.62,0.03006),(51.87,0.0284),(54.11,0.026783),(56.34,
0.025216),(58.58,0.023688),(61.25,0.0219),(63.66,0.020022),(66.08,0.018091
),(68.52,0.0161),(70.99,0.014056),(73.49,0.011965),(76,0.009852)) death rates
table[MALE, AG 65 TO 69]([(0,0)-
(80,0.1)],(0,1),(19.92,0.096446),(22.3,0.089546),(24.66,0.083489),
(27.01,0.07811),(29.32,0.073284),(31.64,0.068925),(33.95,0.064956),(36.23,
0.061321),(38.5,0.057978),(40.63,0.055173),(42.86,0.052635),(45.12,0.05014
),(47.37,0.047696),(49.62,0.045308),(51.87,0.042977),(54.11,0.040713),(56.34
,0.038515),(58.58,0.036376),(61.25,0.033787),(63.66,0.031099),(66.08,0.028317
),(68.52,0.025433),(70.99,0.022445),(73.49,0.019361),(76,0.016207)) death rates
table[MALE, AG 70 TO 74]([(0,0)-
(80,0.2)],(0,1),(19.92,0.149635),(22.3,0.138669),(24.66,0.129223),
(27.01,0.120967),(29.32,0.113663),(31.64,0.107132),(33.95,0.10125),(36.23,
0.09591),(38.5,0.091032),(40.63,0.086976),(42.86,0.083426),(45.12,0.079866
),(47.37,0.07638),(49.62,0.072976),(51.87,0.069655),(54.11,0.066431),(56.34
,0.063306),(58.58,0.060262),(61.25,0.056487),(63.66,0.052506),(66.08,0.048388
),(68.52,0.044078),(70.99,0.039558),(73.49,0.034824),(76,0.02989)) death rates
table[MALE, AG 75 TO 79]([(0,0)-
(80,0.4)],(0,1),(19.92,0.22951),(22.3,0.212135),(24.66,0.197665),(
27.01,0.185337),(29.32,0.174656),(31.64,0.165277),(33.95,0.156946),(36.23,
0.149482),(38.5,0.142737),(40.63,0.137144),(42.86,0.132341),(45.12,0.127625
),(47.37,0.123009),(49.62,0.118498),(51.87,0.114104),(54.11,0.109833),(56.34
,0.105693),(58.58,0.101661),(61.25,0.096657),(63.66,0.091211),(66.08,0.085513
),(68.52,0.079468),(70.99,0.073022),(73.49,0.066131),(76,0.058764)) death rates
table[MALE, AG 80 AND OVER]([(0,0)-
(80,0.4)],(0,1),(19.92,0.387521),(22.3,0.371088),(24.66,0.356328),
(27.01,0.34296),(29.32,0.330768),(31.64,0.319573),(33.95,0.309246),(36.23,

0.299675),(38.5,0.290759),(40.63,0.28317),(42.86,0.2765),(45.12,0.269829),
(47.37,0.263169),(49.62,0.256538),(51.87,0.249959),(54.11,0.243444),(56.34
,0.237022),(58.58,0.23066),(61.25,0.222615),(63.66,0.213667),(66.08,0.204084
),(68.52,0.193666),(70.99,0.182251),(73.49,0.16969),(76,0.155821)) Units: 1/Year

deaths[sex, age]= Population[sex,age] *death rates per age[sex,age] Units: Person/Year

deaths per age group[sex,AG UNDER 1]= deaths[sex,AGE 0] deaths per age group[sex,AG 1 TO 4]=SUM(deaths[sex,AGE 1 to 4!]) deaths per age group[sex,AG 5 to 9]=SUM(deaths[sex,AGE 5 to 9!]) deaths per age group[sex,AG 10 to 14]=SUM(deaths[sex,AGE 10 to 14!]) deaths per age group[sex,AG 15 TO 19]=SUM(deaths[sex,AGE 15 to 19!]) deaths per age group[sex,AG 20 to 24]=SUM(deaths[sex,AGE 20 to 24!]) deaths per age group[sex,AG 25 to 29]=SUM(deaths[sex,AGE 25 to 29!]) deaths per age group[sex,AG 30 to 34]=SUM(deaths[sex,AGE 30 to 34!]) deaths per age group[sex,AG 35 to 39]=SUM(deaths[sex,AGE 35 to 39!]) deaths per age group[sex,AG 40 to 44]=SUM(deaths[sex,AGE 40 to 44!]) deaths per age group[sex,AG 45 to 49]=SUM(deaths[sex,AGE 45 to 49!]) deaths per age group[sex,AG 50 to 54]=SUM(deaths[sex,AGE 50 to 54!]) deaths per age group[sex,AG 55 to 59]=SUM(deaths[sex,AGE 55 to 59!]) deaths per age group[sex,AG 60 to 64]=SUM(deaths[sex,AGE 60 to 64!]) deaths per age group[sex,AG 65 TO 69]=SUM(deaths[sex,AGE 65 to 69!]) deaths per age group[sex,AG 70 TO 74]=SUM(deaths[sex,AGE 70 to 74!]) deaths per age group[sex,AG 75 TO 79]=SUM(deaths[sex,AGE 75 to 79!]) deaths per age group[sex,AG 80 AND OVER]=deaths[sex,AGE 80 AND OVER] Units: Person/Year

decrease in vehicle ownership from public transport= if then else(CE policy switch=3:OR:S3 CE increased investment into public transport =3,S3 reduction in vehicle demand from public transport CE HA (Time), if then else(CE policy switch=2:OR:S3 CE increased investment into public transport =2,S3 reduction in vehicle demand from public transport CE CA (Time), if then else(CE policy switch=1:OR:S3 CE increased investment into public transport =1,S3 reduction in vehicle demand from public transport CE LA (Time),0)))*SWITCH OFF PUBLIC TRANSPORT Units: 1

decrease in vehicle ownership from ride sharing= if then else(CE policy switch=3:OR:S1 CE curtailing demand policy=3,S1 reduction in vehicle demand CE HA (Time), if then else(CE policy switch=2:OR:S1 CE curtailing demand policy=2,S1 reduction in vehicle demand CE CA (Time), if then else(CE policy switch=1:OR:S1 CE curtailing demand policy=1,S1 reduction in vehicle demand CE LA (Time), 0))) Units: 1

deforestation= (deforestation rate(Time)*relative harvested area^elasticity of relative harvested area to deforestation)-indicated deforestation reduction Units: Ha/Year

DEFORESTATION CO2 EMISSION= (deforestation*DEFORESTATION CO2 EMISSION FACTOR)/ton to mtoe Units: mtoe/Year

DEFORESTATION CO2 EMISSION FACTOR= 0.3 Units: Ton/Ha/Year

deforestation rate([(1970,0)-(2020,2e+007)],(1970,1.68e+007),(1978,1.68e+007),(1990,1.68e+007),(1995,1.68e+007),(2002,1.58e+007),(2009,1.45e+007),(2014,1.26e+007),(2019.85,1.06e+007)) Units: Ha/Year

deforestation reduction= if then else(indicated green economy investment fraction=0, 0, deforestation reduction target (Time)*SWITCH policy deforestation) Units: Ha/Year

deforestation reduction target([(2011,0)-(2050,8e+006)],(2011,4.03509e+006),(2030,7.87904e+006),(2050,7.87904e+006)) Units: Ha/Year

delay amount of carbon being sequestered by the forest= DELAY N(amount of carbon being sequestered by the forest, 30, 4.4989e+008, 1) Units: tons/Year

delayed share of coal= DELAY FIXED (electricity generation rate[coal power]/SUM(electricity generation rate[power generation technology !]), "1 year delay time" , initial share of coal) Units: 1

delayed share of gas= DELAY FIXED (electricity generation rate[GAS TURBINE]/SUM(electricity generation rate[power generation technology !]), "1 year delay time" , initial share of gas) Units: 1

delayed share of oil= DELAY FIXED (electricity generation rate[DIESEL AND FUEL OIL]/SUM(electricity generation rate [power generation technology !])+electricity generation rate[COGENERATION]/SUM(electricity generation rate [power generation technology!]), "1 year delay time" , initial share of oil) Units: 1

Demolition of old buildings= MAX(0,Stock of discarded buildings/Time to scrap buildings) Units: building/Year

depreciation rate= 0.01 Units: Dmnl/Year

DESALINATION WATER SUPPLY INVESTMENT= water supply management investment*FRACTION OF INVESTMENT FOR DESALINATION (Time) Units: usd15/Year

desired afforestation from investment([(1970,0)-(2050,2e+007)],(1970,0),(2010,0),(2011,4.82e+006),(2050,1.446e+007)) Units: Ha/Year

desired building stock per capita accounting for increased income= building demand per population*(GDP 2024 relativzed^elasticity of GDP to building demand)*(1-Ambition on

less intensive use of floor space-ambition on reduction in building demand) Units: sqm/Person

desired bus stock= average bus ownership(Time)*total population/(1-car travel reduction fraction) Units: vehicle

desired car stock= average car ownership rates*total population*(1-car travel reduction fraction) Units: vehicle

desired clothing stock per capita accounting for increased income= clothing demand per population*(GDP 2024 relativzed^elasticity of GDP to demand for clothing)*(if then else(CE policy switch =3:OR:S1 CE curtailing demand policy clothing=3,(1-S1 reduction in clothing demand HA (Time)),if then else(CE policy switch =2:OR:S1 CE curtailing demand policy clothing=2, (1-S1 reduction in clothing demand CA (Time)),if then else(CE policy switch =1:OR:S1 CE curtailing demand policy clothing=1,(1-S1 reduction in clothing demand LA (Time)),1)))) Units: Ton/Person/Year

"desired co-generation energy production increase"([(2008,0)-(2030,20)],(2008,0),(2011,0),(2012,0),(2013,0)) Units: MW

desired coal energy production increase([(2000,0)-(2050,200000)],(2009.79,80000),(2049.39,195000)) Units: MW

desired diseal and fuel oil energy production increase([(2000,0)-(2100,10000)],(2008,11000),(2050,15000)) Units: MW

desired gas turbine energy production increase([(2000,60000)-(2050,200000)],(2010.4,89824.6),(2049.69,190000)) Units: MW

desired geothermal production increase([(2011,0)-(2050,4000)],(2011,2842.11),(2013,2070.18),(2017,1807.02),(2027,2175.44),(2032,3000),(2039,3561.4),(2050,3877.19)) Units: MW

desired geothermal production increase base([(2006,0)-(2050,2000)],(2016,900.44),(2026,1068.42),(2050,1456.14)) Units: MW

desired hydro production increase([(2001,50000)-(2050,70000)],(2001.83,60175.4),(2015.14,73684.2),(2022.17,74912.3),(2030,67719.3),(2040,87719.3),(2050,102719)) Units: MW

desired landfill gas production increase([(2008,0)-(2030,8)],(2008,0),(2013,0),(2014,0),(2015,0),(2016,0)) Units: MW

desired landfill gas production increase policy([(2008,0)-(2030,8)],(2008,0),(2013,0),(2014,0),(2016,0)) Units: MW

desired nuclear energy production increase([(2006,0)-(2035,20000)],(2006.68,17982.5),(2017.34,19736.8),(2035,12736.8)) Units: MW

desired number of children per woman= SMOOTH N(MAX(minimum desired fertility rate, initial desired number of children per woman * effect of economic condition on desired number of children per woman * effect of adult literacy on desired number of children per woman), time for changes in desired children per woman, initial desired number of children per woman , 6) Units: Dmnl

Desired ownership for vehicles= total population*vehicle ownership per population accounting for increased income Units: vehicle/Year

desired reservoirs coverage time= 1 Units: Year

dESIRED reservoirs RECHARGE= reservoir capacity-water in reservoirs Units: Km3

desired reservois capacity= total water demand*desired reservoirs coverage time Units: Km3

desired solar production increase([(2003,0)-(2050,40000)],(2003,13333.3),(2016,105526),(2021,170965),(2029,280614),(2050,290246)) Units: MW

Desired stock of buildings= total population*desired building stock per capita accounting for increased income Units: sqm

Desired stock of clothing= desired clothing stock per capita accounting for increased income*total population Units: clothing/Year

Desired stock of plastic= total population*desired stsock of plastic per capita accounting for increased income Units: Ton/Year

desired stsock of plastic per capita accounting for increased income= plastic demand per population*(GDP 2024 relativzed^elasticity of gdp to demand for plastic)*(if then else(CE policy switch=3:OR:S1 CE curtailing demand policy plastic =3,(1-S1 reduction in plastic demand HA(Time)),if then else(CE policy switch =2:OR:S1 CE curtailing demand policy plastic=2,(1-S1 reduction in plastic demand CA (Time)),if then else(CE policy switch=1:OR:S1 CE curtailing demand policy plastic =1,(1-S1 reduction in plastic demand LA(Time)),1)))) Units: Ton/(Year*Person)

desired tidal energy production increase([(2009,0)-(2050,400)],(2009,25),(2013,25.526),(2023,75.0877),(2025,120.281)) Units: MW

desired truck stock heavy trucks= average truck ownership heavy trucks(Time)*total population Units: vehicle

desired truck stock medium trucks= average truck ownership medium trucks(Time)*total population Units: vehicle

desired vehicles stock three wheel= average vehicle ownership three wheel(Time)*total population Units: vehicle

desired vehicles stock two wheel= average vehicle ownership two wheel(Time)*total population Units: vehicle

desired waste energy production increase([(2008,0)-(2050,10000)],(2008,1930),(2014,18166.7),(2030,19833.3),(2050,18166.7)) Units: MW

desired wastewater produced per capita= initial wastewater produced per capita*relative pc disposable income^elasticity of wastewater produced to relative pc disposable income Units: Km3/Person/Year

desired wave energy production increase([(2008,0)-(2030,20)],(2008,0),(2011,0),(2012,0),(2013,0)) Units: MW

desired wind production increase([(2008,0)-(2050,60000)],(2008,26315.8),(2012,45526.3),(2019,122351),(2025, 150421)) Units: MW

desired wind production increase policy([(2000,0)-(2025,80)],(2008,0),(2009,0),(2010,0),(2011,0),(2012,0),(2013,0) ,(2014,0),(2015,0),(2016,0),(2017,0),(2018,0),(2019,0),(2020,0),(2021,0),(2022 ,0),(2023,0),(2024,0),(2025,0)) Units: MW

diesel and fuel oil share of power generation= diseal and fuel oil energy electricity generation/total electricity generation Units: Dmnl

direct fisheries employment= vessel capacity*employment per vessel Units: Person

Discard of building= DELAY MATERIAL (Sale of buildings+Refurbishing houses, (Average global lifetime of a building *(if then else(CE policy switch=3:OR:CE lifetime extension switch =3,S2 CE additional lifetime for building HA(Time),if then else(CE policy switch =2:OR:CE lifetime extension switch=2,S2 CE additional lifetime for building CA (Time),if then else(CE lifetime extension switch=1:OR:CE policy switch=1,S2 CE additional lifetime for building LA (Time) ,1))))) , Sale of buildings+Refurbishing houses,1) Units: sqm/Year

Discard of clothing= DELAY FIXED(Sale of clothing+reusing of used clothing, if then else(CE policy switch =3,S2 CE additional lifetime for clothing HA(Time)*Average global lifetime of a clothing ,if then else(CE policy switch=2,Average global lifetime of a clothing*S2 CE additional lifetime for clothing CA (Time), if then else(CE policy switch=1,Average global lifetime of a clothing*S2 CE additional lifetime for clothing LA

(Time),Average global lifetime of a clothing))) , Sale of clothing+reusing of used clothing) Units: Ton/Year

Discard of EVs= DELAY FIXED (sale of EVs+reusing of EVs, Average global lifetime of a vehicle , sale of EVs +reusing of EVs) Units: vehicle/Year

Discard of plastic= DELAY FIXED(Sale of plastic+reusing of used plastic, (Average global lifetime of a plastic *(if then else(CE policy switch=3:OR:S2 lifetime for plastic switch =3,S2 CE additional lifetime for platic HA(Time),if then else(CE policy switch =2:OR:S2 lifetime for plastic switch=2,S2 CE additional lifetime for platic CA (Time),if then else(CE policy switch=1:OR:S2 lifetime for plastic switch=1 ,S2 CE additional lifetime for platic LA(Time) ,1))))) , Sale of plastic+reusing of used plastic) Units: Ton/Year

Discard of Vehicle= DELAY FIXED (Sale of vehicle+reusing of used vehicles, Average global lifetime of a vehicle , Sale of vehicle+reusing of used vehicles) Units: vehicle/Year

diseal and fuel oil capital life time= 30 Units: Year

diseal and fuel oil energy capacity= INTEG (diseal and fuel oil energy construction-diseal and fuel oil energy discard , 750000) Units: MW

diseal and fuel oil energy construction= if then else(Time<2010, Combustible investment(Time)/diseal and fuel oil energy cost per mw (Time)/diseal and fuel oil energy construction time , future diseal and fuel oil energy investment/diseal and fuel oil energy cost per mw (Time)/diseal and fuel oil energy construction time)*if then else(CE switch reduction in diesel and fuel oil capacity=3,Reduction in Diesel anf fuel oil energy capacity HA ,if then else(CE switch reduction in diesel and fuel oil capacity=2,Reduction in Diesel anf fuel oil energy capacity CA ,if then else(CE switch reduction in diesel and fuel oil capacity=1,Reduction in Diesel anf fuel oil energy capacity LA ,1))) Units: MW/Year

diseal and fuel oil energy construction employment= (diseal and fuel oil energy construction+gas turbine energy construction)* (diseal and fuel oil energy construction employment factor(Time)+diseal and fuel oil energy manufacturing employment factor (Time)) Units: Person/Year

diseal and fuel oil energy construction employment factor([(2010,0)-(2030,20)],(2010,3.535),(2011,3.4768),(2012,3.4191),(2013,3.3617),(2014,3.3048),(2015,3.2483),(2016,3.1921),(2017,3.1364),(2018,3.0811),(2019 ,3.0261),(2020,2.9716),(2021,2.9145),(2022,2.8579),(2023,2.8018),(2024,2.7461),(2025,2.691),(2026,2.6364),(2027,2.5822),(2028,2.5285),(2029,2.4753),(2030 ,2.4225)) Units: Person/MW

diseal and fuel oil energy construction time= 1 Units: Year

diseal and fuel oil energy cost per mw([(2015,0)-(2030,1e+006)],(2015,429000),(2030,429000)) Units: usd15/MW

diseal and fuel oil energy discard= (diseal and fuel oil energy capacity/diseal and fuel oil capital life time)*if then else(CE switch reduction in diesel and fuel oil capacity=3,Phasing out diesel and fuel oil capacity HA ,if then else(CE switch reduction in diesel and fuel oil capacity=2,Phasing out diesel and fuel oil capacity CA , if then else(CE switch reduction in diesel and fuel oil capacity=1,Phasing out diesel and fuel oil capacity LA ,1))) Units: MW/Year

diseal and fuel oil energy electricity generation= min((TOTAL electricity demand accounting for distribution losses-hydro electricity generation -wind electricity generation-solar electricity generation-geothermal electricity generation -tidal energy electricity generation-wave energy electricity generation-landfill gas electricity generation -nuclear energy electricity generation-waste energy electricity generation- "co-generation energy electricity generation"-gas turbine energy electricity generation), diseal and fuel oil energy power capacity use/mwh to gwh) Units: GWh/Year

diseal and fuel oil energy electricity generation in bkwh= diseal and fuel oil energy electricity generation*gwh to bkwh Units: BKWH/Year

diseal and fuel oil energy load factor([(1970,0)-(2100,10)],(2010,0.257362),(2022,0.219106),(2023,0.207447),(2030,0.144228),(2035,0.125354),(2040,0.110838),(2050,0.0953966)) Units: Dmnl

diseal and fuel oil energy maintenance cost= diseal and fuel oil energy capacity*diseal and fuel oil energy maintenance cost per mw Units: usd15/Year

diseal and fuel oil energy maintenance cost per mw= 50000 Units: usd15/MW/Year

diseal and fuel oil energy manufacturing employment factor([(2010,0)-(2030,0.1)],(2010,0.001),(2011,0.001),(2012,0.001),(2013,0.001),(2014,0.001),(2015,0.001),(2016,0.0009),(2017,0.0009),(2018,0.0009),(2019,0.0009),(2020,0.0009),(2021,0.0009),(2022,0.0008),(2023,0.0008),(2024,0.0008),(2025,0.0008),(2026,0.0008),(2027,0.0008),(2028,0.0007),(2029,0.0007),(2030,0.0007)) Units: Person/MW

diseal and fuel oil energy operation and maintenance employment= (diseal and fuel oil energy capacity+gas turbine energy capacity)*diseal and fuel oil energy operation and maintenance employment factor (Time) Units: Person/Year

diseal and fuel oil energy operation and maintenance employment factor([(2010,0)-(2030,1)],(2010,0.456),(2011,0.4485),(2012,0.4411),(2013,0.4337),(2014,0.4263),(2015,0.419),(2016,0.4118),(2017,0.4046),(2018,0.3974),(2019,0.3904),(2020,0.3833),(2021,0.376),(2022,0.3687),(2023,0.3614),(2024,0.3542

),(2025,0.3471),(2026,0.3401),(2027,0.3331),(2028,0.3262),(2029,0.3193),(2030
,0.3125)) Units: Person/MW

diseal and fuel oil energy power capacity use= diseal and fuel oil energy load factor(Time)*potential electricity generation diseal and fuel oil energy Units: MWh/Year

disposable income= real gross domestic product-public consumption-public investment Units: usd15/Year

disposal cost per ton of other disposed waste([(1970,0)-(2010,20)],(1970,4),(1990,10),(2010,17.5)) Units: USD/Ton

disposed waste= industrial waste for other disposal Units: Ton/Year

distillate fuel oil emission factor= 74100 Units: Kg/Tj

distribution losses([(1973,0)-(2050,2e+007)],(1973,903465),(1974,993272),(1975,1.08945e+006),(1976,1.33183e+006),(1977,1.53429e+006),(1978,1.71521e+006),(1979,1.89328e+006),(1980,1.87757e+006),(1981,1.86215e+006),(1982,1.73551e+006),(1983,1.83642e+006),(1984,2.16477e+006),(1985,2.23459e+006),(1986,2.31725e+006),(1987,2.51704e+006),(1988,2.89399e+006),(1989,2.88331e+006),(1990,2.85441e+006),(1991,2.86907e+006),(1992,2.71639e+006),(1993,2.61451e+006),(1994,2.63171e+006),(1995,2.67411e+006),(1996,2.65372e+006),(1997,2.60794e+006),(1998,2.51798e+006),(1999,2.57213e+006),(2000,2.65337e+006),(2001,2.74416e+006),(2002,2.81766e+006),(2003,3.12719e+006),(2004,3.47668e+006),(2005,3.84975e+006),(2006,4.16077e+006),(2050,1.161e+007)) Units: Dmnl

distribution losses fraction= if then else(CE policy switch=3,SDG ambition on reduction of post harvest losses HA ,if then else(CE policy switch=2,SDG ambition on reduction of post harvest losses CA ,if then else(CE policy switch=1,SDG ambition on reduction of post harvest losses LA ,1)))*BAU distribution losses fraction Units: Dmnl

distribution losses share= WITH LOOKUP (Time, ([(1970,0)-(2050,1)],(1970,0.213682),(1971,0.207573),(1972,0.199626),(1973,0.190892),(1974,0.20185),(1975,0.216558),(1976,0.260457),(1977,0.292218),(1978,0.316558),(1979,0.337143),(1980,0.322931),(1981,0.309318),(1982,0.276947),(1983,0.28004),(1984,0.314001),(1985,0.307437),(1986,0.303917),(1987,0.317436),(1988,0.351371),(1989,0.336879),(1990,0.320412),(1991,0.310534),(1992,0.283621),(1993,0.263977),(1994,0.256239),(1995,0.251489),(1996,0.241762),(1997,0.229419),(1998,0.214293),(1999,0.21195),(2000,0.211694),(2001,0.211893),(2002,0.210816),(2003,0.227596),(2004,0.247545),(2005,0.266603),(2006,0.278478),(2007,0.279765),(2008,0.280235),(2009,0.280059))) Units: Dmnl

DROPOUT FRACTION= 6.5 Units: Dmnl

duration of covid impacts table([(2000,0)-(2026,1)],(2000,0),(2019,0),(2019.75,0.5),(2020,1),(2024,0)) Units: Dmnl

e waste per unit of industrial production([(1970,0)-(2010,1e-006)],(1970,1.1e-007),(2010,1.4e-007)) Units: Ton/usd15

"e-waste recycled"= "e-waste"*"fraction of e-waste to uses"[erecycle] Units: Ton/Year

"e-waste to landfill"= "e-waste"*"fraction of e-waste to uses"[elandfill] Units: Ton/Year

"e-waste upstream cost"= "e-waste"*total upstream cost Units: USD/Year

"e-waste upstream employment"= "e-waste"*total upstream employment factor per ton Units: Person/Year

"e-waste waste recycled from green investment"= "fraction of e- waste to uses increase"[erecycle]*"e-waste" Units: Ton/Year

"e-waste"= industry production*e waste per unit of industrial production(Time) Units: Ton/Year

ecological footprint to biocapacity ratio= total ecological footprint/total biocapacity Units: Dmnl

economic output generated per building= WITH LOOKUP (Time, ([(1970,0)-(2050,5000)],(1970,1500),(2000,3478),(2024,3478),(2050,5000))) Units: USD/building

economic output generated per clothing= WITH LOOKUP (Time, ([(2000,0)-(2022,80000)],(2000,33233.1),(2001,34710),(2002,35842.9),(2003,36911.5),(2004,37982.1),(2005,39602.9),(2006,40905.2),(2007,42383.5),(2008,43754.8),(2009,47519.1),(2010,48891),(2011,50019.5),(2012,52568.3),(2013,53504.2),(2014,55908.5),(2015,59409.3),(2016,61178.6),(2017,63120.5),(2018,63361.5),(2019,66143.5),(2020,70240.7),(2021,67814.9),(2022,72637.8),(2050,125000))) Units: USD/Ton

economic output generated per plastic= WITH LOOKUP (Time, ([(2000,2000)-(2024,4000)],(2000,2324.33),(2001,2276.73),(2002,2250.52),(2003,2300.76),(2004,2382.5),(2005,2487.08),(2006,2512.84),(2007,2616.6),(2008,2920.19),(2009,2839.13),(2010,2859.29),(2011,2926.56),(2012,2925.09),(2013,2902.15),(2014,2948.95),(2015,2861.61),(2016,2818.73),(2017,2938.07),(2018,2986.29),(2019,2926.31),(2020,2986.04),(2021,3184.71),(2022,3444.22),(2023,3478.56),(2024,3564.77),(2050,5640))) Units: USD/Ton

economic output generated per vehicle= WITH LOOKUP (Time, ([(1970,0)-(2050,100000)],(1970.24,7894.74),(1998.78,22293.6),(2000,22293.6),(2001,21778.1),(2002,22779.7),(2003,24697),(2004,27069.9),(2005,28984.3),

(2006,30662.7),(2007,33509.7),(2008,35172.7),(2009,33327),(2010,36788.6),(2011
,39555.7),(2012,40479.3),(2013,41646),(2014,43260.8),(2015,42359.2),(2016,42754.1
),(2017,44709.3),(2018,46194.3),(2019,45873.7),(2020,51749.1),(2021,51182.7
),(2022,60732.3),(2023,63067.6),(2024,64583.6),(2050,100000))) Units: USD/vehicle

economic output per building employee= nominal economic output from building/total skilled employment in the building sector Units: USD/Person

economic output per employee= nominal economic output from vehicile production/total skilled employment in the vehicle sector Units: USD/Person

economic output per employee for clothing= nominal economic output from clothing production/total skilled employment in the clothing sector Units: USD/Person

economic output per plastic employee= nominal economic output from plastic production/total skilled employment in the plastic sector Units: USD/Person

education expenditure= real gross domestic product*Public spending on education as a fraction of GDP Units: usd15/Year

education expenditure per pupil= education expenditure/SUM(population of school going age[sex!]) Units: usd15/Year/Person

EE BAU= energy efficiency BAU(Time) Units: Dmnl

EE CA= energy efficiency constrained ambition(Time) Units: Dmnl

EE HA= energy efficiency high ambition(Time) Units: Dmnl

EE LA= energy efficiency low ambition(Time) Units: Dmnl

effect of adult literacy on desired number of children per woman= relative average years of schooling^elasticity of desired number of children to literacy Units: Dmnl

effect of agriculture employment on labor= relative agriculture employment^elasticity of agriculture employment to labor Units: Dmnl

effect of AIDS deaths on condom prevalence([(0,0)-
(1,1)],(0,0),(0.01,0.0185852),(0.02,0.0370333),(0.03,0.0554689),(0.04
,0.0740067),(0.05,0.0927513),(0.06,0.111796),(0.07,0.131226),(0.08,0.15111)
,(0.09,0.171509),(0.1,0.19247),(0.11,0.214025),(0.12,0.236193),(0.13,0.258977
),(0.14,0.282367),(0.15,0.306336),(0.16,0.330841),(0.17,0.355826),(0.18,0.381222
),(0.19,0.406945),(0.2,0.432902),(0.21,0.458992),(0.22,0.485106),(0.23,0.51113
),(0.24,0.536951),(0.25,0.562456),(0.26,0.587535),(0.27,0.612084),(0.28,0.636008
),(0.29,0.659221),(0.3,0.681646),(0.31,0.703221),(0.32,0.723893),(0.33,0.743624
),(0.34,0.762385),(0.35,0.780161),(0.36,0.796946),(0.37,0.812745),(0.38,0.827571
),(0.39,0.841443),(0.4,0.854389),(0.41,0.86644),(0.42,0.877632),(0.43,0.888004

),(0.44,0.897596),(0.45,0.906451),(0.46,0.914611),(0.47,0.922118),(0.48,0.929016
),(0.49,0.935344),(0.5,0.941143),(0.51,0.94645),(0.52,0.951304),(0.53,0.955737
),(0.54,0.959784),(0.55,0.963474),(0.56,0.966837),(0.57,0.9699),(0.58,0.972688
),(0.59,0.975224),(0.6,0.97753),(0.61,0.979626),(0.62,0.981529),(0.63,0.983258
),(0.64,0.984828),(0.65,0.986252),(0.66,0.987545),(0.67,0.988717),(0.68,0.98978
),(0.69,0.990744),(0.7,0.991617),(0.71,0.992409),(0.72,0.993126),(0.73,0.993777
),(0.74,0.994366),(0.75,0.994899),(0.76,0.995382),(0.77,0.99582),(0.78,0.996216
),(0.79,0.996575),(0.8,0.9969),(0.81,0.997194),(0.82,0.997461),(0.83,0.997702
),(0.84,0.99792),(0.85,0.998118),(0.86,0.998296),(0.87,0.998458),(0.88,0.998605
),(0.89,0.998737),(0.9,0.998857),(0.91,0.998966),(0.92,0.999064),(0.93,0.999153
),(0.94,0.999234),(0.95,0.999307),(0.96,0.999373),(0.97,0.999432),(0.98,0.999486
),(0.99,0.999535),(1,0.999579)) Units: Dmnl

effect of average life expectancy on total factor productivity industry= relative average life expectancy^ELASTICITY OF AVERAGE LIFE EXPECTANCY ON TOTAL FACTOR PRODUCTIVITY industry (Time) Units: Dmnl

effect of average life expectancy on total factor productivity services= relative average life expectancy^ELASTICITY OF AVERAGE LIFE EXPECTANCY ON TOTAL FACTOR PRODUCTIVITY services (Time) Units: Dmnl

effect of average years of schooling on labor productivity industry= relative average years of schooling^elasticity of average years of schooling on labor productivity Industry (Time) Units: Dmnl

effect of average years of schooling on services labor productivity= relative average years of schooling^elasticity of average years of schooling on labor productivity services (Time) Units: Dmnl

effect of capital= relative capital agriculture^agriculture capital elasticity Units: Dmnl

effect of CCS on emissions= if then else(IEA NET ZERO SWITCH=1,(1-EXOGENOUS CCS CAPACITY),1) Units: Dmnl

effect of chemical fertilizer use on soil quality= min(1, relative chemical fertilizer use^elasticity of soil quality to chemical fertilizer use) Units: Dmnl

effect of coal fraction total resources remaining= World Coal Fraction Total Resources Remaining/reference coal fraction total resource remaining Units: Dmnl

effect of Coal price on ROW demand= if then else(Time<2005,1,(relative international coal price/reference relative international coal price)^Elasticity of Coal Price on ROW Demand) Units: Dmnl

effect of economic condition on desired number of children per woman= relative pc gdp^elasticity of desired number of children to income Units: Dmnl

effect of economic conditions on commercial electricity demand= effect of economic conditions on commercial electricity demand table (relative services production) Units: kWh/customers/Year

effect of economic conditions on commercial electricity demand table([(0,0)-(8,40000)],(0,350.877),(0.75841,5789.47),(1.56575,12807),(2.44648,16140.4),(3.22936,20350.9),(4.57492,23157.9),(7.5107,26315.8)) Units: kWh/customers/Year

effect of economic conditions on industrial electricity demand= effect of economic conditions on industrial electricity demand table (relative gdp) Units: kWh/customers/Year

effect of economic conditions on industrial electricity demand table([(0,0)-(10,400000)],(0,18421.1),(0.685015,34210.5),(1.65138,61403.5),(3.48624,112281),(4.22018,156140),(5.50459,188596),(7.30887,225000),(8.96,249100),(9.939,261400)) Units: kWh/customers/Year

effect of economic conditions on residential electricity demand= effect of economic conditions on residential electricity demand table (relative gdp) Units: kWh/customers/Year

effect of economic conditions on residential electricity demand table([(0,0)-(10,4000)],(0,35.0877),(0.587156,929.825),(1.52905,1473.68),(2.35474,1666.67),(3.18043,1789.47),(4.06728,1929.82),(7.92049,2035.09)) Units: kWh/customers/Year

effect of education on contraceptive prevalence rate= relative average years of schooling^elasticity of contraceptive prevalence rate to education Units: Dmnl

effect of education on required pasture land per person= relative average years of schooling^elasticity of required pasture land per person to years of schooling Units: Dmnl

effect of electricity cost on gdp= relative effect of energy price on electricity price^if then else(Time<present year ,elasticity of gdp to electricity cost,future elasticity of gdp to electricity cost) Units: Dmnl

effect of electricity price= SMOOTH N(relative average electricity production cost, 1, 1, 3) Units: Dmnl

effect of emission on service tfp= relative energy emissions^elasticity of emission on service tfp Units: 1

effect of emissions on industry tfp= relative energy emissions^elasticity of emissions on tfp Units: 1

effect of energy price on electricity price= (coal electricity production share*real coal price per MBTU +gas electricity production share *weighted us gas price per mbtu+petroleum electricity production share*real oil price per Mbtu +nonhydro renewable electricty production share*(renewable electricity price (Time)+2))/5 Units: usd15/Mbtu

effect of energy spending on industry tfp= DELAY FIXED(relative energy bill as share of GDP^elasticity of energy spending on tfp , 1,initial relative energy bill) Units: 1

effect of energy spending on service tfp= relative energy bill as share of GDP^elasticity of energy spending on services TFP Units: 1

effect of fertilizer use on yield= DELAY N(relative chemical fertilizer use^elasticity of yield to chemical fertilizer *relative organic fertilizer use^elasticity of yield to organic fertilizer, 3, relative chemical fertilizer use^elasticity of yield to chemical fertilizer *relative organic fertilizer use^elasticity of yield to organic fertilizer, 3) Units: 1

effect of fish stock on catch= stock ratio^elasticity fish Units: 1

effect of fossil fuel emissions mortality table([(0,0)-(2.665e+007,1)],(0,0),(2.665e+007,0.999)) Units: Dmnl/Year

effect of fossil fuel emissions on mortality= (effect of fossil fuel emissions mortality table(co2 emissions per hectare)) Units: Dmnl/Year

effect of fuel grade on CO emissions table([(1,0.5)-(4,1)],(1,1),(2,0.851),(3,0.594),(4,0.547)) Units: Dmnl

effect of fuel grade on NOx emissions table([(1,0.7)-(4,1)],(1,1),(2,0.923),(3,0.804),(4,0.782)) Units: Dmnl

effect of fuel grade on transport CO emissions[transport]= if then else (scenario master switch>0, effect of fuel grade on CO emissions table(Lookup for change in fuel quality (Time)), 1) effect of fuel grade on transport CO emissions[HOUSEHOLDS]= 1 effect of fuel grade on transport CO emissions[other energy uses]= 1 effect of fuel grade on transport CO emissions[INDUSTRY]= 1 effect of fuel grade on transport CO emissions[NONENERGY USE]= 1 Units: Dmnl

effect of fuel grade on transport NOx emissions[transport]= if then else (scenario master switch>0,effect of fuel grade on NOx emissions table (Lookup for change in fuel quality(Time)),1) effect of fuel grade on transport NOx emissions[HOUSEHOLDS]= 1 effect of fuel grade on transport NOx emissions[other energy uses]= 1 effect of fuel grade on transport NOx emissions[INDUSTRY]= 1 effect of fuel grade on transport NOx emissions[NONENERGY USE]= 1 Units: Dmnl

effect of harvested area on fertilizer use= relative harvested area^elasticity of fertilizer use to harvested area Units: 1

EFFECT OF INDUSTRY PRODUCTION TO WATER RECYCLE= 0.02 Units: Dmnl

effect of investment on potential production= Function for Effect of Investment on Potential Production(World Oil Production Capacity /Effective world oil potential production from reserves) Units: Dmnl

effect of labor= relative labor effect^elasticity of yield to labor Units: Dmnl

effect of life expectancy on labor= relative average life expectancy^elasticity of life expectancy on labor Units: Dmnl

effect of Natural Gas fraction total resources remaining= World Natural Gas Fraction Total Resources Remaining/reference Natural Gas fraction total resource remaining Units: Dmnl

effect of natural gas price on ROW demand= if then else(Time<2005,1,(relative international natural gas price/reference relative international natural gas price)^Elasticity of Natural Gas Price to ROW Demand) Units: Dmnl

effect of nutrition on life expectancy= SMOOTH N((relative quality of nutrition^elasticity of life expectancy to nutrition), 5, 1, 3) Units: 1

effect of oil price on fertilizer use= SMOOTH N(relative average oil price^elasticity of oil price on chemical fertilizer use , 2, 1, 3) Units: Dmnl

effect of oil price on transportation fuel demand= 1 Units: Dmnl

effect of organic fertilizer use on soil quality= relative organic fertilizer use^elasticity of soil quality to organic fertilizer use Units: 1

effect of over production on fraction recoverable= 1.2 Units: Dmnl

effect of pollution on life expectancy= SMOOTH N(relative co2 emissions per hectare^elasticity of life expectancy to pollution , 5, 1, 3) Units: Dmnl

effect of primary sold biomass on relative oil price= relative oil price^elasticity of primary biomas to price Units: dmml

effect of primary sold biomass on relative total population= effect of primary sold biomass on relative total population table(relative total population) Units: dmml

effect of primary sold biomass on relative total population table([(1,0)-(4,4)],(1,1),(1.2,1.175),(1.4,1.456),(1.6,1.737),(2,2.07),(3,3)) Units: dmnl

effect of primary solid biomass on relative population below poverty line= relative population below poverty line^elasticity solid biomas demand to poverty Units: dmml

"effect of R&D"= relative Research and development^"elasticity of yield to R&D" Units: Dmnl

effect of relative campaign expenditure on probability to get informed via campaign = DELAY N(relative campaign expenditure^elasticity of inform probability to relative campaign expenditure , 6, relative campaign expenditure^elasticity of inform probability to relative campaign expenditure , 3) Units: Dmnl

EFFECT OF RELATIVE GDP ON TRAVEL VOLUME= relative gdp^elasticity of travel volume to gdp Units: Dmnl

effect of relative GHG emissions on probability to become recyclers= effect of relative GHG emissions on probability to become recyclers table(relative GHG emissions per capita) Units: Dmnl

effect of relative GHG emissions on probability to become recyclers table([(0,0)-(3,4)],(0.0183486,0.482456),(0.33945,0.614035),(0.651376,0.77193),(1,1),(1.52294,1.35965),(2.22936,1.86842),(3,2.5)) Units: Dmnl

effect of resources on world price= ((effect of ROW Oil Actual Reserves Production Ratio on Oil Price)^elasticity of Oil Price on ROW Oil Actual Reserves Production Ratio) Units: Dmnl

effect of ROW Oil Actual Reserves Production Ratio on Oil Price= (1/(ROW Oil Actual Reserves Production Ratio/Reference ROW Oil Actual Reserves Production Ratio)) Units: Dmnl

effect of schooling on labor= relative average years of schooling^elasticity of schooling on labor Units: Dmnl

effect of share of forest land on soil quality= relative forest land^elasticity of deforestation on soil quality Units: 1

"effect of share of separators on probability to reach non-recyclers"= effect of share of susceptibles on probability to get informed via campaign table (relative share of recyclers) Units: Dmnl

effect of share of susceptibles on probability to get informed via campaign table ([(0,0)-(2,4)],(0,3.44737),(0.385321,2.44737),(0.568807,1.92105),(0.75841,1.47368),(1,1),(1.1682,0.736842),(1.44954,0.460526),(1.71254,0.289474),(1.99388,0.157895)) Units: Dmnl

effect of soil quality= DELAY N(relative soil quality^elasticity of yield to soil quality, 3, relative soil quality ^elasticity of yield to soil quality, 3) Units: Dmnl

effect of soil quality on fertilizer demand= DELAY N(soil quality^elasticity of fertilizer demand to soil quality, 2, 1 , 3) Units: 1

effect of technology on industry tfp= industry technology^elasticity of technology on industry tfp Units: 1

EFFECT OF WASTE RECYCLE ON INDUSTRY PRODUCTION= DELAY N(RELATIVE RECYLCE RATE^EFFECT OF INDUSTRY PRODUCTION TO WATER RECYCLE , 1, 1, 3) Units: 1

effect of water stress= fraction of water available^elasticity of water stress Units: Dmnl

effect of water stress on ag production= DELAY N(relative water stress^elasticity of ag yield to water, 1, 1, 3) Units: 1

EFFECT OF WATER STRESS ON INDUSTRY PRODUCTIVITY= DELAY N(relative water stress^ELASTICITY OF INDUSTRIAL PRODUCTION TO WATER STRESS , 1, 1, 3) Units: 1

effect of world oil demand and supply balance= world oil demand supply balance^elasticity of cost to demand and supply Units: 1

effect of world oil demand supply balance on price= ELASTICITY OF OIL PRICE TO DEMAND SUPPLY BALANCE*world oil demand supply balance Units: 1

effect of world oil demand supply on price= relative world oil demand supply balance^elasticity of price to world oil demand supply balance Units: 1

effective actual world oil fraction recoverable= Effective World Oil Recoverable Reserves/World Oil Discovered Reserves Units: Dmnl

effective contraceptive prevalence rate= contraceptive prevalence rate*effectiveness of contraception methods Units: Dmnl

effective crops yield per hectare= (1-actual crop diseases loss)*natural crops yield per hectare+Increased productivity yield per hectare Units: Ton/Ha

effective death rates per age group[sex, age group]= deaths per age group[sex,age group]/Population Group[sex,age group] Units: Dmnl/Year

Effective ROW oil demand= DELAY N(world oil demand,1,world oil demand,1) Units: MB/Year

Effective World Oil Fraction Recoverable= Oil Fraction Recoverable(Time)*indicated tech progress*effect of over production on fraction recoverable Units: Dmnl

Effective world oil potential production from reserves= Effective World Oil Recoverable Reserves/world oil reference reserve production ratio Units: MB/Year

Effective World Oil Recoverable Reserves= (World Oil Discovered Reserves+World Oil Cumulative Production)*Effective World Oil Fraction Recoverable -World Oil Cumulative Production Units: MB

effectiveness of contraception methods= 1 Units: Dmnl

efficiency factor power generation= power generation co2 emission abatement from green investment/total co2 emissions from power generation bau Units: Dmnl

efficiency ratio transport from green investment= transportation emission abatement/indicated total transportation emissions in tons Units: Dmnl

elasticity fish= 0.8 Units: Dmnl

elasticity look up function([(0,-0.02)-(1,-0)],(0,0),(1,-0.02)) Units: Dmnl

elasticity look up function for nutrition([(1,0)-(2,0.04)],(1,0.04),(1.25,0.04),(1.3,0)) Units: Dmnl

elasticity of ag yield to water= 0.08 Units: Dmnl

elasticity of agric water demand to harvested area= 4.9 Units: Dmnl

ELASTICITY OF agric WATER WITHDRAWAL RATE ON TOTAL FACTOR PRODUCTIVITY= 0.2 Units: Dmnl

elasticity of agriculture employment to labor= 0.2 Units: Dmnl

elasticity of agriculture investment to pc gdp= -0.2 Units: Dmnl

elasticity of air travel volume to gdp growth= 0.9 Units: Dmnl

ELASTICITY OF AVERAGE LIFE EXPECTANCY ON TOTAL FACTOR PRODUCTIVITY industry ([(1970,0)-(2050,0.4)],(1970,0.1),(2010,0.1),(2023,0.1),(2035,0.15)) Units: Dmnl

ELASTICITY OF AVERAGE LIFE EXPECTANCY ON TOTAL FACTOR PRODUCTIVITY services ([(1970,0)-(2050,0.2)],(1970,0.12),(2010,0.24),(2050,0.45)) Units: Dmnl

elasticity of average years of schooling on labor productivity Industry([(1970,0)-(2050,1)],(1970,0.7),(2010,0.7),(2024,0.55),(2050,0.55)) Units: Dmnl

elasticity of average years of schooling on labor productivity services([(1970,0.4)-(2050,0.5)],(1970,0.45),(2010,0.45),(2030.18,0.46),(2050,0.55)) Units: Dmnl

elasticity of capital labor ratio to relative employment ratio= 3 Units: Dmnl

elasticity of capital labour ratio to average life expectancy agric= 1.5 Units: Dmnl

elasticity of capital labour ratio to average life expectancy agric brown= 0.55 Units: Dmnl

elasticity of capital labour ratio to average life expectancy agric green= 0.55 Units: Dmnl

elasticity of capital labour ration to average life expectancy industry= WITH LOOKUP (Time, ([(1970,2)-(2010,3)],(1970,2.5),(2002,2.5),(2010,2.9))) Units: Dmnl

elasticity of capital labour ration to average life expectancy services= WITH LOOKUP (Time, ([(1970,1)-(2003,3)],(1970,2.2),(1994,2.2),(1996,1.1))) Units: Dmnl

elasticity of capital labour ration to average years of schooling agriculture = WITH LOOKUP (Time, ([(1980,1)-(2022,3)],(1980,2),(2002,2),(2022,2.65))) Units: Dmnl

elasticity of capital labour ration to average years of schooling agriculture brown = 1.5 Units: Dmnl

elasticity of capital labour ration to average years of schooling agriculture green = 1.5 Units: Dmnl

elasticity of capital labour ration to average years of schooling industry= 0.65 Units: Dmnl

elasticity of capital labour ration to average years of schooling services= 1.6 Units: Dmnl

elasticity of capital to COVID impacts= 0.1 Units: Dmnl

Elasticity of Coal Cost on Demand Supply Ratio= 0.05 Units: Dmnl

Elasticity of Coal Cost on recoverable reserve demand ratio= 0.05 Units: Dmnl

Elasticity of Coal Price on ROW Demand= -0.25 Units: Dmnl

Elasticity of Coal Price to Total Resources Remaining= 0.8 Units: Dmnl

elasticity of contraceptive prevalence rate to education= 0.7 Units: Dmnl

elasticity of cost to demand and supply= 1.5 Units: Dmnl

elasticity of deforestation on soil quality= 0.8 Units: Dmnl

elasticity of desired number of children to income= -1.3 Units: Dmnl

elasticity of desired number of children to literacy= -0.8 Units: Dmnl

elasticity of education expenditure on target years of schooling= 0.175 Units: Dmnl

elasticity of emission on service tfp= -0.07 Units: Dmnl

elasticity of emissions on tfp= -0.15 Units: Dmnl

elasticity of employment= 0.5 Units: Dmnl

elasticity of energy spending on services TFP= -0.1 Units: Dmnl

elasticity of energy spending on tfp= -0.1 Units: Dmnl

elasticity of factor productivity on desired arable land= -0.1 Units: Dmnl

elasticity of factor productivity on desired pasture land= -0.3 Units: Dmnl

elasticity of fertilizer demand to soil quality= -10 Units: Dmnl

elasticity of fertilizer use to harvested area= 4 Units: Dmnl

elasticity of GDP to building demand= WITH LOOKUP (Time, ([(1970,0)-(2050,0.5)],(1970,0),(2024,0),(2050,0.5))) Units: Dmnl

elasticity of GDP to demand for clothing= 0.75 Units: Dmnl

elasticity of gdp to demand for plastic= 0.03 Units: Dmnl

elasticity of GDP to demand for vehicles= WITH LOOKUP (Time, ([(1970,0)-(2050,0.3)],(1970,0),(2024,0),(2050,0.25))) Units: Dmnl

elasticity of gdp to electricity cost= -0.025 Units: Dmnl

ELASTICITY OF INDUSTRIAL PRODUCTION TO WATER STRESS= -0.1 Units: dmnl

ELASTICITY OF INDUSTRIAL WATER WITHDRAWAL RATE ON TOTAL FACTOR PRODUCTIVITY = 0.01 Units: Dmnl

elasticity of industry investment to pc gdp= -0.075 Units: Dmnl

elasticity of inform probability to relative campaign expenditure= 0.043 Units: Dmnl

elasticity of international water travel energy consumption on relative gdp = 0.38 Units: Dmnl

elasticity of life expectancy on labor= 0.075 Units: Dmnl

elasticity of life expectancy to nutrition= elasticity look up function for nutrition(relative quality of nutrition) Units: Dmnl

elasticity of life expectancy to pollution= elasticity look up function(relative co2 emissions per hectare) Units: Dmnl

elasticity of livestock production to oil price= 0.15 Units: Dmnl

ELASTICITY of MUNICIPAL WATER DEMAND to income pc= 0.55 Units: Dmnl

ELASTICITY of MUNICIPAL WATER DEMAND to population= 1.12 Units: Dmnl

Elasticity of Natural Gas Cost on Demand Supply Ratio= 0.75 Units: Dmnl

Elasticity of Natural Gas Cost on recoverable reserve demand ratio= 0.1 Units: Dmnl

Elasticity of Natural Gas Price to ROW Demand= -0.25 Units: Dmnl

Elasticity of Natural Gas Price to Total Resources Remaining= 1.5 Units: Dmnl

elasticity of oil price on chemical fertilizer use= -0.015 Units: Dmnl

elasticity of Oil Price on ROW Oil Actual Reserves Production Ratio= 0.8 Units: Dmnl

ELASTICITY OF OIL PRICE TO DEMAND SUPPLY BALANCE= 0.7 Units: Dmnl

elasticity of price to world oil demand supply balance= 0.7 Units: Dmnl

elasticity of primary biomas to price= 0.02 Units: Dmnl

elasticity of relative harvested area to deforestation= 0.7 Units: Dmnl

elasticity of relative production on water demand= 1.25 Units: Dmnl

elasticity of required pasture land per person to years of schooling= -1.187 Units: Dmnl

elasticity of schooling on labor= 0.25 Units: Dmnl

elasticity of services investment to pc gdp= 0.25 Units: Dmnl

elasticity of soil quality on fertilizer use= 0.1 Units: Dmnl

elasticity of soil quality to chemical fertilizer use= -0.12 Units: Dmnl

elasticity of soil quality to organic fertilizer use= 0.05 Units: Dmnl

elasticity of technology on industry tfp= 0.85 Units: Dmnl

elasticity of total travel volume to population= 0.1 Units: Dmnl

elasticity of travel volume to gdp= 0.9 Units: Dmnl

elasticity of treated wastewater reused to water availability= 0.01 Units: Dmnl

elasticity of wastewater produced to relative pc disposable income= 0.01 Units: Dmnl

elasticity of water stress= 0.2 Units: Dmnl

Elasticity of World Coal Price on Demand Supply Ratio= 0.4 Units: Dmnl

Elasticity of World Coal Price on recoverable reserve demand ratio= 0.6 Units: Dmnl

Elasticity of World Natural Gas Price on Demand Supply Ratio= 0.01 Units: Dmnl

elasticity of yield to chemical fertilizer= 0.05 Units: Dmnl

elasticity of yield to labor= 0.4 Units: Dmnl

elasticity of yield to organic fertilizer= 0.05 Units: Dmnl

"elasticity of yield to R&D"= 0.18 Units: Dmnl

elasticity of yield to soil quality= 0.25 Units: Dmnl

elasticity solid biomas demand to poverty= 0.01 Units: dmnl

elasticity to water= 0.325 Units: Dmnl

Electricity capacity from Biomass time series([(1900,0)-(2025,1e+010)],(1992,0),(1993,0),(1994,0),(1995,0),(1996,0),(1997,0),(1998,0),(1999,0),(2001,0),(2008,0),(2025,37000)) Units: kWh/Year

electricity co2 emission= electricity energy consumption ag*CO2 EMISSION FACTORS[electricity]*ktoe to mtoe Units: mtoe/Year

electricity coal demand in QDBTU= coal energy electricity generation in bkwh/QDBTU to BKWH Units: qdbtu/Year

electricity consumption= total industrial power demand+other power demand+residential power demand+ commercial power demand Units: GWh/Year

electricity consumption from building= Captured energy demand for buildings+Heat demand for buildings+Nuclear demand for buildings Units: Tj/Year

electricity consumption from clothing= Captured energy demand for clothing+Heat demand for clothing+Nuclear demand for clothing Units: Tj/Year

electricity consumption from plastic= Captured energy demand for plastic+Heat demand for plastic+Nuclear demand for plastic Units: Tj/Year

electricity consumption from vehicles= Captured energy demand for vehicles+Heat demand for vehicles+Nuclear demand for vehicles Units: Tj/Year

electricity demand over supply= (TOTAL electricity demand accounting for distribution losses)/total electricity generation Units: Dmnl

electricity emission factor= 0.608 Units: Kg/kWh

electricity energy consumption ag= (agriculture electricity demand*QDBTU to MB(Time))/ktoe to MB Units: ktoe/Year

electricity from biomass= electricity from biomass production*electricity from biomass production ratio Units: kWh/Year

electricity from biomass cofiring existing plant= coal energy electricity generation*share of biomass cofiring in exisiting plants *share of selected coal power plants for bimass cofiring Units: kWh/Year

electricity from biomass cofiring existing plant investment= electricity from biomass cofiring existing plant investment time series(Time) *biomass cofiring adjustment Units: usd15/Year/Year

electricity from biomass cofiring existing plant investment time series([(0,0)-(2000,10)],(1970,0),(2000,0)) Units: usd15/Year

electricity from biomass cofiring existing plant total investment= INTEG (electricity from biomass cofiring existing plant investment, 0) Units: usd15/Year

electricity from biomass cofiring new plant= organic waste used in electricity generation from organic waste new plant* kwh per ton of waste Units: kWh/Year

electricity from biomass cofiring new plant capacity= electricity from biomass cofiring new plant total investment*investment effect on electricity from biomass cofiring new plant *electricity from biomass cofiring new plant efficiency time series Units: kWh/Year

electricity from biomass cofiring new plant capacity factor= 0 Units: Dmnl

electricity from biomass cofiring new plant efficiency time series:= 1 Units: USD/Year

electricity from biomass cofiring new plant investment= electricity from biomass cofiring new plant investment time series(Time)/time delay for electricity from biomass cofiring new plant Units: usd15/Year/Year

electricity from biomass cofiring new plant investment time series([(0,0)-(2000,10)],(1970,0),(2000,0)) Units: usd15/Year

electricity from biomass cofiring new plant total investment= INTEG (electricity from biomass cofiring new plant investment, 0) Units: usd15/Year

electricity from biomass investment= electricity from biomass investment time series(Time)/time delay for electricity from biomass existing plant investment Units: usd15/Year/Year

electricity from biomass investment time series([(0,0)-(2000,10)],(1970,0),(2000,0)) Units: usd15/Year

electricity from biomass plant capacity= electricity from biomass total investment*investment effect on electricity from biomass Units: kWh/Year

electricity from biomass plant capacity factor= 0 Units: Dmnl

electricity from biomass production= electricity from biomass plant capacity*electricity from biomass plant capacity factor Units: Ton/Year

electricity from biomass production ratio= 0.6 Units: kWh/Ton

electricity from biomass total investment= INTEG (electricity from biomass investment, 0) Units: usd15/Year

electricity from LFG= min(landfill gas power capacity use*1000, LFG for Electricity*LFG to electricity) Units: kWh/Year

electricity from LFG capacity= electricity from LFG total investment*investment effect of electricity from LFG Units: kWh/Year

electricity from LFG investment= electricity from LFG investment time series(Time)/time delay for electricity from LFG investment Units: usd15/Year/Year

electricity from LFG investment time series([(0,0)-(2000,10)],(1970,0),(2000,0)) Units: usd15/Year

electricity from LFG total investment= INTEG (electricity from LFG investment, 0) Units: usd15/Year

electricity gas demand in QDBTU= gas turbine energy electricity generation in bkwh/QDBTU to BKWH Units: qdbtu/Year

electricity generation rate[DIESEL AND FUEL OIL]= (diseal and fuel oil energy electricity generation*GWh to TJ)*mwh per tj electricity generation rate[COGENERATION]= ("co-generation energy electricity generation"*GWh to TJ)*mwh per tj electricity generation rate[GAS TURBINE]= (gas turbine energy electricity generation*GWh to TJ)*mwh per tj electricity generation rate[coal power]= (coal energy electricity generation*GWh to TJ)*mwh per tj electricity generation rate[nuclear]= (nuclear energy electricity generation*GWh to TJ)*mwh per tj electricity generation rate[BIOMASS]= 0 electricity generation rate[HYDROPOWER LARGE SCALE]= (hydro electricity generation*GWh to TJ)*mwh per tj electricity generation rate[HYDROPOWER SMALL SCALE]= 0 electricity generation rate[SOLAR LARGE SCALE]= (solar electricity generation*GWh to TJ)*mwh per tj electricity generation rate[SOLAR SMALL SCALE]= 0 electricity generation rate[WIND ONSHORE]= (wind electricity generation*GWh to TJ)*mwh per tj electricity generation rate[WIND OFFSHORE]= 0 electricity generation rate[WASTE GENERATION]= (waste energy electricity generation*GWh to TJ)*mwh per tj electricity generation

rate[GEOTHERMAL]= (geothermal electricity generation*GWh to TJ)*mwh per tj Units: MW*hr/Year

electricity petroleum demand in QDBTU= diseal and fuel oil energy electricity generation in bkwh/QDBTU to BKWH Units: qdbtu/Year

electricity price= electricity price table Units: usd15/kWh

electricity price per Mbtu= real Electricity Price per mbtu*gdp deflator Units: USD/Mbtu

Electricity Price Substitutability= DELAY N((relative electricity price /Relative Weighted Average Energy Price), 1,1, 1) Units: Dmnl

electricity price table Units: usd15/kWh

"Electricity, Gas and Water supply employment"= total employment*sectoral distribution of employment[egw] Units: Person

electrification switch= if then else(IEA NET ZERO SWITCH=1,Ambition on electrification,0) Units: Dmnl

emerging fraction of ground water= 0.05 Units: Dmnl/Year

emission from electricity consumption= (world electricity final consumption in mb*mb to TJ)*average emissions per tj of electricity generation Units: Ton/Year

emission reduction through waste use per year= usable waste in short tons*co2 equivalents per short ton land filled waste Units: Ton/Year

emissions from coal consumotion= (mb to TJ*world coal final consumption in mb)*coal GHG emission coefficient Units: Ton/Year

emissions from land fills= (remaining waste in Landfill/ton per short ton)*co2 equivalents per short ton land filled waste Units: Ton/Year

emissions from natural gas consumption= (mb to TJ*world natural gas final consumption in mb)*natural gas GHG emission coefficient Units: Ton/Year

emissions from oil consumption= ((world oil final consumption in mb-oil demand for power generation in mb) *mb to TJ)*petroleum GHG emission coefficient Units: Ton/Year

emissions from renewable resources consumption= (mb to TJ*renewable resources GHG emission coefficient)*world renewable resources final consumption in mb Units: Ton/Year

emissions per GWh of coal power generation= 980 Units: Ton/GWh

emissions per GWh of gas power generation= 553 Units: Ton/GWh

emissions per GWh of liquid fuel power generation= 594.397 Units: Ton/GWh

Employee skill level: High, Middle, Low

employment created per person walking and cycling= 0.001 Units: Dmnl

employment distribution: AGr, con, FIS, for, INDt, oge, tou, hor, tsc, tlt, egw, sds, wcd

employment for energy provisioning= (cobalt energy consumption+copper energy consumption+lithium energy consumption +nickel energy consumption)*employment per unit of energy consumed Units: Person/Year

employment for extraction= total extraction rate*employment per unit produced Units: Person/Year

employment for water provisioning= (cobalt water consumption+copper water consumption+lithium water consumption +nickel water consumption)*employment per unit of water consumed Units: Person/Year

employment from private car use urban= total private cars urban*Persons employed per car Units: Person/Year

employment from public transport use urban= public transport users population*Employment per person using public transport Units: Person/Year

employment from walking and cycling= employment created per person walking and cycling*walking and cycling population Units: Person/Year

employment per gender in building sector[sex]= Sale of buildings*gendered employment per building[sex](Time) Units: Person/Year

employment per gender in clothing sector[sex]= Sale of clothing*gendered employment per clothing[sex](Time) Units: Person/Year

employment per gender in plastic sector[sex]= Sale of plastic*gendered employment per plastic[sex](Time) Units: Person/Year

employment per gender in vehicle sector[sex]= Sale of vehicle*gendered employment per vehicle[sex](Time) Units: Person/Year

Employment per person using public transport= 0.0170091 Units: Dmnl

employment per skill level in the building sector[Employee skill level]= skill level employment per building[Employee skill level](Time)*Sale of buildings Units: people/Year

employment per skill level in the clothing sector[Employee skill level]= skill level employment per clothing[Employee skill level](Time)*Sale of clothing Units: people/Year

employment per skill level in the plastic sector[Employee skill level]= skill level employment per plastic[Employee skill level](Time)*Sale of plastic Units: people/Year

employment per skill level in the vehicle sector[Employee skill level]= skill level employment per vehicle[Employee skill level](Time)*Sale of vehicle Units: people/Year

employment per unit of energy consumed= 0.00115744 Units: Person/Tj

employment per unit of water consumed= 0 Units: Person/liter

employment per unit produced= 0.012 Units: Person/Ton

employment per vessel= 1.75 Units: Person/vessel

EMPLOYMENT RATE= total employment/total population Units: 1

employment ratio= total employment/labor supply Units: Dmnl

employment to be relocated= employment per vessel*vessels to redraw due to buyback program Units: Person/Year

ENERGY: electricity, distillate fuel, natural gas, residual fuel, lpg, coal energy , coke

energy bill= DELAY FIXED (cost of electricity+cost of coal+cost of natural gas+cost of oil,0.5,1.82e+011) Units: USD/Year

energy bill as a share of nominal GDP= energy bill/nominal GDP Units: 1

energy bill as share of total real gdp= energy bill in USD/real gross domestic product Units: Dmnl

energy bill in USD= energy bill Units: USD/Year

energy carbon intensity= 0.216*277.778 Units: TonCO2e/Tj

"energy consumption per unit (extraction and processing)"= 10/1000 Units: Tj/Ton

energy demand initial trend demand= -0.009 Units: qdbtu/Year

energy demand perceived condition change= (total energy demand-energy demand perceived present condition)/time to perceive present condition Units: qdbtu/Year*Year

energy demand perceived present condition= INTEG (energy demand perceived condition change, total energy demand/(1+time to perceive present condition*energy demand initial trend demand)) Units: qdbtu/Year

energy demand reference condition= INTEG (energy demand reference condition change, energy demand perceived present condition/(1+time to adjust energy demand reference condition *energy demand initial trend demand)) Units: qdbtu/Year

energy demand reference condition change= (energy demand perceived present condition-energy demand reference condition)/time to adjust energy demand reference condition Units: qdbtu/Year/Year

energy demand reference trend= (energy demand perceived present condition-energy demand reference condition)/(energy demand reference condition*time to adjust energy demand reference condition) Units: 1/Year

energy demand trend= INTEG (energy demand trend change, energy demand initial trend demand) Units: 1/Year

energy demand trend change= (energy demand reference trend-energy demand trend)/time to perceive energy demand trend Units: 1/Year/Year

energy efficiency BAU([(1970,0.9)-(2050,2)],(1970,1),(1990,1),(2010,1),(2020,1.2),(2040,1.4),(2050 ,1.5)) Units: Dmnl

energy efficiency constrained ambition([(2010,0)-(2050,3)],(2010,1),(2011,1.02),(2012,1.04),(2013,1.06),(2014,1.08),(2015,1.1),(2016,1.12),(2017,1.14),(2018,1.16),(2019,1.18),(2020,1.2),(2021 ,1.21),(2022,1.22),(2023,1.23),(2024,1.24),(2025,1.25),(2026,1.26),(2027,1.28772),(2028,1.31605),(2029,1.345),(2030,1.37459),(2031,1.40483),(2032,1.43574), (2033,1.46733),(2034,1.49961),(2035,1.5326),(2036,1.56632),(2037,1.60078),(2038,1.63599),(2039,1.67198),(2040,1.70877),(2041,1.74636),(2042,1.78478),(2043,1.82405),(2044,1.86417),(2045,1.90519),(2046,1.9471),(2047,1.98994),(2048 ,2.03372),(2049,2.07846),(2050,2.12418)) Units: Dmnl

energy efficiency high ambition([(2010,0)-(2050,4)],(2010,1),(2011,1.02),(2012,1.04),(2013,1.06),(2014,1.08),(2015,1.1),(2016,1.12),(2017,1.14),(2018,1.16),(2019,1.18),(2020,1.2),(2021 ,1.21),(2022,1.22),(2023,1.23),(2024,1.24),(2025,1.25),(2026,1.26),(2027,1.31544),(2028,1.37332),(2029,1.43375),(2030,1.49683),(2031,1.56269),(2032,1.63145),(2033,1.70323),(2034,1.77818),(2035,1.85641),(2036,1.9381),(2037,2.02337) ,(2038,2.1124),(2039,2.20535),(2040,2.30238),(2041,2.40369),(2042,2.50945), (2043,2.61987),(2044,2.73514),(2045,2.85549),(2046,2.98113),(2047,3.1123),(2048,3.24924),(2049,3.3922),(2050,3.54146)) Units: Dmnl

Energy efficiency in building construction= INTEG (change in ee for buildings, 1) Units: Dmnl

Energy efficiency in clothing manufacturing= INTEG (change in ee for clothing, 1) Units: Dmnl

Energy efficiency in plastic manufacturing= INTEG (change in ee for plastic, 1) Units: Dmnl

Energy efficiency in vehicle manufacturing= INTEG (change in ee for vehicles, 1) Units: Dmnl

energy efficiency jobs= WITH LOOKUP (Time, ([(1000,0)-(2050,1.5e+006)],(1970,0),(2030,0))) Units: Person/Year

energy efficiency jobs factor= 0.38 Units: Person/GWh

energy efficiency low ambition([(2010,0.9)-(2050,2)],(2010,1),(2011,1.02),(2012,1.04),(2013,1.06),(2014,1.08),(2015,1.1),(2016,1.12),(2017,1.14),(2018,1.16),(2019,1.18),(2020,1.2),(2021,1.21),(2022,1.22),(2023,1.23),(2024,1.24),(2025,1.25),(2026,1.26),(2027,1.27386),(2028,1.28787),(2029,1.30204),(2030,1.31636),(2031,1.33084),(2032,1.34548),(2033,1.36028),(2034,1.37524),(2035,1.39037),(2036,1.40567),(2037,1.42113),(2038,1.43676),(2039,1.45256),(2040,1.46854),(2041,1.4847),(2042,1.50103),(2043,1.51754),(2044,1.53423),(2045,1.55111),(2046,1.56817),(2047,1.58542),(2048,1.60286),(2049,1.62049),(2050,1.63832)) Units: Dmnl

energy efficiency ratio from green investment industry= industry abatenment/indicated total industry co2 emissions Units: Dmnl

energy efficiency switch= if then else(S3 energy efficiency SWITCH=3:OR:CE policy switch=3,EE HA, if then else(S3 energy efficiency SWITCH=2:OR:CE policy switch=2,EE CA, if then else(S3 energy efficiency SWITCH=1:OR:CE policy switch=1,EE LA,EE BAU))) Units: Dmnl

energy employment= biofuel employment+coal extraction employment+gas extraction employment+oil extraction employment +total power employment no fuel Units: Person

energy green investment= (green economy investment*energy green investment fraction(Time))+residual forest investment to energy Units: usd15/Year

energy green investment fraction([(2011,0)-(2050,0.6)],(2011,0.7),(2050,0.7)) Units: Dmnl

energy recovery of waste cost= treatment cost of energy recovery cost per ton*waste for energy recovery Units: USD/Year

energy recovery waste= INTEG (waste for energy recovery-use of waste for energy generation, 5.85e+009) Units: Ton

energy sectors: residential, commercial, industrial, transportation, electric

energy type: gasoline power, diesel, biodiesel, ethanol, hydrogen, CNG, lpg, electricity , jet fuel, residual fuel, distillate fuel, natural gas, coal energy, coke

enrolment rate index= (NET ENROLMENT RATE FRACTION-min primary enrolment rate)/(max primary enrolment rate -min primary enrolment rate) Units: 1

estimated cost of pesticide= INITIAL(60) Units: 1

estimated forest tree value= INITIAL(value added forestry(Time)) Units: usd15/Ha

estimated pesticide increase from new green investment= pest control investment/estimated cost of pesticide Units: Ton/Year

ethanol emissions factor= 0.88 Units: Dmnl

evaporation per hectare per degree per year= 7.5e-006 Units: Km3/Year/Ha/c

EVs in use= INTEG (reusing of EVs+sale of EVs-Discard of EVs, initial EVs in use) Units: vehicle

ewaste: erecycle, elandfill

EXOGENOUS CCS CAPACITY= WITH LOOKUP (Time, ([(2020,0)-(2050,1)],(2020,0),(2026,0),(2030,0.309),(2035,0.531),(2040,0.65),(2050,1))) Units: Dmnl

exogenous coal price= WITH LOOKUP (Time, ([(1980,0)-(2030,400)],(1980,42.935),(1981,50.818),(1982,54.768),(1983,38.188),(1984,30.958),(1985,33.75),(1986,31.125),(1987,27.5),(1988,34.875),(1989, 38),(1990,39.667),(1991,39.667),(1992,38.563),(1993,31.333),(1994,32.3),(1995 ,39.372),(1996,38.074),(1997,35.099),(1998,29.231),(1999,25.892),(2000,26.25),(2001,32.313),(2002,27.06),(2003,27.954),(2004,56.73),(2005,50.816),(2006 ,52.731),(2007,70.089),(2008,138.024),(2009,76.16),(2010,104.599),(2011,129.607),(2012,101.443),(2013,90.134),(2014,75.729),(2015,62.693),(2016,70.082),(2017 ,94.138),(2018,113.231),(2019,82.193),(2020,61.983),(2024,143.551),(2026,129.955),(2027,128.849),(2028,128.92),(2029,129.104),(2030,129.297))) Units: USD/Ton

exogenous electricity price= 0.157149 Units: USD/kWh

exogenous natural gas price= WITH LOOKUP (Time, ([(1985,0)-(2030,40)],(1985,3.81),(1986,3.44),(1987,2.13),(1988,1.9),(1989 ,1.589),(1990,2.035),(1991,3.008),(1992,2.365),(1993,2.598),(1994,2.312),(1995 ,2.696),(1996,2.75),(1997,2.67),(1998,2.245),(1999,1.807),(2000,3.454),(2001 ,3.873),(2002,2.666),(2003,3.486),(2004,3.755),(2005,5.915),(2006,8.213),(2007 ,8.143),(2008,13.138),(2009,8.855),(2010,8.223),(2011,10.597),(2012,11.981) ,(2013,11.189),(2014,10.463),(2015,7.305),(2016,4.353),(2017,5.744),(2018,7.916

),(2019,4.455),(2020,3.178),(2023,12.883),(2024,10.891),(2025,12.511),(2026
,10.69),(2027,9.058),(2028,8.073),(2029,7.75),(2030,7.847))) Units: USD/mmbtu

exogenous oil price= WITH LOOKUP (Time, ([(1980,0)-
(2030,400)],(1980,42.935),(1981,50.818),(1982,54.768),(1983,38.188
),(1984,30.958),(1985,33.75),(1986,31.125),(1987,27.5),(1988,34.875),(1989,
38),(1990,39.667),(1991,39.667),(1992,38.563),(1993,31.333),(1994,32.3),(1995
,39.372),(1996,38.074),(1997,35.099),(1998,29.231),(1999,25.892),(2000,26.25
),(2001,32.313),(2002,27.06),(2003,27.954),(2004,56.73),(2005,50.816),(2006
,52.731),(2007,70.089),(2008,138.024),(2009,76.16),(2010,104.599),(2011,129.607
),(2012,101.443),(2013,90.134),(2014,75.729),(2015,62.693),(2016,70.082),(2017
,94.138),(2018,113.231),(2019,82.193),(2020,61.983),(2021,143.985),(2024,143.551
),(2025,116.364),(2026,129.955),(2027,128.849),(2028,128.92),(2029,129.104)
,(2030,129.297))) Units: USD/Barrel

Exogenous real gross domestic product= WITH LOOKUP (Time, ([(1970,0)-
(2080,6e+014)],(1970,1.95704e+013),(1971,2.01746e+013),(1972,2.07974e+013
),(1973,2.14395e+013),(1974,2.21014e+013),(1975,2.27838e+013),(1976,2.34872e+013
),(1977,2.42123e+013),(1978,2.49598e+013),(1979,2.57304e+013),(1980,2.65248e+013
),(1981,2.70397e+013),(1982,2.71353e+013),(1983,2.78493e+013),(1984,2.91519e+013
),(1985,3.02333e+013),(1986,3.12112e+013),(1987,3.2383e+013),(1988,3.3857e+013
),(1989,3.51181e+013),(1990,3.60745e+013),(1991,3.65137e+013),(1992,3.72551e+013
),(1993,3.79434e+013),(1994,3.92143e+013),(1995,4.04325e+013),(1996,4.1884e+013
),(1997,4.35422e+013),(1998,4.47839e+013),(1999,4.63944e+013),(2000,4.85017e+013
),(2001,4.94912e+013),(2002,5.0645e+013),(2003,5.22196e+013),(2004,5.45617e+013
),(2005,5.67652e+013),(2006,5.93033e+013),(2007,6.19041e+013),(2008,6.3188e+013
),(2009,6.23542e+013),(2010,6.5177e+013),(2011,6.73587e+013),(2012,6.91823e+013
),(2013,7.1181e+013),(2014,7.34222e+013),(2015,7.57236e+013),(2016,7.78548e+013
),(2017,8.05457e+013),(2018,8.32006e+013),(2019,8.54553e+013),(2020,8.30206e+013
),(2021,8.83502e+013),(2022,9.13187e+013),(2023,9.40065e+013),(2024,9.66981e+013
),(2025,9.95941e+013),(2026,1.02577e+014),(2027,1.05649e+014),(2028,1.08813e+014
),(2029,1.12072e+014),(2030,1.15428e+014),(2031,1.18885e+014),(2032,1.22446e+014
),(2033,1.26113e+014),(2034,1.2989e+014),(2035,1.3378e+014),(2036,1.37786e+014
),(2037,1.41913e+014),(2038,1.46163e+014),(2039,1.5054e+014),(2040,1.55049e+014
),(2041,1.59693e+014),(2042,1.64475e+014),(2043,1.69401e+014),(2044,1.74474e+014
),(2045,1.797e+014),(2046,1.85082e+014),(2047,1.90624e+014),(2048,1.96333e+014
),(2049,2.02213e+014),(2050,2.0827e+014),(2051,2.14507e+014),(2052,2.20931e+014
),(2053,2.27548e+014),(2054,2.34363e+014),(2055,2.41382e+014),(2056,2.48611e+014
),(2057,2.56056e+014),(2058,2.63725e+014),(2059,2.71623e+014),(2060,2.79758e+014
),(2061,2.88136e+014),(2062,2.96766e+014),(2063,3.05654e+014),(2064,3.14808e+014
),(2065,3.24236e+014),(2066,3.33946e+014),(2067,3.43948e+014),(2068,3.54248e+014
),(2069,3.64858e+014),(2070,3.75785e+014),(2071,3.87039e+014),(2072,3.98631e+014
),(2073,4.10569e+014),(2074,4.22865e+014),(2075,4.3553e+014),(2076,4.48573e+014

),(2077,4.62008e+014),(2078,4.75844e+014),(2079,4.90095e+014),(2080,5.04773e+014))) Units: usd15/Year

expected total water consumption reduction from green invesstment= TOTAL WATER consumption*indicated fraction of water consumption reduction from efficiency Units: Km3/Year

fat per person per day= DELAY N(total fat consumed/total population/days in one year, 2, total fat consumed /total population/days in one year,1) Units: gr/Person/day

fat per ton of food vegetables= 45302.3 Units: gr/Ton

fat per ton of meat= 205786 Units: gr/Ton

female life expectancy index= life expectancy[FEMALE]-27.5/87.5-27.5 Units: Dmnl

fertilizer: chemical, organic

fertilizer co2 emission= (chemical fertilizer use*fertilizer co2 emission factor)/ton to mtoe Units: mtoe/Year

fertilizer co2 emission factor= 0.5 Units: Ton/Ton

fertilizer consumption= initial fertilizer*effect of harvested area on fertilizer use Units: Ton/Year

fertilizer consumption per ha= fertilizer consumption/Harvested area Units: Ton/Ha

fertilizer consumption per ha in liters or kg= fertilizer consumption per ha*1000 Units: Ton/Ha

fertilizer cost difference per ha= fertilizer consumption per ha in liters or kg*fertilizer cost difference per liter or kg Units: usd15/Ha

fertilizer cost difference per liter or kg= cost difference/1000 Units: usd15/Ton

fertilizer use by type[chemical]= fertilizer consumption*fraction of chemical fertilizer use
fertilizer use by type[organic]= (1-fraction of chemical fertilizer use)*fertilizer consumption Units: Ton/Year

FF GHG emissions in ton= DELAY FIXED (ind fossil fuel GHGas emissions in Tons,0.5,2.9e+009) Units: Ton/Year

FINAL TIME = 2050 Units: Year

first gen employment factor= 7.93e-006 Units: Person/Ige

fish age: newborn,FISHYR0,fishyr1, fishyr2, fishyr3, fishyr4, fishyr5, fishyr6, fishyr7 , fishyr8, fishyr9, fishyr10, fishyr11, fishyr12, fishyr13, fishyr14, fishyr15

fish age specific fertility distribution[spawning]= fish age specific fertility distribution table(spawning) Units: dmml

fish age specific fertility distribution table([(2,0)-(15,0.1)],(2,0.0611995),(3,0.0636475),(4,0.0673195),(5,0.0734394),(6,0.0734394),(7,0.0734394),(8,0.0734394),(9,0.0734394),(10,0.0734394),(11,0.0734394),(12,0.0734394),(13,0.0734394),(14,0.0734394),(15,0.0734394)) Units: Dmnl

fish babies[FISHSEX]= (recruitment-juvenile predation)*fish sex ratio[FISHSEX] Units: Ton/Year

fish catch= min(total fish stock, CATCH PER UNIT vessel*vessel capacity) Units: Ton/Year

fish eggs= fish fertility rate*SUM(spawning stock[spawning!]*fish age specific fertility distribution [spawning!])+management effect on fish stock Units: Ton/Year

fish fertility rate= 0.5 Units: Ton/Year

fish harvest[FISHSEX, fishyr15]= min(FISH STOCK[FISHSEX,fishyr15],MAX(0, fish catch*catch sex ratio[FISHSEX])) fish harvest[FISHSEX,fishyr14]= min(FISH STOCK[FISHSEX,fishyr14], MAX(0, fish catch*catch sex ratio[FISHSEX]-fish harvest[FISHSEX, fishyr15])) fish harvest[FISHSEX,fishyr13]= min(FISH STOCK[FISHSEX,fishyr13], MAX(0, fish catch*catch sex ratio[FISHSEX]-fish harvest[FISHSEX, fishyr14]-fish harvest[FISHSEX, fishyr15])) fish harvest[FISHSEX,fishyr12]= min(FISH STOCK[FISHSEX,fishyr12], MAX(0,fish catch*catch sex ratio[FISHSEX]-fish harvest[FISHSEX, fishyr13]-fish harvest[FISHSEX, fishyr14]-fish harvest [FISHSEX, fishyr15])) fish harvest[FISHSEX,fishyr11]= min(FISH STOCK[FISHSEX,fishyr11], MAX(0,fish catch*catch sex ratio[FISHSEX]-fish harvest[FISHSEX, fishyr12]-fish harvest[FISHSEX, fishyr13]-fish harvest [FISHSEX, fishyr14]-fish harvest[FISHSEX, fishyr15])) fish harvest[FISHSEX,fishyr10]= min(FISH STOCK[FISHSEX,fishyr10], MAX(0,fish catch*catch sex ratio[FISHSEX]-fish harvest[FISHSEX, fishyr11]-fish harvest[FISHSEX, fishyr12]-fish harvest [FISHSEX, fishyr13]-fish harvest[FISHSEX, fishyr14]-fish harvest[FISHSEX, fishyr15])) fish harvest[FISHSEX,fishyr9]= min(FISH STOCK[FISHSEX,fishyr9], MAX(0,fish catch*catch sex ratio[FISHSEX]-fish harvest[FISHSEX, fishyr10]-fish harvest[FISHSEX, fishyr11]-fish harvest [FISHSEX, fishyr12]-fish harvest[FISHSEX, fishyr13]-fish harvest[FISHSEX, fishyr14]-fish harvest[FISHSEX, fishyr15])) fish harvest[FISHSEX,fishyr8]= min(FISH STOCK[FISHSEX,fishyr8],MAX (0,fish catch*catch sex ratio[FISHSEX]-fish harvest[FISHSEX, fishyr9]-fish harvest[FISHSEX, fishyr10]-fish harvest [FISHSEX, fishyr11]-fish harvest[FISHSEX, fishyr12]-fish harvest[FISHSEX, fishyr13]-fish harvest[FISHSEX, fishyr14])-fish harvest[FISHSEX, fishyr15]) fish

harvest[FISHSEX,fishyr7]= min(FISH STOCK[FISHSEX,fishyr7], MAX(0,fish catch*catch sex ratio[FISHSEX]-fish harvest[FISHSEX, fishyr8]-fish harvest[FISHSEX, fishyr9]-fish harvest [FISHSEX, fishyr10]-fish harvest[FISHSEX, fishyr11]-fish harvest[FISHSEX, fishyr12]-fish harvest[FISHSEX, fishyr13]-fish harvest[FISHSEX, fishyr14]- fish harvest[FISHSEX, fishyr15])) fish harvest[FISHSEX,fishyr6]= min(FISH STOCK[FISHSEX,fishyr6], MAX(0,fish catch*catch sex ratio[FISHSEX]-fish harvest[FISHSEX, fishyr7]-fish harvest[FISHSEX, fishyr8]-fish harvest [FISHSEX, fishyr9]-fish harvest[FISHSEX, fishyr10]-fish harvest[FISHSEX, fishyr11]-fish harvest[FISHSEX, fishyr12]-fish harvest[FISHSEX, fishyr13]-fish harvest [FISHSEX, fishyr14]-fish harvest[FISHSEX, fishyr15])) fish harvest[FISHSEX,fishyr5]= min(FISH STOCK[FISHSEX,fishyr5], MAX(0,fish catch*catch sex ratio[FISHSEX]-fish harvest[FISHSEX, fishyr6]-fish harvest[FISHSEX, fishyr7]-fish harvest [FISHSEX, fishyr8]-fish harvest[FISHSEX, fishyr9]-fish harvest[FISHSEX, fishyr10]-fish harvest[FISHSEX, fishyr11]-fish harvest[FISHSEX, fishyr12]-fish harvest [FISHSEX, fishyr13]-fish harvest[FISHSEX, fishyr14]-fish harvest[FISHSEX, fishyr15])) fish harvest[FISHSEX,fishyr4]= min(FISH STOCK[FISHSEX,fishyr4], MAX(0,fish catch*catch sex ratio[FISHSEX]-fish harvest[FISHSEX, fishyr5]-fish harvest[FISHSEX, fishyr6]-fish harvest [FISHSEX, fishyr7]-fish harvest[FISHSEX, fishyr8]-fish harvest[FISHSEX, fishyr9]-fish harvest[FISHSEX, fishyr10]-fish harvest[FISHSEX, fishyr11]-fish harvest [FISHSEX, fishyr12]-fish harvest[FISHSEX, fishyr13]-fish harvest[FISHSEX, fishyr14]-fish harvest[FISHSEX, fishyr15])) fish harvest[FISHSEX,fishyr3]= min(FISH STOCK[FISHSEX,fishyr3], MAX(0,fish catch*catch sex ratio[FISHSEX]-fish harvest[FISHSEX, fishyr4]-fish harvest[FISHSEX, fishyr5]-fish harvest [FISHSEX, fishyr6]-fish harvest[FISHSEX, fishyr7]-fish harvest[FISHSEX, fishyr8]-fish harvest[FISHSEX, fishyr9]-fish harvest[FISHSEX, fishyr10]-fish harvest [FISHSEX, fishyr11]-fish harvest[FISHSEX, fishyr12]-fish harvest[FISHSEX, fishyr13]-fish harvest[FISHSEX, fishyr14]-fish harvest[FISHSEX, fishyr15])) fish harvest[FISHSEX,fishyr2]= min(FISH STOCK[FISHSEX,fishyr2], MAX(0,fish catch*catch sex ratio[FISHSEX]-fish harvest[FISHSEX, fishyr3]-fish harvest[FISHSEX, fishyr4]-fish harvest [FISHSEX, fishyr5]-fish harvest[FISHSEX, fishyr6]-fish harvest[FISHSEX, fishyr7]-fish harvest[FISHSEX, fishyr8]-fish harvest[FISHSEX, fishyr9]-fish harvest [FISHSEX, fishyr10]-fish harvest[FISHSEX, fishyr11]-fish harvest[FISHSEX, fishyr12]-fish harvest[FISHSEX, fishyr13]-fish harvest[FISHSEX, fishyr14]- fish harvest[FISHSEX, fishyr15])) fish harvest[FISHSEX,fishyr1]= min(FISH STOCK[FISHSEX,fishyr1], MAX(0,fish catch*catch sex ratio[FISHSEX]-fish harvest[FISHSEX, fishyr2]-fish harvest[FISHSEX, fishyr3]-fish harvest [FISHSEX, fishyr4]-fish harvest[FISHSEX, fishyr5]-fish harvest[FISHSEX, fishyr6]-fish harvest[FISHSEX, fishyr7]-fish harvest[FISHSEX, fishyr8]-fish harvest [FISHSEX, fishyr9]-fish harvest[FISHSEX, fishyr10]-fish harvest[FISHSEX, fishyr11]-fish harvest[FISHSEX, fishyr12]-fish harvest[FISHSEX, fishyr13]-fish harvest [FISHSEX, fishyr14]-fish harvest[FISHSEX, fishyr15])) fish harvest[FISHSEX,FISHYR0]= min(FISH STOCK[FISHSEX,FISHYR0], (fish catch*catch sex ratio[FISHSEX]-fish harvest [FISHSEX, fishyr1]-fish harvest[FISHSEX, fishyr2]-fish harvest[FISHSEX, fishyr3]-fish

harvest[FISHSEX, fishyr4]-fish harvest[FISHSEX, fishyr5]-fish harvest [FISHSEX, fishyr6]-fish harvest[FISHSEX, fishyr7]-fish harvest[FISHSEX, fishyr8]-fish harvest[FISHSEX, fishyr9]-fish harvest[FISHSEX, fishyr10]-fish harvest [FISHSEX, fishyr11]-fish harvest[FISHSEX, fishyr12]-fish harvest[FISHSEX, fishyr13]-fish harvest[FISHSEX, fishyr14]-fish harvest[FISHSEX, fishyr15])) Units: Ton/Year

fish production= fish catch*fish value added Units: usd15/Year

fish sex ratio[FISH FEMALE]= 0.5 fish sex ratio[FISH MALE]= 0.5 Units: Dmnl

FISH STOCK[FISHSEX, newborn]= INTEG (fish babies[FISHSEX], INITIAL FISH STOCK[FISHSEX, newborn]) FISH STOCK[FISHSEX, fishage over 0]= INTEG (-(fish harvest[FISHSEX, fishage over 0]+natural death[FISHSEX, fishage over 0]), INITIAL FISH STOCK[FISHSEX,fishage over 0]) Units: Ton

FISH STOCK SHIFT[FISHSEX]= SHIFT IF TRUE(FISH STOCK[FISHSEX, newborn] , MODULO(Time,1) < TIME STEP/2, fishyr15,1,0) Units: Ton

fish value added= fish value added table(Time) Units: usd15/Ton

fish value added table([(1970,0)-(2050,5000)],(1970,1155.14),(1971,1091.8),(1972,1049.1),(1973,1038.95),(1974,1038.84),(1975,980.112),(1976,950.572),(1977,927.49),(1978,907.784),(1979,902.989),(1980,917.086),(1981,936.408),(1982,917.847),(1983,953.858),(1984,961.311),(1985,960.166),(1986,966.052),(1987,968.754),(1988,978.453),(1989,995.892),(1990,982.002),(1991,1000.96),(1992,999.197),(1993,1013.95),(1994,1015.87),(1995,1068.04),(1996,1092.67),(1997,1127.41),(1998,1176.93),(1999,1219.22),(2000,1241.55),(2001,1266.15),(2002,1305.13),(2003,1370.86),(2004,1432.35),(2005,1475.25),(2006,1547.65),(2007,1587.83),(2008,1575.07),(2009,1655.16),(2010,1722.79),(2011,1788.34),(2012,1865.13),(2013,1954.93),(2014,2053.08),(2015,2153.28),(2016,2275.94),(2017,2405.04),(2018,2529.92),(2019,2519.79),(2020,2751.58),(2021,2878.92),(2022,3000.09),(2050,5000)) Units: usd15/Ton

fishage over 0: (FISHYR0-fishyr15)

fisheries employees relocation cost= employment to be relocated*average cost of worker relocation Units: usd15/Year

fisheries employment relocation investment= fisheries employees relocation cost Units: usd15/Year

fisheries green investment= green economy investment*fisheries green investment fraction(Time) Units: usd15/Year

fisheries green investment fraction([(2011,0)-(2050,0.3)],(2011,0),(2050,0)) Units: Dmnl

fisheries management investment= MAX(0, fisheries green investment-fisheries employment relocation investment -vessel buyback investment) Units: usd15/Year

fishery switch= 0 Units: Dmnl

Fishing coal demand= DELAY N((indicated Fishing coal demand 0*Coal Price Substitutability^Fishing elasticity of coal demand to coal price), time to adapt demand to price changes,(indicated Fishing coal demand 0* Coal Price Substitutability^Fishing elasticity of coal demand to coal price), 3) Units: qdbtu/Year

Fishing coal gdp intensity= normalized Fishing coal demand/real gross domestic product Units: qdbtu/usd15

Fishing elasticity of coal demand to coal price= -0.1 Units: Dmnl

Fishing elasticity of coal demand to price= 1 Units: Dmnl

Fishing elasticity of electricity demand to electricity price= -0.05 Units: Dmnl

Fishing elasticity of electricity to gdp= 0.4 Units: Dmnl

Fishing elasticity of natural gas demand to natural gas price= -0.001 Units: Dmnl

Fishing Elasticity of natural gas demand to price= 0.1 Units: Dmnl

Fishing elasticity of oil demand to price= 0.6 Units: Dmnl

Fishing elasticity of petroleum demand to oil price= -0.05 Units: Dmnl

Fishing elasticity of renewable resources demand to price= 1 Units: Dmnl

Fishing elasticity of renewable resources demand to renewable resources price = -0.3 Units: Dmnl

Fishing electricity demand= DELAY N((indicated Fishing electricity net demand 0*Electricity Price Substitutability ^Fishing elasticity of electricity demand to electricity price), time to adapt demand to price changes,(indicated Fishing electricity net demand 0 *Electricity Price Substitutability ^Fishing elasticity of electricity demand to electricity price), 3) Units: qdbtu/Year

Fishing electricity GDP Intensity= normalized Fishing electricity net demand/real gross domestic product Units: qdbtu/usd15

fishing ground footprint= initial fishing ground footprint*relative total fish stock Units: Dmnl

Fishing natural gas demand= DELAY N((indicated Fishing natural gas demand 0*Natural Gas Price Substitutability ^Fishing elasticity of natural gas demand to natural gas price),

time to adapt demand to price changes,(indicated Fishing natural gas demand 0 *Natural Gas Price Substitutability^Fishing elasticity of natural gas demand to natural gas price), 3) Units: qdbtu/Year

Fishing natural gas GDP Intensity= normalized Fishing natural gas demand/real gross domestic product Units: qdbtu/usd15

Fishing petroleum demand= DELAY N((indicated Fishing petroleum demand 0*Oil Price Substitutability ^Fishing elasticity of petroleum demand to oil price), time to adapt demand to price changes ,(indicated Fishing petroleum demand 0 *Oil Price Substitutability^Fishing elasticity of petroleum demand to oil price), 3) Units: qdbtu/Year

Fishing petroleum gdp intensity= normalized Fishing petroleum demand/real gross domestic product Units: qdbtu/usd15

Fishing renewable resources demand= DELAY N((indicated Fishing renewable resources demand 0*Renewable Resources Price Substitutability ^Fishing elasticity of renewable resources demand to renewable resources price), time to adapt demand to price changes, (indicated Fishing renewable resources demand 0 *Renewable Resources Price Substitutability ^ Fishing elasticity of renewable resources demand to renewable resources price), 3) Units: qdbtu/Year

Fishing renewable resources GDP intensity= normalized Fishing renewable resources demand/real gross domestic product Units: qdbtu/usd15

FISHSEX: FISH MALE, FISH FEMALE

food processing investment= agriculture green investment*food processing investment fraction(Time) Units: usd15/Year

food processing investment fraction([(2011,0)-(2050,1)],(2011,0.25),(2050,0.25)) Units: Dmnl

food that reaches the market= agric yield available for food-total distribution losses Units: Ton/Year

food vegetables consumption in tons= agric yield available for food*fraction of vegetables to food Units: Ton/Year

forest area= natural forest area+planted forest area Units: Ha

forest area harvested= deforestation+harvested forest Units: Ha/Year

forest footprint= initial forest footprint*relative forest production Units: Dmnl

Forest Land= INTEG (change in forest+change in forest from pasture-forest to agricultural-forest to pasture -Forest to settlement, initial forest land) Units: Ha

forest land available for conversion= Forest Land-non convertible forest land Units: Ha

FOREST POLICY SWITCH= 0 Units: Dmnl

forest product: fuelwood,INDUSTRIALROUNDWOOD,sawnwood

forest production= forest area harvested*average yeild per ha(Time) Units: m3/Year

forest production employment= forest production*forestry employment factor(Time) Units: Person/Year

forest production type[forest product]= SHARE OF FOREST PRODUCT[forest product](Time)*forest production Units: m3/Year

forest regeneration= natural forest area/regeneration time Units: Ha/Year

forest to agricultural= min(required change in arable land, forest land available for conversion*maximum forest yearly conversion) Units: Ha/Year

forest to pasture= 0 Units: Ha/Year

Forest to settlement= 0 Units: Ha/Year

forestry employment= afforestation employment+forest production employment Units: Person

forestry employment factor([(1970,0)-(2010,0.1)],(1970,0.00397727),(1971,0.00384687),(1972,0.00376619),(1973,0.00372203),(1974,0.0037088),(1975,0.0037217),(1976,0.00374844),(1977,0.00378214),(1978,0.00381989),(1979,0.00385954),(1980,0.00390053),(1981,0.00395474),(1982,0.00400722),(1983,0.00405424),(1984,0.00409367),(1985,0.00407449),(1986,0.00405247),(1987,0.00402794),(1988,0.00410566),(1989,0.00418551),(1990,0.00426991),(1991,0.00447902),(1992,0.00470035),(1993,0.00493299),(1994,0.00496868),(1995,0.00500549),(1996,0.00504446),(1997,0.00508516),(1998,0.00512833),(1999,0.00517373),(2000,0.00532751),(2001,0.00532479),(2002,0.00532296),(2003,0.00532008),(2004,0.00531702),(2005,0.00531672),(2006,0.00532096),(2007,0.00533172),(2008,0.00534975),(2009,0.00537435)) Units: Person/m3

forestry green investment= green economy investment*forestry green investment fraction(Time) Units: usd15/Year

forestry green investment fraction([(2011,0)-(2050,0.3)],(2011,0),(2050,0)) Units: Dmnl

forestry production= forest production*value added forestry(Time) Units: usd15/Year

forestry waste per ha time series= 1.86 Units: Ton/Ha/Year

FOSSIL FUEL AND NUCLEAR: DIESEL AND FUEL OIL, COGENERATION, GAS TURBINE, coal power, nuclear

fossil fuel C emission= (fossil fuel consumption in Tj coal*FOSSIL FUEL C EMISSION FACTOR coal)+(fossil fuel consumption in Tj natural gas *FOSSIL FUEL C EMISSION FACTOR natural gas)+(fossil fuel consumption in Tj petroleum *FOSSIL FUEL C EMISSION FACTOR petroleum) Units: Ton/Year

FOSSIL FUEL C EMISSION FACTOR coal= 15.2 Units: Ton/Tj

FOSSIL FUEL C EMISSION FACTOR natural gas= 14.4 Units: Ton/Tj

FOSSIL FUEL C EMISSION FACTOR petroleum= 15.2 Units: Ton/Tj

fossil fuel CH4 emission= (fossil fuel consumption in Tj coal*FOSSIL FUEL CH4 EMISSION FACTOR coal)+ (fossil fuel consumption in Tj natural gas*FOSSIL FUEL CH4 EMISSION FACTOR natural gas)+(fossil fuel consumption in Tj petroleum*FOSSIL FUEL CH4 EMISSION FACTOR petroleum) Units: Kg/Year

FOSSIL FUEL CH4 EMISSION FACTOR coal= 0 Units: Kg/Tj

FOSSIL FUEL CH4 EMISSION FACTOR natural gas= 350 Units: Kg/Tj

FOSSIL FUEL CH4 EMISSION FACTOR petroleum= 40 Units: Kg/Tj

fossil fuel CO2 emission= fossil fuel C emission*molecular weight of CO2/molecular weight of C Units: Ton/Year

fossil fuel consumption coal= total coal consumption in qdbtu*QDBTU to BTU Units: BTU/Year

fossil fuel consumption in Tj coal= fossil fuel consumption coal*BTU to Tj*GCV to NCV Units: Tj/Year

fossil fuel consumption in Tj natural gas= fossil fuel consumption natural gas*BTU to Tj*GCV to NCV Units: Tj/Year

fossil fuel consumption in Tj petroleum= fossil fuel consumption petroleum*BTU to Tj*GCV to NCV Units: Tj/Year

fossil fuel consumption natural gas= total natural gas consumption in qdbtu * QDBTU to BTU Units: BTU/Year

fossil fuel consumption petroleum= total petroleum consumption in qdbtu*QDBTU to BTU Units: BTU/Year

Fossil fuel demand for buildings= ((fossil fuel demand per building*Sale of buildings)/Material efficiency for buildings)-building materials to be reused[fossil fuel material] Units: Ton/Year

Fossil fuel demand for clothing= MAX(0,(((fossil fuel demand per clothing*ambition for decreasing plastics) *Sale of clothing)/Material efficiency for clothing)-clothing materials to be reused [fossil fuel material]) Units: Ton/Year

Fossil fuel demand for plastic= MAX(0,((fossil fuel demand per plastic*Sale of plastic)/Material efficiency for plastic)-plastic materials to be reused[fossil fuel material]) Units: Ton/Year

Fossil fuel demand for vehicles= ((fossil fuel demand per vehicle*Sale of vehicle)/Material efficiency for vehicles)-Vehicle materials to be reused[fossil fuel material] Units: Ton/Year

fossil fuel demand per building= WITH LOOKUP (Time, ([(2000,0.6)-(2050,2)],(2000,1.21477),(2001,1.25221),(2002,1.21095),(2003,1.18081),(2004,1.12635),(2005,1.06953),(2006,1.04913),(2007,0.9659),(2008,0.890205),(2009,1.02655),(2010,0.99771),(2011,1.11992),(2012,1.02788),(2013,0.913486),(2014,0.906881),(2015,0.963697),(2016,1.0307),(2017,1.10584),(2018,1.0536),(2019,1.0675),(2020,1.09977),(2021,0.933101),(2022,0.9228),(2023,0.898337),(2024,0.858658),(2050,0.7))) Units: Ton/building

fossil fuel demand per clothing= WITH LOOKUP (Time, ([(2000,2)-(2050,4)],(2000,2.58773),(2001,2.87293),(2002,2.87227),(2003,3.04432),(2004,2.97138),(2005,2.93753),(2006,2.91995),(2007,2.69625),(2008,2.60714),(2009,2.87178),(2010,2.7233),(2011,2.46668),(2012,2.39447),(2013,2.48206),(2014,2.52158),(2015,2.74033),(2016,2.70849),(2017,2.63671),(2018,2.62508),(2019,2.73645),(2020,2.89497),(2021,2.6306),(2022,2.35165), (2050,2.7))) Units: Dmnl

fossil fuel demand per plastic= WITH LOOKUP (Time, ([(2000,0)-(2050,0.2)],(2000,0.152954),(2001,0.142538),(2002,0.142376),(2003,0.144434),(2004,0.143625),(2005,0.135343),(2006,0.129004),(2007,0.140676),(2008,0.129226),(2009,0.131078),(2010,0.127593),(2011,0.121581),(2012,0.11989),(2013,0.118513),(2014,0.113276),(2015,0.104007),(2016,0.106393),(2017,0.113328),(2018,0.108851),(2019,0.104143),(2020,0.112554),(2021,0.108514),(2022,0.106739),(2023,0.104596),(2050,0.077))) Units: Dmnl

fossil fuel demand per vehicle= WITH LOOKUP (Time, ([(2000,4)-(2050,7)],(2000,4.81634),(2001,4.97572),(2002,5.41566),(2003,5.66376),(2004,5.50529),(2005,5.4446),(2006,5.46877),(2007,5.87673),(2008,5.61461),(2009,5.56736),(2010,5.71115),(2011,5.67026),(2012,5.70149),(2013,5.74279),(2014,5.76081),(2015,5.8095),(2016,5.6335),(2017,5.65559),(2018,5.49524),(

2019,5.37011),(2020,6.01563),(2021,5.66433),(2022,6.05622),(2023,6.14171),(2024,6.05621),(2050,7.05621))) Units: Ton/vehicle

fossil fuel GHGs emissions in Tons= total energy production emissions/TON to KG Units: Ton/Year

fossil fuel N2O emission= fossil fuel C emission*N IN N2O TO C RATIO*N TO N2O WEIGHT*KG PER TON Units: Kg/Year

fossil fuel share of consumption coal= fossil fuel consumption coal/total fossil fuel consumption Units: Dmnl

fossil fuel share of consumption natural gas= fossil fuel consumption natural gas/total fossil fuel consumption Units: Dmnl

fossil fuel share of consumption petroleum= fossil fuel consumption petroleum/total fossil fuel consumption Units: Dmnl

fossil fuel SOx emission= (total energy burned petroleum*SOX COEF petroleum)+(total energy burned petroleum coal *SOX COEF coal)+(total energy burned petroleum natural gas*SOX COEF natural gas) Units: Kg/Year

fraction for predation= 0.5 Units: Dmnl

fraction of agric land for 1st generation biofuels= land for 1st generation biofuel/Harvested area Units: Dmnl

fraction of agriculture capital to green agriculture([(1970,0)-(2100,1)],(1970,0.05),(2010,0.1)) Units: Dmnl

fraction of agriculture water for biogasoline and biodiesel= water used for biogasoline and biodiesel production/total agriculture water use Units: Dmnl

fraction of biomass waste to uses[bwaste]= fraction of biomass waste to uses increase[bwaste]+initial fraction of biomass waste to uses [bwaste] Units: Dmnl

fraction of biomass waste to uses increase[bwaste]= fraction of biomass waste uses policy[bwaste]-initial fraction of biomass waste to uses [bwaste] Units: Dmnl

fraction of biomass waste uses policy[bwaste]= if then else(indicated green economy investment fraction=0, initial fraction of biomass waste to uses [bwaste], fraction of biomass waste uses policy target[bwaste](Time)) Units: Dmnl

fraction of biomass waste uses policy target[benergy recovery]([(1970,0)-(2050,1)],(1970,0.7),(2010,0.7),(2050,1)) fraction of biomass waste uses policy target[Bmaterial recovery]([(1970,0)-(2050,1)],(1970,0.2),(2010,0.2),(2050,0)) fraction of

biomass waste uses policy target[blandfill]([(1970,0)-(2050,1)],(1970,0.1),(2010,0.1),(2050,0)) Units: Dmnl

fraction of bus type[bus type]= 0.5, 0.5 Units: Dmnl

"fraction of c&d waste to uses increase"[cwaste]= "fraction of c&d waste uses policy"[cwaste]-"initial fraction of c&d waste to uses" [cwaste] Units: dmnl

"fraction of c&d waste to uses"[cwaste]= "fraction of c&d waste to uses increase"[cwaste]+"initial fraction of c&d waste to uses" [cwaste] Units: Dmnl

"fraction of c&d waste uses policy target"[Cenergy recovery]([(1970,0)-(2050,1)],(1970,0.2),(2010,0.2),(2050,0)) "fraction of c&d waste uses policy target"[cmaterial recovery]([(1970,0)-(2050,1)],(1970,0.2),(2010,0.2),(2050,1)) "fraction of c&d waste uses policy target"[clandfill]([(1970,0)-(2050,1)],(1970,0.6),(2010,0.6),(2050,0)) Units: dmnl

"fraction of c&d waste uses policy"[cwaste]= if then else(indicated green economy investment fraction=0, "initial fraction of c&d waste to uses" [cwaste], "fraction of c&d waste uses policy target"[cwaste](Time)) Units: dmnl fraction of ccs coal energy generation= ccs coal energy electricity generation/coal energy electricity generation Units: 1

fraction of ccs natural gas energy generation= ccs gs turbine energy electricity generation/gas turbine energy electricity generation Units: 1

fraction of chemical fertilizer use= MAX(0.1, (initial fraction of chemical fertilizer use(Time)*effect of oil price on fertilizer use)-fraction of org increase to fertilizer consumption) Units: Dmnl

fraction of coal demand for power generation= coal demand for power generation in mst/coal demand Units: 1

fraction of coal use with ccs= fraction of ccs coal energy generation*fraction of coal demand for power generation Units: 1

fraction of crops for biofuels= 0.05 Units: Dmnl

"fraction of e- waste to uses increase"[ewaste]= "fraction of e- waste uses policy"[ewaste]-"initial fraction of e- waste to uses" [ewaste] Units: Dmnl

"fraction of e- waste uses policy target"[erecycle]([(1970,0)-(2050,1)],(1970,0.15),(2010,0.15),(2050,1)) "fraction of e- waste uses policy target"[elandfill]([(1970,0)-(2050,1)],(1970,0.85),(2010,0.85),(2050,0)) Units: Dmnl

"fraction of e- waste uses policy"[ewaste]= if then else(indicated green economy investment fraction=0, "initial fraction of e- waste to uses" [ewaste], "fraction of e- waste uses policy target"[ewaste](Time)) Units: Dmnl

"fraction of e-waste to uses"[ewaste]= "initial fraction of e- waste to uses"[ewaste]+"fraction of e- waste to uses increase" [ewaste] Units: Dmnl

Fraction of employment Services Units: Dmnl

fraction of food losses= total food losses/crops yield in volume Units: Dmnl

fraction of gdp for urban areas([(1970,0.6)-(2010,1)],(1970,0.7),(2000,0.8),(2010,0.85)) Units: Dmnl

fraction of hatched eggs= 0.8 Units: Dmnl

fraction of health expenditure([(2002,0)-(2006,1)],(2002,0.0994274),(2003,0.100342),(2004,0.0992719),(2005,0.0987598),(2006,0.0976724)) Units: Dmnl

fraction of identified reserves= (World Oil Discovered Reserves+World Oil Cumulative Production)/World Oil Total Resource Units: Dmnl

fraction of increase pesticide from new investment= SMOOTH N((estimated pesticide increase from new green investment/current pesticide use)*0.7, 2, (estimated pesticide increase from new green investment/current pesticide use)*0.7, 3) Units: Dmnl

fraction of indicated air travel reduction([(1970,0)-(2050,10)],(1970,0),(2010,0),(2011,0.06),(2050,0.25)) Units: Dmnl

fraction of indicated car travel reduction([(1970,0)-(2050,1)],(1970,0),(2010,0),(2011,0.06),(2050,0.35)) Units: Dmnl

fraction of industrial waste to uses increase[iwaste]= fraction of industrial waste uses policy[iwaste]-initial fraction of industry waste to uses [iwaste] Units: Dmnl

fraction of industrial waste uses policy[iwaste]= if then else(indicated green economy investment fraction=0, initial fraction of industry waste to uses [iwaste], fraction of industrial waste uses policy target[iwaste](Time)) Units: dmnl

fraction of industrial waste uses policy target[irecycle]([(1970,0)-(2050,1)],(1970,0.07),(2010,0.07),(2050,0.15)) fraction of industrial waste uses policy target[ienergy recovery]([(1970,0)-(2050,1)],(1970,0.118),(2010,0.118),(2050,0.15)) fraction of industrial waste uses policy target[ilandfill]([(1970,0)-(2050,1)],(1970,0.126),(2010,0.126),(2050,0.22)) fraction of industrial waste uses policy target[iincineration]([(1970,0)-(2050,1)],(1970,0.109),(2010,0.109),(2050,0.48)) fraction

of industrial waste uses policy target[iothers]([(1970,0)-(2050,1)],(1970,0.577),(2010,0.577),(2050,0)) Units: dmnl

fraction of industry waste to uses[iwaste]= fraction of industrial waste to uses increase[iwaste]+initial fraction of industry waste to uses [iwaste] Units: Dmnl

fraction of investment agriculture= initial fraction investment agriculture*relative pc gdp^elasticity of agriculture investment to pc gdp Units: Dmnl

FRACTION OF INVESTMENT FOR DESALINATION([(1970,0)-(2100,0.6)],(1970,0),(2010,0),(2011,0.3),(2050,0.3)) Units: Dmnl

fraction of investment industry= initial fraction investment industry*relative pc gdp^elasticity of industry investment to pc gdp Units: Dmnl

fraction of investment services= initial fraction investment services*relative pc gdp^elasticity of services investment to pc gdp Units: Dmnl

fraction of municipal waste to uses[mwaste]= fraction of municipal waste to uses increase[mwaste]+initial fraction of municipal waste to uses [mwaste] Units: Dmnl

fraction of municipal waste to uses increase[mwaste]= fraction of municipal waste to uses policy[mwaste]-initial fraction of municipal waste to uses [mwaste] Units: Dmnl

fraction of municipal waste to uses policy[mwaste]= if then else(indicated green economy investment fraction=0, initial fraction of municipal waste to uses [mwaste], fraction of municipal waste to uses policy target[mwaste](Time)) Units: Dmnl

fraction of municipal waste to uses policy target[mrecycle]([(1970,0)-(2050,1)],(1970,0.1),(2010,0.1),(2050,0.343)) fraction of municipal waste to uses policy target[menergy recovery]([(1970,0)-(2050,1)],(1970,0.106),(2010,0.106),(2050,0.423)) fraction of municipal waste to uses policy target[mlandfill]([(1970,0)-(2050,1)],(1970,0.604),(2010,0.604),(2050,0.044)) fraction of municipal waste to uses policy target[mcompost]([(1970,0)-(2010,1)],(1970,0.1),(2050,0.1)) Units: Dmnl

fraction of natural gas for power generation= gas turbine demand for power generation in qdbtu/natural gas demand Units: Dmnl

fraction of natural gas with ccs= fraction of ccs natural gas energy generation*fraction of natural gas for power generation Units: 1

"fraction of o&m cost"= 0.5 Units: Dmnl

fraction of org increase to fertilizer consumption= actual organic fertilizer increase/fertilizer consumption Units: Dmnl

fraction of planted forest for production([(1970,0)-(2050,10)],(1970,0.2),(2009,0.315789),(2019,0.701754),(2030,0.868421),(2050,0.842105)) Units: Dmnl

FRACTION OF PRECIPITATION INTO RENEWABLE WATER= 0.2879 Units: Dmnl

fraction of private cars population reduction([(2011,0)-(2050,1)],(2011,0.04),(2050,0.2)) Units: Dmnl

fraction of rain infiltrating= 1-fraction of rain to surface Units: Dmnl

fraction of rain to surface= 0.9431 Units: Dmnl

fraction of reduction in total travel volume due to efficiency([(1970,0)-(2050,1)],(1970,0),(2010,0),(2011,0.01),(2050,0.25)) Units: Dmnl

fraction of renewable power generation to total power generation= total renewable energy production power/total power generated Units: Dmnl

fraction of URBAN population([(1970,0)-(2050,1)],(1970,0.36),(1975,0.373),(1980,0.391),(1985,0.409),(1990,0.43),(1995,0.447),(2000,0.466),(2005,0.486),(2010,0.506),(2015,0.527),(2020,0.549),(2025,0.572),(2030,0.597),(2035,0.622),(2040,0.647),(2045,0.672),(2050 ,0.696)) Units: Dmnl

fraction of vegetables to food= 0.78 Units: Dmnl

fraction of water available= min(total water available/total water demand, 1) Units: Dmnl

fraction of water consumption reduction from efficiency= fraction of water consumption reduction from efficiency table(Time) Units: Dmnl

fraction of water consumption reduction from efficiency table([(2011,0)-(2050,2)],(2011,0.06),(2050,0.3)) Units: Dmnl

fraction of water for biogasoline and biodiesel= water used for biogasoline and biodiesel production/total renewable water Units: Dmnl

fraction usable of discharge water= 0.05 Units: Dmnl

fractional additional employment due to shift to organic farming= 0.3 Units: Dmnl

fractional public transport buses= 0.7 Units: Dmnl

freight rail average fuel efficiency time series([(1970,0)-(2050,0.1)],(1970,0.00614035),(2000,0.00526316),(2008,0.00526316),(2012,0.00491228),(2016,0.00473684),(2024,0.00438596),(2028,0.00421053),(2034,0.00421053),(2042,0.00385965),(2050,0.00385965)) Units: L/Km

freight rail CO2 emissions= (freight rail energy consumption*share of freight rail fuel consumption time series [diesel](Time)*CO2 EMISSION FACTORS [diesel]) Units: mtoe/Year

freight rail employment factor= WITH LOOKUP (Time, ([(1996,0)-(2050,2e-006)],(2003,8.45e-007),(2004,8.29e-007),(2005,8.2e-007),(2006,5.33e-007),(2007,6.08e-007),(2008,5.96e-007),(2009,5.84e-007),(2010 ,5.72e-007),(2011,5.61e-007),(2012,5.5e-007),(2013,5.39e-007),(2014,5.28e-007),(2015,5.17e-007),(2016,5.07e-007),(2017,4.97e-007),(2018,4.87e-007),(2019 ,4.77e-007),(2020,4.68e-007),(2021,4.58e-007),(2022,4.49e-007),(2023,4.4e-007),(2024,4.31e-007),(2025,4.23e-007),(2026,4.14e-007),(2027,4.06e-007),(2028 ,3.98e-007),(2029,3.9e-007),(2030,3.82e-007),(2031,3.74e-007),(2032,3.67e-007),(2033,3.6e-007),(2034,3.52e-007),(2035,3.45e-007),(2036,3.38e-007),(2037, 3.32e-007),(2038,3.25e-007),(2039,3.19e-007),(2040,3.12e-007),(2041,3.06e-007),(2042,3e-007),(2043,2.94e-007),(2044,2.88e-007),(2045,2.82e-007),(2046,2.77e-007),(2047,2.71e-007),(2048,2.66e-007),(2049,2.6e-007),(2050,2.55e-007))) Units: Person/Km

freight rail energy consumption= freight rail average fuel efficiency time series(Time)*freight rail travel volume *convert LITRE to mtoe*(1-efficiency ratio transport from green investment) Units: mtoe/Year

freight rail travel employment= freight rail employment factor*freight rail travel volume Units: Person

freight rail travel volume= indicated rail travel volume[freight] Units: Km/Year

fresh matter to dry matter factor= 0.75 Units: Dmnl

fuel cost per TJ[FOSSIL FUEL AND NUCLEAR]= average cost of fuel per TJ of energy used[FOSSIL FUEL AND NUCLEAR]*mwh per tj Units: USD/Tj

FUEL USE= Average LITRES OF PETROL PER CAPITA*URBAN population Units: litre/Year

fuel use expenditure= FUEL USE*average price per litre Units: usd15/Year

fuel use for power generation in TJ[power generation technology]= fuel use per MWh by technology new[power generation technology]*electricity generation rate [power generation technology] Units: Tj/Year

fuel use per MWh by technology new[DIESEL AND FUEL OIL]= WITH LOOKUP (Time, ([(2001,0.008)-(2019,0.02)],(2001,0.00984),(2002,0.00988),(2003,0.01009),(2004,0.00871),(2005,0.01042),(2006,0.00912),(2007,0.01039),(2008,0.00967),(2009,0.01212),(2010,0.0101),(2011,0.01187),(2012,0.0088),(2013,0.00884),(2014,0.00989),(2015,0.00952),(2016,0.00883),(2017,0.00898),(2018,0.009),(2019,0.00813)))
fuel use per MWh by technology new[COGENERATION]= 0 fuel use per MWh by technology new[GAS TURBINE]= WITH LOOKUP (Time, ([(2001,0.007)-(2019,0.02)],(2001,0.01035),(2002,0.01011),(2003,0.00997)

,(2004,0.01009),(2005,0.00991),(2006,0.00882),(2007,0.00978),(2008,0.00998
),(2009,0.00838),(2010,0.00911),(2011,0.00733),(2012,0.00935),(2013,0.01052
),(2014,0.00898),(2015,0.00919),(2016,0.00956),(2017,0.00929),(2018,0.00892
),(2019,0.00715))) fuel use per MWh by technology new[coal power]= WITH LOOKUP (
Time, ([(2001,0)-(2019,0.06)],(2001,0.01597),(2002,0.01642),(2003,0.0165),(2004
,0.0518),(2005,0.01927),(2006,0.02168),(2007,0.02264),(2008,0.02234),(2009
,0.01865),(2010,0.01691),(2011,0.01658),(2012,0.02969),(2013,0.02952),(2014
,0.02688),(2015,0.02776),(2016,0.02587),(2017,0.0152),(2018,0.0068),(2019, 0.00661)))
fuel use per MWh by technology new[nuclear]= WITH LOOKUP (Time, ([(1000,0)-
(2020,10)],(2000,0),(2020,0))) fuel use per MWh by technology new[BIOMASS]= WITH
LOOKUP (Time, ([(1000,0)-(2020,10)],(2000,0),(2020,0))) fuel use per MWh by
technology new[hydropower]= WITH LOOKUP (Time, ([(1000,0)-
(2020,10)],(2000,0),(2020,0))) fuel use per MWh by technology new[SOLAR]= WITH
LOOKUP (Time, ([(1000,0)-(2020,10)],(2000,0),(2020,0))) fuel use per MWh by
technology new[WIND]= WITH LOOKUP (Time, ([(1000,0)-(2020,10)],(2000,0),(2020,0)))
fuel use per MWh by technology new[WASTE GENERATION]= WITH LOOKUP (Time,
([(1000,0)-(2020,10)],(2000,0),(2020,0))) fuel use per MWh by technology
new[GEOTHERMAL]= WITH LOOKUP (Time, ([(1000,0)-(2020,10)],(2000,0),(2020,0)))
Units: Tj/(MW*hr)

Function for Effect of Investment on Potential Production([(0,0)-
(1.6,1)],(0,0),(0.2,0.3),(0.4,0.55),(0.6,0.75),(0.8,0.9),(1,1),(1.2 ,1),(1.4,1),(1.6,1)) Units: Dmnl

"future co-generation energy investment"= "desired co-generation energy production
increase"(Time)*"co-generation energy cost per mw" (Time) Units: usd15

future coal energy investment= desired coal energy production increase(Time)*coal
energy cost per mw(Time) Units: usd15

future diseal and fuel oil energy investment= desired diseal and fuel oil energy
production increase(Time)*diseal and fuel oil energy cost per mw (Time) Units: usd15

future elasticity of gdp to electricity cost= -0.025 Units: Dmnl

future gas turbine energy investment= desired gas turbine energy production
increase(Time)*gas turbine energy cost per mw (Time) Units: usd15

future geothermal investment= desired geothermal production increase
base(Time)*geothermal cost per mw(Time) Units: usd15

future hydro investment= desired hydro production increase(Time)*hydro cost per
mw(Time) Units: usd15

future landfill gas investment= desired landfill gas production increase
policy(Time)*landfill gas cost per mw (Time) Units: usd15

future nuclear energy investment= desired nuclear energy production increase(Time)*nuclear energy cost per mw (Time) Units: usd15

future solar investment= desired solar production increase(Time)*solar cost per mw(Time) Units: usd15

future tidal energyl investment= desired tidal energy production increase(Time)*tidal energy cost per mw(Time) Units: usd15

future waste energy investment= desired waste energy production increase(Time)*waste energy cost per mw(Time) Units: usd15

future wave energy investment= desired wave energy production increase(Time)*wave energy cost per mw(Time) Units: usd15

future wind investment= desired wind production increase(Time)*wind cost per mw(Time) Units: usd15

"gas ccs 0&m cost"= GAS CCS CAPACITY*gas turbineenergy maintenance cost per mw*"fraction of o&m cost" Units: usd15/Year

GAS CCS CAPACITY= INTEG (GAS CCS CONSTRUCTION-GAS CCS DECAY, 0) Units: MW

GAS CCS CONSTRUCTION= (gas ccs investment/gas ccs construction cost(Time))/construction time Units: MW/Year

gas ccs construction cost([(2007,0)-(2030,600000)],(2007,500000),(2030,400000)) Units: usd15/MW

GAS CCS DECAY= GAS CCS CAPACITY/gas turbine capital life time Units: MW/Year

gas ccs investment= gas ccs investment total-"gas ccs 0&m cost" Units: usd15/Year

gas ccs investment total= ccs green investment*(1-ccs investment fraction to coal) Units: usd15/Year

gas co2 emission= gas energy consumption ag*CO2 EMISSION FACTORS[lpg]*ktoe to mtoe Units: mtoe/Year

gas efficiency loss from ccs= 0.08 Units: Dmnl

gas electricity production share= min(1,gas turbine energy electricity generation/nonhydro electricity production) Units: Dmnl

gas employment factor([(1970,0)-(2050,30)],(1970,17.52),(1971,17.23),(1972,16.87),(1973,16.38),(1974,15.94),(1975,15.91),(1976,16.21),(1977,16.4),(1978,16.43),(1979,16.46),(1980,16.58),(1981,17.05),(1982,17.85),(1983,18.69),(1984,19.4),(1985,19.85

),(1986,20.08),(1987,20.1),(1988,19.99),(1989,19.77),(1990,19.62),(1991,19.65
),(1992,19.71),(1993,19.72),(1994,19.75),(1995,19.72),(1996,19.56),(1997,19.34
),(1998,19.08),(1999,18.85),(2000,18.66),(2001,18.55),(2002,18.45),(2003,18.34
),(2004,18.21),(2005,17.97),(2006,17.78),(2007,17.75),(2008,18.18),(2009,18.61
),(2010,18.68),(2050,14.2)) Units: Person/BCF

gas energy consumption ag= (agriculture natural gas demand*QDBTU to MB(Time))/ktoe to MB Units: ktoe/Year

gas extraction employment= gas employment factor(Time)*World Natural Gas Production Rate Units: Person

gas generation efficiency table([(1980,0)-(2050,1)],(1980,0.31),(1990,0.35),(2000,0.389),(2050,0.6)) Units: Dmnl

Gas potential production trend= (World Natural Gas Potential Production*(1+ROW Gas Potential Production Trend *Minimum Extraction Time)^5) Units: BCF/Year

gas production cost from data= 5 Units: usd15/Mbtu

Gas reference demand supply balance for cost= INITIAL(Natural Gas demand supply ratio) Units: Dmnl

gas turbine capital life time= 30 Units: Year

gas turbine demand for power generation in barrels= gas turbine demand per gwh of power generation(Time)*gas turbine energy electricity generation *(1-efficiency factor power generation) Units: Ton/Year

gas turbine demand for power generation in mb= gas turbine demand for power generation in barrels/1e+006 Units: MB/Year

gas turbine demand for power generation in qdbtu= gas turbine demand for power generation in mb/QDBTU to MB(Time) Units: qdbtu/Year

gas turbine demand per gwh of power generation([(1990,0)-(2050,4000)],(1990,2330),(2007,1680),(2015,1540),(2020,1500),(2025,1470),(2030,1450)) Units: Ton/GWh

gas turbine energy capacity= INTEG (gas turbine energy construction-gas turbine energy discard, 150000) Units: MW

gas turbine energy construction= if then else(Time<2010, gas turbine energy investment(Time)/gas turbine energy cost per mw (Time)/gas turbine energy construction time ,(future gas turbine energy investment/gas turbine energy cost per mw(Time)/gas turbine energy construction time))*if then else(CE switch reduction in gas turbine capacity=3,Reduction in gas turbine capacity HA ,if then else(CE switch

reduction in gas turbine capacity=2,Reduction in gas turbine capacity CA ,if then else(CE switch reduction in gas turbine capacity=1,Reduction in gas turbine capcaity LA ,1))) Units: MW/Year

gas turbine energy construction time= 1 Units: Year

gas turbine energy cost per mw([(2015,0)-(2030,1e+006)],(2015,429000),(2030,429000)) Units: usd15/MW

gas turbine energy discard= (gas turbine energy capacity/gas turbine capital life time)*if then else(CE switch reduction in gas turbine capacity =3,Phasing out gas turbine capacity HA,if then else(CE switch reduction in gas turbine capacity =2,Phasing out gas turbine capacity CA,if then else(CE switch reduction in gas turbine capacity =1,Phasing out gas turbine capacity LA,1))) Units: MW/Year

gas turbine energy electricity generation= min((TOTAL electricity demand accounting for distribution losses-hydro electricity generation -wind electricity generation-solar electricity generation-geothermal electricity generation -tidal energy electricity generation-wave energy electricity generation-landfill gas electricity generation -nuclear energy electricity generation-waste energy electricity generation- "co-generation energy electricity generation"), gas turbine energy power capacity use /mwh to gwh) Units: GWh/Year

gas turbine energy electricity generation in bkwh= gas turbine energy electricity generation*gwh to bkwh Units: BKWH/Year

gas turbine energy investment([(1970,0)-(2010,6e+010)],(1970,8.77e+009),(1988,1.25e+010),(2007,4.43e+010)) Units: usd15

gas turbine energy load factor= 0.4 Units: Dmnl

gas turbine energy maintenance cost= gas turbine energy capacity*gas turbineenergy maintenance cost per mw Units: usd15/Year

gas turbine energy power capacity use= gas turbine energy load factor*potential electricity generation gas turbine energy Units: MWh/Year

gas turbine share of power generation= gas turbine energy electricity generation/total electricity generation Units: Dmnl

gas turbineenergy maintenance cost per mw= 7875 Units: usd15/MW/Year

Gas US Effect of Demand Supply Balance on Cost= Natural Gas demand supply ratio/Gas reference demand supply balance for cost Units: Dmnl

Gas US Elasticity of cost to availability of resource= 0.05 Units: Dmnl

Gas World A= (natural gas demand-Gas World Perceived precent condition)/Time to Perceive Perceived Present condition Units: BCF/(Year*Year)

Gas World Adjustment for Expected Growth in Demand= Gas World Trend*World Natural Gas Recoverable Reserves Units: BCF/Year

Gas World Adjustment of Total Recoverable Resources Remaining= (Gas World Required Total Recoverable Resources for Production-World Natural Gas Recoverable Reserves)/Time to Adjust Reserves Units: BCF/Year

Gas World available production years= World Natural Gas Recoverable Reserves/World Desired Recoverable Gas Units: Year

Gas World B= (Gas World Reference Trend-Gas World Trend)/Time to Perceive Trend Units: 1/(Year*Year)

Gas World C= (Gas World Perceived precent condition-Gas World Reference Condition)/TERC Units: BCF/(Year*Year)

Gas World desired available ratio effect on price= ZIDZ(Gas World reference year of production,Gas World available production years) Units: Dmnl

Gas World Elasticity of price to availability of resource= 0.45 Units: Dmnl

Gas World Initial Trend Demand= 0.03 Units: 1/Year

Gas World Perceived precent condition= INTEG (Gas World A, natural gas demand/(1+Time to Perceive Perceived Present condition*Gas World Initial Trend Demand)) Units: BCF/Year

Gas World Reference Condition= INTEG (Gas World C, Gas World Perceived precent condition/(1+TERC*Gas World Initial Trend Demand)) Units: BCF/Year

Gas World Reference Trend= (Gas World Perceived precent condition-Gas World Reference Condition)/(Gas World Reference Condition *TERC) Units: 1/Year

Gas World reference year of production= INITIAL(Gas World available production years) Units: Year

Gas World Required Total Recoverable Resources for Production= Natural Gas Reference Reserve Production Ratio for price* natural gas demand Units: BCF

Gas World Trend= INTEG (Gas World B, Gas World Initial Trend Demand) Units: 1/Year

GCV to NCV= 0.95 Units: Dmnl

GDP 2024 relativzed= relative gdp/relative GDP in 2024 Units: 1

gdp deflator= gdp deflator table(Time) Units: USD/usd15

gdp deflator table([(1975,0)-
(2061,2)],(1975,0.27517),(1976,0.284393),(1977,0.309123),(1978,0.35134
),(1979,0.390066),(1980,0.431715),(1981,0.437933),(1982,0.431828),(1983,0.429503
),(1984,0.42626),(1985,0.43049),(1986,0.491678),(1987,0.539435),(1988,0.576514
),(1989,0.58057),(1990,0.63503),(1991,0.65484),(1992,0.685407),(1993,0.68421
),(1994,0.712629),(1995,0.770534),(1996,0.760962),(1997,0.729575),(1998,0.708091
),(1999,0.706062),(2000,0.698299),(2001,0.680167),(2002,0.690294),(2003,0.750782
),(2004,0.80976),(2005,0.842904),(2006,0.874482),(2007,0.94418),(2008,1.01653
),(2009,0.976827),(2010,1.02371),(2011,1.10176),(2012,1.09661),(2013,1.09678
),(2014,1.09296),(2015,1),(2016,0.988473),(2017,1.01774),(2018,1.04794),(2019
,1.03554),(2020,1.03729),(2021,1.11336),(2022,1.12173),(2023,1.13791),(2024
,1.15128),(2025,1.1648),(2026,1.17849),(2027,1.19233),(2028,1.20634),(2029,
1.22051),(2030,1.23485),(2031,1.24936),(2032,1.26404),(2033,1.27889),(2034,
1.29392),(2035,1.30912),(2036,1.3245),(2037,1.34006),(2038,1.3558),(2039,1.37173
),(2040,1.38785),(2041,1.40415),(2042,1.42065),(2043,1.43734),(2044,1.45423
),(2045,1.47131),(2046,1.4886),(2047,1.50608),(2048,1.52378),(2049,1.54168)
,(2050,1.55979),(2051,1.57812),(2052,1.59666),(2053,1.61542),(2054,1.6344),
(2055,1.6536),(2056,1.67303),(2057,1.69268),(2058,1.71257),(2059,1.73269),(
2060,1.75304),(2061,1.77364)) Units: USD/usd15

gdp growth rate= TREND(real gross domestic product, 1, INITIAL GDP GROWTH RATE)
Units: Dmnl/Year

GE share of agriculture land from fallow land([(2000,0.8)-
(2030,1)],(2000,0.9),(2015,0.8),(2016,0.8),(2025,0.8),(2030,1)) Units: Dmnl

gendered employment per building[MALE]([(2000,0)-
(2050,0.2)],(2000,0.156256),(2001,0.158267),(2002,0.154457),(2003
,0.145552),(2004,0.133946),(2005,0.124995),(2006,0.116794),(2007,0.102465),
(2008,0.0949527),(2009,0.10141),(2010,0.0930507),(2011,0.0849256),(2012,0.0825557
),(2013,0.0791129),(2014,0.0773288),(2015,0.0798315),(2016,0.0800034),(2017
,0.0778025),(2018,0.0730322),(2019,0.0732244),(2020,0.0765243),(2021,0.0644988
),(2022,0.0638741),(2023,0.0622285),(2024,0.0594414),(2050,0.0248416)) gendered
employment per building[FEMALE]([(2000,0)-
(2050,0.08)],(2000,0.0726946),(2001,0.0723736),(2002,0.0685328)
,(2003,0.0645943),(2004,0.0592722),(2005,0.0545804),(2006,0.0502023),(2007
,0.0431439),(2008,0.0401277),(2009,0.0435849),(2010,0.0395942),(2011,0.0355205
),(2012,0.0349234),(2013,0.0334947),(2014,0.0329226),(2015,0.034616),(2016
,0.0346802),(2017,0.0361312),(2018,0.0334492),(2019,0.0330655),(2020,0.0342951
),(2021,0.0285052),(2022,0.0281605),(2023,0.0273714),(2024,0.0260848),(2050
,0.0109013)) Units: people/building

gendered employment per clothing[MALE]([(2000,0)-(2050,4)],(2000,3.01899),(2001,3.23569),(2002,3.1635),(2003,3.11085),(2004,2.89733),(2005,2.73665),(2006,2.5974),(2007,2.27949),(2008,2.12224),(2009,2.32923),(2010,2.12833),(2011,1.93723),(2012,1.86438),(2013,1.90646),(2014,1.91977),(2015,2.07155),(2016,2.02148),(2017,1.94959),(2018,1.85299),(2019,1.94818),(2020,2.01393),(2021,1.7601),(2022,1.56196),(2050,0.933923)) gendered employment per clothing[FEMALE]([(2000,0)-(2050,2)],(2000,1.74423),(2001,1.86915),(2002,1.80824),(2003,1.7721),(2004,1.63197),(2005,1.54293),(2006,1.46155),(2007,1.27795),(2008,1.17359),(2009,1.26262),(2010,1.1439),(2011,1.04244),(2012,0.987727),(2013,0.998573),(2014,1.00676),(2015,1.079),(2016,1.04589),(2017,0.992488),(2018,0.940436),(2019,0.981565),(2020,1.01905),(2021,0.899166),(2022,0.796944),(2050,0.473089))
Units: people/Ton

gendered employment per plastic[MALE]([(2000,0)-(2050,0.02)],(2000,0.0159005),(2001,0.0154163),(2002,0.0146327),(2003,0.014525),(2004,0.0144118),(2005,0.0141764),(2006,0.0129733),(2007,0.0124405),(2008,0.0134435),(2009,0.0126071),(2010,0.0125367),(2011,0.0113136),(2012,0.0109873),(2013,0.0106205),(2014,0.0103134),(2015,0.00976707),(2016,0.00914896),(2017,0.0092266),(2018,0.00947201),(2019,0.00898803),(2020,0.00864152),(2021,0.00921349),(2022,0.00896792),(2023,0.00881056),(2024,0.00865669)) gendered employment per plastic[FEMALE]([(2000,0.004)-(2024,0.01)],(2000,0.00903763),(2001,0.00870614),(2002,0.00811863),(2003,0.00811444),(2004,0.00783432),(2005,0.00761703),(2006,0.00687964),(2007,0.00651008),(2008,0.00710024),(2009,0.00649408),(2010,0.00626401),(2011,0.00574145),(2012,0.00560618),(2013,0.00551932),(2014,0.00531452),(2015,0.00512697),(2016,0.00480756),(2017,0.0049234),(2018,0.00509549),(2019,0.00485038),(2020,0.00472661),(2021,0.00502173),(2022,0.00489244),(2023,0.00480509),(2024,0.00471895)) Units: people/Ton

gendered employment per vehicle[MALE]([(2000,0.5)-(2050,0.8)],(2000,0.581376),(2001,0.583204),(2002,0.602474),(2003,0.618685),(2004,0.635523),(2005,0.648857),(2006,0.656411),(2007,0.66794),(2008,0.653174),(2009,0.654458),(2010,0.659519),(2011,0.653698),(2012,0.651731),(2013,0.649671),(2014,0.662035),(2015,0.673412),(2016,0.666098),(2017,0.66151),(2018,0.649251),(2019,0.653258),(2020,0.745983),(2021,0.670691),(2022,0.715169),(2023,0.724915),(2024,0.71637)) gendered employment per vehicle[FEMALE]([(2000,0.3)-(2050,0.5)],(2000,0.3327),(2001,0.334975),(2002,0.338846),(2003,0.352636),(2004,0.356423),(2005,0.365034),(2006,0.372634),(2007,0.385498),(2008,0.379118),(2009,0.380092),(2010,0.380334),(2011,0.376226),(2012,0.375261),(2013,0.372234),(2014,0.377701),(2015,0.382756),(2016,0.377883),(2017,0.376092),(2018,0.367527),(2019,0.368543),(2020,0.420804),(2021,0.380275),(2022,0.404699),(2023,0.409138),(2024,0.403327)) Units: people/vehicle

general industrial elasticity of units to price= WITH LOOKUP (Time, ([(1970,0)-(2050,1)],(1970,0.3),(2050,0.35))) Units: Dmnl

GENERAL INDUSTRIAL ELECTRICITY CUSTOMERS= 6.1e+007 Units: customers

geothermal BKWH to QDBTU conversion([(1980,0)-(2006,0.1)],(1980,0.0216),(1981,0.0216),(1982,0.0216),(1983,0.0213),(1984,0.0213),(1985,0.0213),(1986,0.0213),(1987,0.0213),(1988,0.0211),(1989,0.0211),(1990,0.0211),(1991,0.021),(1992,0.020914),(1993,0.020914),(1994,0.020914),(1995,0.020914),(1996,0.02096),(1997,0.02096),(1998,0.021017),(1999,0.021017),(2000,0.021017),(2001,0.021017),(2002,0.021017),(2003,0.021017),(2004,0.021017),(2005,0.021017),(2006,0.021017)) Units: qdbtu/BKWH

geothermal capacity= INTEG (geothermal construction-geothermal discard, initial geothermal capacity) Units: MW

geothermal capacity from green investment= geothermal green investment/geothermal cost per mw(Time)/geothermalconstruction time Units: MW/Year

geothermal capital life time= 30 Units: Year

geothermal construction= if then else(Time<2010, geothermal investment(Time)/geothermal cost per mw (Time)/geothermalconstruction time, (future geothermal investment /geothermal cost per mw(Time)/geothermalconstruction time)+geothermal capacity from green investment)*if then else(IEA NET ZERO SWITCH=1,"Increase in geothermal capacity IEA.NZ" ,1) Units: MW/Year

geothermal construction employment= geothermal construction*(geothermal construction employment factor(Time)+geothermal manufacturing employment factor (Time)) Units: Person/Year

geothermal construction employment factor([(2010,0)-(2030,10)],(2010,6.6514),(2011,6.4172),(2012,6.1903),(2013,5.9704),(2014,5.7573),(2015,5.5509),(2016,5.3509),(2017,5.1572),(2018,4.9695),(2019,4.7878),(2020,4.6118),(2021,4.455),(2022,4.3026),(2023,4.1546),(2024,4.0107),(2025,3.8709),(2026,3.7351),(2027,3.6032),(2028,3.4751),(2029,3.3507),(2030,3.2299)) Units: Person/MW

geothermal cost per mw([(2015,0)-(2030,8e+006)],(2015,2.93e+006),(2030,2.79e+006)) Units: usd15/MW

geothermal discard= geothermal capacity/geothermal capital life time Units: MW/Year

geothermal electricity generation= min((TOTAL electricity demand accounting for distribution losses-hydro electricity generation -wind electricity generation-solar electricity generation), geothermal power capacity use /mwh to gwh) Units: GWh/Year

geothermal electricity generation in qdbtu= geothermal energy production in bkwh*geothermal BKWH to QDBTU conversion(Time) Units: qdbtu/Year

geothermal electricity generation in QDBTU table([(1971,0)-(2010,10)],(1971,0.155379),(1972,0.184412),(1973,0.224782),(1974,0.235432),(1975,0.270557),(1976,0.300741),(1977,0.301628),(1978,0.29551),(1979,0.365773),(1980,0.45838),(1981,0.51728),(1982,0.540509),(1983,0.605297),(1984,0.691506),(1985,0.768573),(1986,0.860142),(1987,0.93075),(1988,0.9454),(1989,1.1318),(1990,1.24456),(1991,1.27876),(1992,1.32638),(1993,1.35962),(1994,1.38033),(1995,1.37557),(1996,1.44945),(1997,1.46466),(1998,1.58951),(1999,1.68507),(2000,1.73076),(2001,1.72776),(2002,1.55942),(2003,1.61995),(2004,1.67752),(2005,1.70488),(2006,1.7392),(2007,1.81321)) Units: qdbtu/Year

geothermal energy production in bkwh= geothermal electricity generation in QDBTU table(Time) Units: qdbtu/Year

geothermal green investment= geothermal green investment fraction(Time)*power generation investment Units: usd15/Year

geothermal green investment fraction([(2011,0)-(2050,0.3)],(2011,0.01),(2050,0.01)) Units: Dmnl

geothermal investment([(1970,0)-(2006,4e+009)],(1970,1.05e+008),(1975,3.51e+007),(1983,2.63e+008),(1988,1.35e+009),(1995,1.67e+009),(2005,1.65e+009)) Units: usd15

geothermal load factor= 0.78 Units: Dmnl

geothermal maintenance cost= geothermal capacity*geothermal maintenance cost per mw Units: usd15/Year

geothermal maintenance cost per mw= 20000 Units: usd15/MW/Year

geothermal manufacturing employment factor([(2010,0)-(2030,10)],(2010,7.0806),(2011,6.8312),(2012,6.5896),(2013,6.3555),(2014,6.1287),(2015,5.909),(2016,5.6961),(2017,5.4899),(2018,5.2901),(2019,5.0967),(2020,4.9093),(2021,4.7424),(2022,4.5802),(2023,4.4226),(2024,4.2694),(2025,4.1207),(2026,3.9761),(2027,3.8357),(2028,3.6993),(2029,3.5669),(2030,3.4382)) Units: Person/MW

geothermal operation and maintenance employment= geothermal capacity*geothermal operation and maintenance employment factor (Time) Units: Person/Year

geothermal operation and maintenance employment factor([(2010,0)-(2030,10)],(2010,2.36),(2011,2.2769),(2012,2.1964),(2013,2.1183),(2014,2.0427),(2015,1.9695),(2016,1.8985),(2017,1.8298),(2018,1.7632),(2019

,1.6988),(2020,1.6363),(2021,1.5807),(2022,1.5266),(2023,1.4741),(2024,1.423),(2025,1.3734),(2026,1.3253),(2027,1.2785),(2028,1.233),(2029,1.1889),(2030 ,1.146)) Units: Person/MW

geothermal power capacity use= geothermal load factor* potential electricity generation geothermal Units: MWh/Year

geothermal share of power generation= geothermal electricity generation/total electricity generation Units: Dmnl

geothermalconstruction time= 1 Units: Year

ger industries emissions share of industry= industries emissions/ind fossil fuel CO2 emission Units: Dmnl

ghg emissions per capita= fossil fuel GHGs emissions in Tons/total population Units: Ton/Person/Year

gini coefficient([(1988,0)-(2002,1)],(1988,0.623),(1993,0.655),(1998,0.644),(2002,0.657)) Units: Dmnl

government investment for promoting waste management= government investment for promoting waste management time series Units: usd15/Year/Year

government investment for promoting waste management time series= 0 Units: usd15/Year

grazingland footprint= initial grazingland footprint*relative pasture land Units: Dmnl

green agriculture capital= capital agriculture*fraction of agriculture capital to green agriculture(Time) Units: usd15

green agriculture desired capital labor ratio= initial green agriculture capital labor ratio*relative average years of schooling ^elasticity of capital labour ration to average years of schooling agriculture green *relative average life expectancy^elasticity of capital labour ratio to average life expectancy agric green Units: usd15/Person

green agriculture employment= INTEG (green employment change, initial green agriculture employment) Units: Person

green agriculture labor demand= (green agriculture capital/green agriculture desired capital labor ratio) Units: Person

green economy investment= indicated gross domestic product*indicated green economy investment fraction Units: usd15/Year

green economy investment fraction([(1900,0)-(2050,0.1)],(1970,0),(2010,0),(2026,0),(2027,0)) Units: Dmnl

green employment change= (indicated green agriculture employment demand-green agriculture employment)/time to adjust agriculture employment green Units: Person/Year

Greenhouse Gas Emissions per $ of GDP= fossil fuel GHGs emissions in Tons/real gross domestic product Units: Ton/usd15

ground water= INTEG (infiltration-ground water emergence-ground water withdrawal, initial ground water) Units: Km3

ground water emergence= ground water*emerging fraction of ground water Units: Km3/Year

ground water potential supply= ground water/time to withdraw ground water Units: Km3/Year

ground water withdrawal= 1750 Units: Km3/Year

GROWTH RATE base period= 1 Units: Year

growth rate in emissions= TREND(total annual co2e emissions, 0.75, 0.015) Units: 1

gwh per TJ= 3.6 Units: Tj/GWh

gwh to bkwh= 0.001 Units: GWh/BKWH

GWH to KWH= 1e+006 Units: kWh/GWh

GWH TO QDBTU= 3.412e-006 Units: qdbtu/GWh

GWh to TJ= 3.6 Units: Tj/GWh

ha of land use per sqm= WITH LOOKUP (Time, ([(2000,0)-(2050,0.8)],(2000,0.755573),(2001,0.730024),(2002,0.683965),(2003,0.629281),(2004,0.544471),(2005,0.514638),(2006,0.479649),(2007,0.397064),(2008,0.39316),(2009,0.402224),(2010,0.366793),(2011,0.31689),(2012,0.310249),(2013,0.299943),(2014,0.278892),(2015,0.292904),(2016,0.286965),(2017,0.286458),(2018,0.276241),(2019,0.275876),(2020,0.28143),(2021,0.257226),(2022,0.248797),(2023,0.24014),(2024,0.226701),(2050,0.154386))) Units: Ha/sqm

ha of land use per ton of clothing= WITH LOOKUP (Time, ([(2000,0)-(2050,6)],(2000,5.51943),(2001,5.59222),(2002,5.03415),(2003,4.62278),(2004,4.12396),(2005,3.95272),(2006,3.73078),(2007,3.3009),(2008,3.02104),(2009,3.28104),(2010,3.15051),(2011,2.78786),(2012,2.47447),(2013,2.80164)

,(2014,2.61251),(2015,2.83162),(2016,2.79603),(2017,2.95227),(2018,2.86394)
,(2019,2.91064),(2020,3.01034),(2021,2.80003),(2022,2.4582),(2049.85,1.57895)))
Units: Ha/Ton

ha of land use per ton of plastic= WITH LOOKUP (Time, ([(2000,0)-
(2052,0.05)],(2000,0.0498875),(2001,0.0449522),(2002,0.0414372
),(2003,0.0395535),(2004,0.0379388),(2005,0.0392345),(2006,0.0374799),(2007
,0.0343483),(2008,0.0414384),(2009,0.0373966),(2010,0.0348892),(2011,0.031908
),(2012,0.0303063),(2013,0.0281583),(2014,0.0265547),(2015,0.0260119),(2016
,0.0242098),(2017,0.0236079),(2018,0.0244061),(2019,0.0217987),(2020,0.0213973
),(2021,0.0237061),(2022,0.0228063),(2023,0.0222361),(2024,0.021655),(2051.05
,0.0109649))) Units: Ha/Ton

ha of land use per vehicle= WITH LOOKUP (Time, ([(2000,0.5)-
(2024,0.7)],(2000,0.6637),(2001,0.640458),(2002,0.649578),(2003
,0.628577),(2004,0.612713),(2005,0.616266),(2006,0.623369),(2007,0.591873),
(2008,0.598135),(2009,0.636641),(2010,0.591783),(2011,0.581819),(2012,0.5765
),(2013,0.545267),(2014,0.545198),(2015,0.564936),(2016,0.570437),(2017,0.569571
),(2018,0.571125),(2019,0.56583),(2020,0.644677),(2021,0.599387),(2022,0.623177
),(2023,0.629728),(2024,0.616315))) Units: Ha/vehicle

HA TO KM3= 0.01 Units: Km3/Km/Ha

harvest loss fraction= if then else(CE policy switch=3,SDG ambition on reduction of pre harvest losses HA ,if then else(CE policy switch=2,SDG ambition on reduction of pre harvest losses CA ,if then else(CE policy switch=1,SDG ambition on reduction of pre harvest losses LA ,1)))*BAU harvest loss fraction Units: Dmnl

Harvested area= Agricultural Land*Share of agriculture land harvested Units: Ha

Harvested area table([(1970,0)-
(2010,1e+010)],(1970,1.01472e+009),(1971,1.02883e+009),(1972,1.02182e+009
),(1973,1.05103e+009),(1974,1.05455e+009),(1975,1.06114e+009),(1976,1.06645e+009
),(1977,1.07811e+009),(1978,1.08488e+009),(1979,1.07857e+009),(1980,1.08882e+009
),(1981,1.10231e+009),(1982,1.09296e+009),(1983,1.07649e+009),(1984,1.10244e+009
),(1985,1.11769e+009),(1986,1.11348e+009),(1987,1.09322e+009),(1988,1.1135e+009
),(1989,1.12509e+009),(1990,1.12326e+009),(1991,1.12769e+009),(1992,1.1339e+009
),(1993,1.12071e+009),(1994,1.13494e+009),(1995,1.14232e+009),(1996,1.15628e+009
),(1997,1.15702e+009),(1998,1.15079e+009),(1999,1.15042e+009),(2000,1.14956e+009
),(2001,1.15532e+009),(2002,1.14465e+009),(2003,1.17077e+009),(2004,1.19573e+009
),(2005,1.21621e+009),(2006,1.21464e+009),(2007,1.22126e+009)) Units: Ha/Year

harvested forest= ((planted forest area*CONSTANT fraction of planted forest for production)/average maturity of planted forest) Units: Ha/Year

HARVESTED LAND C02 EMISSION= (Harvested area*HARVESTED LAND C02 EMISSION FACTOR)/ton to mtoe Units: mtoe/Year

HARVESTED LAND C02 EMISSION FACTOR= 0.1 Units: Ton/Ha/Year

health expenditure([(1970,0)-(2050,1e+013)],(1970,1.21725e+012),(1971,1.26677e+012),(1972,1.33973e+012),(1973,1.42692e+012),(1974,1.44865e+012),(1975,1.46196e+012),(1976,1.53402e+012),(1977,1.5965e+012),(1978,1.66658e+012),(1979,1.73617e+012),(1980,1.76805e+012),(1981,1.80168e+012),(1982,1.80714e+012),(1983,1.85305e+012),(1984,1.93819e+012),(1985,2.00994e+012),(1986,2.07798e+012),(1987,2.15269e+012),(1988,2.25279e+012),(1989,2.33732e+012),(1990,2.40588e+012),(1991,2.44434e+012),(1992,2.49662e+012),(1993,2.54029e+012),(1994,2.62501e+012),(1995,2.70108e+012),(1996,2.79248e+012),(1997,2.89591e+012),(1998,2.96233e+012),(1999,3.05604e+012),(2000,3.18187e+012),(2001,3.22988e+012),(2002,3.29091e+012),(2003,3.40958e+012),(2004,3.5116e+012),(2005,3.61566e+012),(2006,3.71904e+012),(2027.49,6.00877e+012),(2038.01,6.84211e+012),(2049.51,7.2807e+012)) Units: usd15/Year

healthy life[sex]= (life expectancy[sex]-20)/60*10 Units: Dmnl

Heat demand for buildings= (Heat intensity per building(Time)*Sale of buildings)/Energy efficiency in building construction Units: Tj/Year

Heat demand for clothing= (Heat intensity per clothing(Time)*Sale of clothing)/Energy efficiency in clothing manufacturing Units: Tj/Year

Heat demand for plastic= (Heat intensity per plastic(Time)*Sale of plastic)/Energy efficiency in plastic manufacturing Units: Tj/Year

Heat demand for vehicles= (Heat intensity per vehicle(Time)*Sale of vehicle)/Energy efficiency in vehicle manufacturing Units: Tj/Year

Heat intensity per building([(2000,0)-(2024,4e-006)],(2000,1.48225e-006),(2001,1.57926e-006),(2002,1.78023e-006),(2003,1.53139e-006),(2004,1.27134e-006),(2005,1.37011e-006),(2006,1.208e-006),(2007,1.29592e-006),(2008,1.09123e-006),(2009,1.0187e-006),(2010,1.48266e-006),(2011,1.09632e-006),(2012,1.056e-006),(2013,3.6259e-006),(2014,3.12769e-006),(2015,2.95e-006),(2016,3.13783e-006),(2017,2.7344e-006),(2018,2.45757e-006),(2019,2.32782e-006),(2020,2.31437e-006),(2021,1.73209e-006),(2022,1.543e-006),(2023,1.33574e-006),(2024,1.69364e-006)) Units: Tj/building

Heat intensity per clothing([(2000,0)-(2024,3e-005)],(2000,4.06414e-006),(2001,3.66565e-006),(2002,4.52529e-006),(2003,4.10166e-006),(2004,3.19746e-006),(2005,3.38258e-006),(2006,2.96813e-006),(2007,3.1123e-006),(2008,2.65837e-006),(2009,3.20071e-006),(2010,4.21422e-006),(2011,3.34544e-006),(2012,3.23588e-

006),(2013,6.25982e-006),(2014,5.78873e-006),(2015,5.77171e-006),(2016,5.36418e-006),(2017,6.44544e-006),(2018,6.44111e-006),(2019,6.61556e-006),(2020,7.0636e-006),(2021,5.97916e-006),(2022,5.06621e-006)) Units: Tj/Ton

Heat intensity per plastic([(2000,0)-(2024,4e-007)],(2000,1.14697e-007),(2001,1.12377e-007),(2002,1.33357e-007),(2003,1.28828e-007),(2004,1.30014e-007),(2005,1.54084e-007),(2006,1.52642e-007),(2007,1.80942e-007),(2008,1.81522e-007),(2009,1.66984e-007),(2010,1.831e-007),(2011,1.86776e-007),(2012,1.77789e-007),(2013,3.35325e-007),(2014,3.18379e-007),(2015,2.77552e-007),(2016,2.79758e-007),(2017,3.42354e-007),(2018,3.32317e-007),(2019,3.56023e-007),(2020,3.35883e-007),(2021,3.40083e-007),(2022,3.21086e-007),(2023,3.07562e-007),(2024,3.36335e-007)) Units: Tj/Ton

Heat intensity per vehicle([(2000,0)-(2024,3e-005)],(2000,7.5267e-006),(2001,7.15214e-006),(2002,9.17874e-006),(2003,8.05758e-006),(2004,7.57951e-006),(2005,8.58069e-006),(2006,8.53865e-006),(2007,1.04387e-005),(2008,9.67932e-006),(2009,8.78127e-006),(2010,1.0493e-005),(2011,1.04869e-005),(2012,1.04961e-005),(2013,2.7654e-005),(2014,2.44111e-005),(2015,2.02077e-005),(2016,2.06613e-005),(2017,2.29919e-005),(2018,2.13925e-005),(2019,2.15311e-005),(2020,2.50099e-005),(2021,2.46521e-005),(2022,2.60169e-005),(2023,2.58772e-005),(2024,2.8438e-005)) Units: Tj/vehicle

heavy truck energy consumed by energy type[gasoline power]= trucks energy consumption[heavy truck]*share of energy consumption by heavy truck energy type tABLE [gasoline power] heavy truck energy consumed by energy type[ethanol]= trucks energy consumption[heavy truck]*share of energy consumption by heavy truck energy type tABLE [ethanol] heavy truck energy consumed by energy type[diesel]= trucks energy consumption[heavy truck]*share of energy consumption by heavy truck energy type tABLE [diesel] heavy truck energy consumed by energy type[biodiesel]= trucks energy consumption[heavy truck]*share of energy consumption by heavy truck energy type tABLE [biodiesel] heavy truck energy consumed by energy type[hydrogen]= trucks energy consumption[heavy truck]*share of energy consumption by heavy truck energy type tABLE [hydrogen] Units: mtoe/Year

Hist prod World Oil= World Oil production historical(Time) Units: MB/Year

historical geothermal discard([(1990,0)-(2020,100)],(1991,0),(1993,0),(1994,0),(1996,0),(2009,0)) Units: MW/Year

historical hydro discard([(1990,0)-(2020,60)],(1994,0),(1996,0)) Units: MW/Year

historical solar discard([(1990,0)-(2020,60)],(1994,0),(1996,0)) Units: MW/Year

Hotels and Restaurants employment= total employment*sectoral distribution of employment[hor] Units: Person

hours per day= 24 Units: hour/day

"household pm2.5 emissions"= "pm2.5 emissions from biomass 0"+"pm2.5 emissions from coal new"[HOUSEHOLDS]+"pm2.5 emissions from natural gas"[HOUSEHOLDS]+"pm2.5 emissions from petroleum new" [HOUSEHOLDS] Units: Ton/Year

"HUMAN DEVELOPMENT INDEX (HDI)"= (income index+life expectancy index+enrolment rate index)/3 Units: 1

hydro= hydro electricity generation*GWH TO QDBTU Units: qdbtu/Year

hydro 2008= 3.07842e+006 Units: MW

hydro capacity= INTEG (hydro construction-hydro discard, initial hydro capacity) Units: MW

hydro capacity from green investment= hydro green investment/hydro cost per mw(Time)/hydro construction time Units: MW/Year

hydro capital life time= 30 Units: Year

hydro construction= if then else(Time<2010, hydro investment(Time)/hydro cost per mw(Time)/hydro construction time , (future hydro investment /hydro cost per mw(Time) /hydro construction time)+hydro capacity from green investment)*if then else (IEA NET ZERO SWITCH=1,"Increase in hydro capacity IEA.NZ",1) Units: MW/Year

hydro construction employment= hydro construction*(hydro construction employment factor(Time)+hydro manufacturing employment factor (Time)) Units: Person/Year

hydro construction employment factor([(2010,0)-(2030,100)],(2010,17.28),(2011,17.1664),(2012,17.0508),(2013,16.9332),(2014,16.8135),(2015,16.6919),(2016,16.5681),(2017,16.4423),(2018,16.3144),(2019,16.1843),(2020,16.0521),(2021,15.9019),(2022,15.7498),(2023,15.5958),(2024,15.4398),(2025,15.2819),(2026,15.122),(2027,14.9602),(2028,14.7963),(2029,14.6305),(2030,14.4626)) Units: Person/MW

hydro construction time= 1 Units: Year

hydro cost per mw([(2015,0)-(2030,6e+006)],(2015,1.85e+006),(2030,1.85e+006)) Units: usd15/MW

hydro discard= hydro capacity/hydro capital life time Units: MW/Year

hydro electricity generation= min(TOTAL electricity demand accounting for distribution losses, hydro power capacity use /mwh to gwh) Units: GWh/Year

hydro electricity generation in BKWH table([(1980,200)-(2050,500)],(1980,276.02),(1981,260.68),(1982,309.21),(1983,332.13

),(1984,321.15),(1985,281.15),(1986,290.84),(1987,249.69),(1988,222.94),(1989
,269.19),(1990,289.75),(1991,286.02),(1992,250.02),(1993,277.52),(1994,254)
,(1995,305.41),(1996,341.16),(1997,350.65),(1998,317.87),(1999,314.66),(2000
,271.34),(2001,213.75),(2002,260.49),(2003,271.51),(2004,265.06),(2005,261.89
),(2006,279.78),(2007,277.72),(2008,284.5),(2025,365)) Units: BKWH/Year

hydro electricity generation in Qdbtu= hydro energy production in QDBTU Units: qdbtu/Year

hydro electricity generation in QDBTU table([(1971,0)-(2010,10)],(1971,3.83493),(1972,4.03505),(1973,4.07622),(1974,4.52001),(1975,4.59354),(1976,4.55597),(1977,4.70783),(1978,5.08937),(1979,5.35626),(1980,5.4623),(1981,5.59424),(1982,5.72387),(1983,5.97829),(1984,6.1787),(1985,6.27699),(1986,6.38781),(1987,6.40687),(1988,6.62785),(1989,6.58682),(1990,6.81965),(1991,7.03644),(1992,7.02877),(1993,7.43995),(1994,7.50984),(1995,7.88693),(1996,7.99765),(1997,8.11579),(1998,8.14232),(1999,8.15351),(2000,8.33359),(2001,8.13875),(2002,8.35996),(2003,8.39729),(2004,8.92221),(2005,9.29827),(2006,9.64617),(2007,9.78981)) Units: qdbtu/Year

hydro energy production in QDBTU= hydro electricity generation in QDBTU table(Time) Units: qdbtu/Year

hydro green investment= hydro green investment fraction(Time)*power generation investment Units: usd15/Year

hydro green investment fraction([(2011,0)-(2050,1)],(2011,0.01),(2050,0.01)) Units: Dmnl

hydro investment([(1970,0)-(2010,1e+011)],(1970,2.68e+010),(1977,6.18e+010),(1986,5.92e+010),(2001.74,8.89e+010),(2010,9.9e+010)) Units: usd15

hydro load factor([(2010,0.3)-(2050,0.4)],(2010,0.383747),(2022,0.355249),(2023,0.34379),(2030,0.350912),(2035,0.350871),(2040,0.351844),(2050,0.359682)) Units: Dmnl

hydro maintenance cost= hydro capacity*hydro maintenance costper mw Units: usd15/Year

hydro maintenance costper mw= 55312.5 Units: usd15/Year

hydro manufacturing employment factor([(2010,0)-(2030,10)],(2010,0.8),(2011,0.7947),(2012,0.7894),(2013,0.7839),(2014,0.7784),(2015,0.7728),(2016,0.767),(2017,0.7612),(2018,0.7553),(2019,0.7493),(2020,0.7432),(2021,0.7362),(2022,0.7292),(2023,0.722),(2024,0.7148),(2025,0.7075),(2026,0.7001),(2027,0.6926),(2028,0.685),(2029,0.6773),(2030 ,0.6696)) Units: Person/MW

hydro operation and maintenance employment= hydro capacity*hydro operation and maintenance employment factor(Time) Units: Person/Year

hydro operation and maintenance employment factor([(2010,0)-(2030,1)],(2010,0.352),(2011,0.3497),(2012,0.3473),(2013,0.3449),(2014,0.3425),(2015,0.34),(2016,0.3375),(2017,0.3349),(2018,0.3323),(2019,0.3297),(2020,0.327),(2021,0.3239),(2022,0.3208),(2023,0.3177),(2024,0.3145),(2025,0.3113),(2026,0.308),(2027,0.3047),(2028,0.3014),(2029,0.298),(2030 ,0.2946)) Units: Person/MW

hydro power capacity use= hydro load factor(Time)*potential electricity generation hydro Units: MWh/Year

hydro share of power generation= hydro electricity generation/total electricity generation Units: Dmnl

hydropower: HYDROPOWER LARGE SCALE, HYDROPOWER SMALL SCALE

identified World Coal reserve developable remaining= World Coal Identified Reserve non recoverable*Coal Fraction Developable(Time) Units: MST

identified World Natural Gas reserve developable remaining= World Natural Gas Identified Reserve non recoverable*Natural Gas Fraction Developable (Time) Units: BCF

identified World Oil reserve developable remaining= World Oil Identified Reserve non recoverable*Oil Fraction Developable(Time) Units: MB

IEA NET ZERO SWITCH= 1 Units: Dmnl

IncClass: (incclass 1 - incclass 100)

incclass not first: (incclass 2 - incclass 100)

incinerator waste= INTEG (waste for incinerator-use of incinerator waste, 900000) Units: Ton

income class level[IncClass]= income class size*IncClass Units: Dmnl

income class size= 300 Units: Dmnl

income distribution[IncClass]= (1/(income class level[IncClass]*std dev of income ln*(2*p)^0.5))*exp(-((LN (income class level[IncClass])-mean of income ln)^2)/(2*std dev of income ln ^2)) Units: Dmnl

income distribution area[incclass not first]= income distribution[incclass not first]-(income distribution[incclass not first]-vector elm map(income distribution[incclass not

first],-1))/2 income distribution area[incclass 1]= income distribution[incclass 1]/2 Units: Dmnl

income index= (pc gdp-min pc gdp)/(max pc gdp-min pc gdp) Units: 1

income weight= 0.7 Units: Dmnl

"Increase in geothermal capacity IEA.NZ"= WITH LOOKUP (Time, ([(2000,0.9)-(2027,2)],(2000,1),(2026,1),(2027,5),(2040,5),(2041,5))) Units: Dmnl

"Increase in hydro capacity IEA.NZ"= WITH LOOKUP (Time, ([(2000,0.9)-(2027,2)],(2000,1),(2026,1),(2027,1.5),(2040,1.5),(2041,1))) Units: Dmnl

"Increase in nuclear capacity IEA.NZ"= WITH LOOKUP (Time, ([(2000,0)-(2050,5)],(2000,1),(2026,1),(2027,3),(2035,5),(2050,2))) Units: Dmnl

"Increase in solar capacity IEA.NZ"= WITH LOOKUP (Time, ([(2000,0.9)-(2027,2)],(2000,1),(2026,1),(2027,5),(2040,5),(2041,5))) Units: Dmnl

"Increase in tidal capacity IEA.NZ"= WITH LOOKUP (Time, ([(2000,0.9)-(2027,2)],(2000,1),(2026,1),(2027,5),(2030,18),(2050,27))) Units: Dmnl

"Increase in waste capacity IEA.NZ"= WITH LOOKUP (Time, ([(2000,0.9)-(2027,2)],(2000,1),(2026,1),(2027,2),(2030,2.5),(2050,3.7))) Units: Dmnl

"Increase in wind capacity IEA.NZ"= WITH LOOKUP (Time, ([(2000,0.9)-(2027,2)],(2000,1),(2026,1),(2027,3.5),(2040,3.5),(2041,3.5))) Units: Dmnl

Increase in yield per hectare reforested due to less food losses= 7.474e-009*0.5 Units: Ton/Ha

Increased productivity yield per hectare= DELAY1I(Additional agricultural productivity, 1 , 0) Units: Ton/Ha

ind CH4 CO2 equivalent= ind fossil fuel CH4 emission*CH4 TO CO2 Units: Kg/Year

ind CO2 emission in kg= ind fossil fuel CO2 emission * TON to KG Units: Kg/Year

ind fossil fuel C emission= (ind fossil fuel consumption in Tj coal*FOSSIL FUEL C EMISSION FACTOR coal)+(ind fossil fuel consumption in Tj natural gas*FOSSIL FUEL C EMISSION FACTOR natural gas)+(ind fossil fuel consumption in Tj petroleum*FOSSIL FUEL C EMISSION FACTOR petroleum) Units: Ton/Year

ind fossil fuel CH4 emission= (ind fossil fuel consumption in Tj coal*FOSSIL FUEL CH4 EMISSION FACTOR coal)+(ind fossil fuel consumption in Tj natural gas*FOSSIL FUEL CH4 EMISSION FACTOR natural gas)+(ind fossil fuel consumption in Tj petroleum*FOSSIL FUEL CH4 EMISSION FACTOR petroleum) Units: Kg/Year

ind fossil fuel CO2 emission= ind fossil fuel C emission*molecular weight of CO2/molecular weight of C Units: Ton/Year

ind fossil fuel consumption coal= ind total coal consumption in qdbtu*QDBTU to BTU Units: BTU/Year

ind fossil fuel consumption in Tj coal= ind fossil fuel consumption coal*BTU to Tj*GCV to NCV Units: Tj/Year

ind fossil fuel consumption in Tj natural gas= ind fossil fuel consumption natural gas*BTU to Tj*GCV to NCV Units: Tj/Year

ind fossil fuel consumption in Tj petroleum= ind fossil fuel consumption petroleum*BTU to Tj*GCV to NCV Units: Tj/Year

ind fossil fuel consumption natural gas= ind total natural gas consumption in qdbtu * QDBTU to BTU Units: BTU/Year

ind fossil fuel consumption petroleum= ind total petroleum consumption in qdbtu*QDBTU to BTU Units: BTU/Year

ind fossil fuel GHG emissions= ind CO2 emission in kg+ind CH4 CO2 equivalent+ind N2O CO2 equivalent Units: Kg/Year

ind fossil fuel GHGas emissions in Tons= ind fossil fuel GHG emissions/TON to KG Units: Ton/Year

ind fossil fuel N2O emission= ind fossil fuel C emission*N IN N2O TO C RATIO*N TO N2O WEIGHT*KG PER TON Units: Kg/Year

ind fossil fuel SOx emission= (ind total energy burned coal*SOX COEF coal)+(ind total energy burned natural gas *SOX COEF natural gas)+(ind total energy burned petroleum*SOX COEF petroleum) Units: Kg/Year

ind N2O CO2 equivalent= ind fossil fuel N2O emission * N2O TO CO2 Units: Kg/Year

ind total coal consumption in qdbtu= normalized industrial coal demand Units: qdbtu/Year

ind total energy burned coal= ind fossil fuel consumption coal*(1-NON FUEL ENERGY CONSUMPTION coal) Units: BTU/Year

ind total energy burned natural gas= ind fossil fuel consumption natural gas*(1-NON FUEL ENERGY CONSUMPTION natural gas) Units: BTU/Year

ind total energy burned petroleum= ind fossil fuel consumption petroleum*(1-NON FUEL ENERGY CONSUMPTION petroleum) Units: BTU/Year

ind total natural gas consumption in qdbtu= normalized industrial natural gas demand Units: qdbtu/Year

ind total petroleum consumption in qdbtu= normalized industrial petroleum demand Units: qdbtu/Year

indicated addition to world oil discovered reserve= if then else(Time>=RESERVE ADDITION YEAR :AND: Time< RESERVE ADDITION YEAR +1, reserve addition,0) Units: MB/Year

indicated addition to world oil undiscovered resource= if then else(Time>=RESOURCE ADDITION YEAR :AND: Time< RESOURCE ADDITION YEAR +1,resource addition,0) Units: MB/Year

indicated agric desired water demand rate= initial agric water demand/TOTAL FACTOR PRODUCTIVITY AGRICULTURE^ELASTICITY OF agric WATER WITHDRAWAL RATE ON TOTAL FACTOR PRODUCTIVITY Units: Km3/Year

indicated agriculture coal demand= indicated agriculture coal gdp intensity*real gross domestic product Units: qdbtu/Year

indicated agriculture coal demand 0= indicated agriculture coal demand-indicated reduction in agriculture coal demand from electrification Units: qdbtu/Year

indicated agriculture coal gdp intensity= initial indicated agriculture coal gdp intensity(Time)/energy efficiency switch Units: qdbtu/usd15

indicated agriculture electricity GDP Intensity= initial indicated agriculture electricity GDP Intensity(Time)/energy efficiency switch Units: qdbtu/usd15

indicated agriculture employment demand= agriculture labor demand*labor availability Units: Person

indicated agriculture natural gas demand= indicated agriculture natural gas GDP Intensity*real gross domestic product Units: qdbtu/Year

indicated agriculture natural gas demand 0= indicated agriculture natural gas demand-Indicated reduction in agriculture natural gas demand Units: qdbtu/Year

indicated agriculture natural gas GDP Intensity= initial indicated agriculture natural gas GDP Intensity(Time)/energy efficiency switch Units: qdbtu/usd15

indicated agriculture petroleum demand= indicated agriculture petroleum gdp intensity*real gross domestic product Units: qdbtu/Year

indicated agriculture petroleum demand 0= indicated agriculture petroleum demand-indicated reduction in agriculture petroleum demand from electrification Units: qdbtu/Year

indicated agriculture petroleum gdp intensity= initial indicated agriculture petroleum gdp intensity(Time)/energy efficiency switch Units: qdbtu/usd15

indicated agriculture renewable resources demand= indicated agriculture renewable resources GDP intensity*real gross domestic product Units: qdbtu/Year

indicated agriculture renewable resources demand 0= indicated agriculture renewable resources demand-indicated reduction in agriculture renewable resources demand from electrification Units: qdbtu/Year

indicated agriculture renewable resources GDP intensity= Initial indicated agriculture renewable resources GDP intensity(Time)/energy efficiency switch Units: qdbtu/usd15

indicated agricultureelectricity net demand= indicated agriculture electricity GDP Intensity*real gross domestic product Units: qdbtu/Year

indicated agricultureelectricity net demand 0= indicated agricultureelectricity net demand+additional agriculture electricity demand from electrification Units: qdbtu/Year

indicated air travel reduction= air travel reduction fraction*air travel volume Units: Km/Year

indicated Aluminum material cost= if then else(Time<2009, Aluminum unit cost(Time), Aluminum material cost*percentage increase in material cost F) Units: USD/Ton

indicated Aluminum price= if then else(Time<2009, Aluminum market price table(Time), Aluminum price* percentage increase in material cost F) Units: USD/Ton

indicated annual wind maintenance cost= indicated output wind plant*indicated wind maintenance cost per kwh Units: usd15/Year

indicated arable land per capita= SMOOTH N(initial required arable land per person*TOTAL FACTOR PRODUCTIVITY AGRICULTURE ^elasticity of factor productivity on desired arable land , time for changes in productivity to affect arable land demand, initial required arable land per person ,1) Units: Ha/Person

indicated brown agriculture employment demand= brown agriculture labor demand*labor availability Units: Person

indicated BUS TRAVEL= (INDICATED ROAD TRAVEL*SHARE OF BUS TRAVEL)+(indicated car travel reduction *share of car travel reduction to buses) Units: Km/Year

INDICATED BUS travel volume[bus type]= INDICATED Share of travel volume BY BUS[bus type]*indicated BUS TRAVEL Units: Km/Year

INDICATED CAR TRAVEL= INDICATED ROAD TRAVEL*SHARE OF CAR TRAVEL Units: Km/Year

indicated car travel reduction= INDICATED CAR TRAVEL*car travel reduction fraction Units: Km/Year

INDICATED CAR travel volume[vehicle tech type]= (actual car travel)*INDICATED Share of travel volume BY CAR[vehicle tech type] Units: Km/Year

indicated Chemical and plastics material cost= if then else(Time<2009, Chemical and plastics unit cost(Time), Chemical and plastics material cost *percentage increase in material cost F) Units: usd15/Ton

indicated Chemical and plastics price= if then else(Time<2009, Chemical and plastics market price table(Time), Chemical and plastics price *percentage increase in material cost F) Units: usd15/Ton

indicated commercial coal demand= indicated commercial coal gdp intensity*real gross domestic product Units: qdbtu/Year

indicated commercial coal demand 0= indicated commercial coal demand-indicated reduction in commercial coal demand from electrification Units: qdbtu/Year

indicated commercial coal gdp intensity= initial indicated commercial coal gdp intensity(Time)/energy efficiency switch Units: qdbtu/usd15

indicated commercial electricity GDP Intensity= initial indicated commercial electricity GDP Intensity(Time)/energy efficiency switch Units: qdbtu/usd15

indicated commercial electricity net demand= indicated commercial electricity GDP Intensity*real gross domestic product Units: qdbtu/Year

indicated commercial electricity net demand 0= indicated commercial electricity net demand+additional commericla electricity demand from electrification Units: qdbtu/Year

indicated commercial natural gas demand= indicated commercial natural gas GDP Intensity*real gross domestic product Units: qdbtu/Year

indicated commercial natural gas demand 0= indicated commercial natural gas demand-Indicated reduction in commericla natural gas demand Units: qdbtu/Year

indicated commercial natural gas GDP Intensity= (initial indicated commercial natural gas GDP Intensity(Time)*1.1)/energy efficiency switch Units: qdbtu/usd15

indicated commercial petroleum demand= indicated commercial petroleum gdp intensity*real gross domestic product Units: qdbtu/Year

indicated commercial petroleum demand 0= indicated commercial petroleum demand-indicated reduction in commercial petroleum demand from electrification Units: qdbtu/Year

indicated commercial petroleum gdp intensity= initial indicated commercial petroleum gdp intensity(Time)/energy efficiency switch Units: qdbtu/usd15

indicated commercial renewable resources demand= indicated Commercial renewable resources GDP intensity*real gross domestic product Units: qdbtu/Year

indicated commercial renewable resources demand 0= indicated commercial renewable resources demand-indicated reduction in commercial renewable resources demand from electrification Units: qdbtu/Year

indicated Commercial renewable resources GDP intensity= Initial indicated Commercial renewable resources GDP intensity(Time)/energy efficiency switch Units: qdbtu/usd15

indicated deforestation reduction= DELAY N(deforestation reduction, 1, 0, 3) Units: Ha/Year

indicated diesel and fuel maintenance cost per kwh= indicated diesel and fuel oil production cost*indicated share of disel and fuel maintenance cost Units: usd15/kWh

indicated diesel and fuel oil production cost= 4 Units: usd15/kWh

indicated Fishing coal demand= indicated Fishing coal gdp intensity*real gross domestic product Units: qdbtu/Year

indicated Fishing coal demand 0= indicated Fishing coal demand-indicated reduction in fishing coal demand from electrification Units: qdbtu/Year

indicated Fishing coal gdp intensity= initial indicated Fishing coal gdp intensity(Time)/energy efficiency switch Units: qdbtu/usd15

indicated Fishing electricity GDP Intensity= initial indicated Fishing electricity GDP Intensity(Time)/energy efficiency switch Units: qdbtu/usd15

indicated Fishing electricity net demand= indicated Fishing electricity GDP Intensity*real gross domestic product Units: qdbtu/Year

indicated Fishing electricity net demand 0= indicated Fishing electricity net demand+additional fishing electricity demand from electrification Units: qdbtu/Year

indicated Fishing natural gas demand= indicated Fishing natural gas GDP Intensity*real gross domestic product Units: qdbtu/Year

indicated Fishing natural gas demand 0= indicated Fishing natural gas demand-Indicated reduction in fishing natural gas demand Units: qdbtu/Year

indicated Fishing natural gas GDP Intensity= initial indicated Fishing natural gas GDP Intensity(Time)/energy efficiency switch Units: qdbtu/usd15

indicated Fishing petroleum demand= indicated Fishing petroleum gdp intensity*real gross domestic product Units: qdbtu/Year

indicated Fishing petroleum demand 0= indicated Fishing petroleum demand-indicated reduction in fishing petroleum demand from electrification Units: qdbtu/Year

indicated Fishing petroleum gdp intensity= initial indicated Fishing petroleum gdp intensity(Time)/energy efficiency switch Units: qdbtu/usd15

indicated Fishing renewable resources demand= indicated Fishing renewable resources GDP intensity*real gross domestic product Units: qdbtu/Year

indicated Fishing renewable resources demand 0= indicated Fishing renewable resources demand-indicated reduction in fishing renewable resources demand from electrification Units: qdbtu/Year

indicated Fishing renewable resources GDP intensity= Initial indicated Fishing renewable resources GDP intensity(Time)/energy efficiency switch Units: qdbtu/usd15

indicated fraction of air travel reduction= fraction of indicated air travel reduction(Time) Units: Dmnl

indicated fraction of car travel reduction= fraction of indicated car travel reduction(Time) Units: Dmnl

indicated fraction of private cars population reduction= fraction of private cars population reduction(Time) Units: Dmnl

indicated fraction of reduction in total travel volume due to efficiency= fraction of reduction in total travel volume due to efficiency(Time) Units: Dmnl

indicated fraction of water consumption reduction from efficiency= if then else(indicated green economy investment fraction=0, 0, fraction of water consumption reduction from efficiency) Units: Dmnl

indicated gas maintenance cost per kwh= indicated gas production cost*indicated share of gas maintenance cost Units: usd15/kWh

indicated gas production cost= 15 Units: usd15/kWh

indicated green agriculture employment demand= green agriculture labor demand*labor availability Units: Person

indicated green economy investment fraction= green economy investment fraction(Time) Units: Dmnl

indicated gross domestic product= DELAY N(real gross domestic product, 1, 1.17887e+013 , 3) Units: usd15/Year

indicated hydro maintenance cost per kwh= indicated hydro production cost*indicated share of hydro maintenance cost Units: usd15/kWh

indicated hydro production cost= 4e+009 Units: usd15/kWh

Indicated industrial coal demand= (indicated industrial Coal GDP Intensity*real gross domestic product)+CE coal consumption in QDBTU Units: qdbtu/Year

Indicated industrial coal demand 0= Indicated industrial coal demand-indicated reduction in industrial coal demand from electrification Units: qdbtu/Year

indicated industrial Coal GDP Intensity= (initial indicated industrial Coal GDP Intensity(Time)*CORRECTION FACTOR coal industrial use)/energy efficiency switch Units: qdbtu/usd15

indicated industrial electricity GDP Intensity= initial indicated industrial electricity GDP Intensity(Time)/energy efficiency switch Units: qdbtu/usd15

Indicated industrial electricity net demand= (indicated industrial electricity GDP Intensity*real gross domestic product)+CE electricity consumption in QDBTU Units: qdbtu/Year

Indicated industrial electricity net demand 0= additional electricity demand from electrification+Indicated industrial electricity net demand Units: qdbtu/Year

indicated industrial emission abatement= DELAY N(industrial emission abatement, 1, 0, 3) Units: Ton/Year

Indicated industrial natural gas demand= (indicated industrial natural gas GDP Intensity*real gross domestic product)+CE natural gas consumption in QDBTU Units: qdbtu/Year

Indicated industrial natural gas demand 0= Indicated industrial natural gas demand-Indicated reduction in industrial natural gas demand Units: qdbtu/Year

indicated industrial natural gas GDP Intensity= (initial indicated industrial natural gas GDP Intensity(Time)*CORRECTION FACTOR natural gas industrial use)/energy efficiency switch Units: qdbtu/usd15

Indicated industrial petroleum demand= (indicated industrial petroleum GDP Intensity*real gross domestic product) +CE oil consumption industry in QDBTU Units: qdbtu/Year

Indicated industrial petroleum demand 0= Indicated industrial petroleum demand-indicated reduction in industrial petroleum demand from electrification Units: qdbtu/Year

indicated industrial petroleum GDP Intensity= (initial indicated industrial petroleum GDP Intensity(Time)*CORRECTION FACTOR petroleum industrial use)/energy efficiency switch Units: qdbtu/usd15

indicated Industrial renewable resources demand= indicated Industrial renewable resources GDP intensity*real gross domestic product Units: qdbtu/Year

indicated Industrial renewable resources demand 0= indicated Industrial renewable resources demand-indicated reduction in industrial renewable resources demand from electrification Units: qdbtu/Year

indicated Industrial renewable resources GDP intensity= (Initial indicated Industrial renewable resources GDP intensity(Time)*CORRECTION FACTOR renewable resources industrial use)/energy efficiency switch Units: qdbtu/usd15

indicated industry employment demand= industry labor demand*labor availability+total employment in CE sectors Units: Person

indicated Leather material cost= if then else(Time<2009, Leather unit cost(Time), Leather material cost*percentage increase in material cost F) Units: USD/Ton

indicated Leather price= if then else(Time<2009, Leather market price table(Time), Leather price*percentage increase in material cost F) Units: USD/Ton

indicated life expectancy at birth= left saturation point+(right saturation point-left saturation point)*(1/(exp (-steepness*well being index)*exp(inflection point *steepness)+1)-(exp(-steepness*well being index)/(exp(inflection point*steepness)+1))) Units: Year

"indicated non-energy use coal demand 0"= "indicated non-energy use coal demand"-indicated reduction in nonenergy coal demand from electrification Units: qdbtu/Year

"indicated non-energy use coal demand"= "indicated non-energy use coal gdp intensity"*real gross domestic product Units: qdbtu/Year

"indicated non-energy use coal gdp intensity"= "initial indicated non-energy use coal gdp intensity"(Time)/energy efficiency switch Units: qdbtu/usd15

"indicated non-energy use electricity GDP Intensity"= "initial indicated non-energy use electricity GDP Intensity"(Time)/energy efficiency switch Units: qdbtu/usd15

"indicated non-energy use electricity net demand 0"= "indicated non-energy use electricity net demand"+additional nonenergy electricity demand from electrification Units: qdbtu/Year

"indicated non-energy use electricity net demand"= "indicated non-energy use electricity GDP Intensity"*real gross domestic product Units: qdbtu/Year

"indicated non-energy use natural gas demand 0"= "indicated non-energy use natural gas demand"-Indicated reduction in nonenergy natural gas demand Units: qdbtu/Year

"indicated non-energy use natural gas demand"= "indicated non-energy use natural gas GDP Intensity"*real gross domestic product Units: qdbtu/Year

"indicated non-energy use natural gas GDP Intensity"= "initial indicated non-energy use natural gas GDP Intensity"(Time)/energy efficiency switch Units: qdbtu/usd15

"indicated non-energy use petroleum demand 0"= "indicated non-energy use petroleum demand"-indicated reduction in nonenergy petroleum demand from electrification Units: qdbtu/Year

"indicated non-energy use petroleum demand"= "indicated non-energy use petroleum gdp intensity"*real gross domestic product Units: qdbtu/Year

"indicated non-energy use petroleum gdp intensity"= ("initial indicated non-energy use petroleum gdp intensity"(Time)*CORRECTION FACTOR OIL CONSUMPTION)/energy efficiency switch Units: qdbtu/usd15

"indicated non-energy use renewable resources demand 0"= "indicated non-energy use renewable resources demand"-indicated reduction in nonenergy renewable resources demand from electrification Units: qdbtu/Year

"indicated non-energy use renewable resources demand"= "indicated non-energy use renewable resources GDP intensity"*real gross domestic product Units: qdbtu/Year

"indicated non-energy use renewable resources GDP intensity"= "Initial indicated non-energy use renewable resources GDP intensity"(Time) /energy efficiency switch Units: qdbtu/usd15

indicated Others coal demand= indicated Others coal gdp intensity*real gross domestic product Units: qdbtu/Year

indicated Others coal demand 0= indicated Others coal demand-indicated reduction in others coal demand from electrification Units: qdbtu/Year

indicated Others coal gdp intensity= initial indicated Others coal gdp intensity(Time)/energy efficiency switch Units: qdbtu/usd15

indicated Others electricity GDP Intensity= initial indicated Others electricity GDP Intensity(Time)/energy efficiency switch Units: qdbtu/usd15

indicated Others electricity net demand= indicated Others electricity GDP Intensity*real gross domestic product Units: qdbtu/Year

indicated Others electricity net demand 0= indicated Others electricity net demand+additional others electricity demand from electrification Units: qdbtu/Year

indicated Others natural gas demand= indicated Others natural gas GDP Intensity*real gross domestic product Units: qdbtu/Year

indicated Others natural gas demand 0= indicated Others natural gas demand-Indicated reduction in others natural gas demand Units: qdbtu/Year

indicated Others natural gas GDP Intensity= initial indicated Others natural gas GDP Intensity(Time)/energy efficiency switch Units: qdbtu/usd15

indicated Others petroleum demand= indicated Others petroleum gdp intensity*real gross domestic product Units: qdbtu/Year

indicated Others petroleum demand 0= indicated Others petroleum demand-indicated reduction in others petroleum demand from electrification Units: qdbtu/Year

indicated Others petroleum gdp intensity= initial indicated Others petroleum gdp intensity(Time)/energy efficiency switch Units: qdbtu/usd15

indicated Others renewable resources demand= indicated Others renewable resources GDP intensity*real gross domestic product Units: qdbtu/Year

indicated Others renewable resources demand 0= indicated Others renewable resources demand-indicated reduction in others renewable resources demand from electrification Units: qdbtu/Year

indicated Others renewable resources GDP intensity= Initial indicated Others renewable resources GDP intensity(Time)/energy efficiency switch Units: qdbtu/usd15

indicated output fuel oil plant= 8.2712e+008 Units: kWh/Year

indicated output gas plant= 6.5815e+006 Units: kWh/Year

indicated output hydro plant= 3.07842e+006*1000*24*365 Units: kWh/Year

indicated output wind plant= 367700 Units: kWh/Year

indicated Paper and pulp material cost= if then else(Time<2009, Paper and pulp unit cost(Time), Paper and pulp material cost *percentage increase in material cost F) Units: USD/Ton

indicated Paper and pulp price= if then else(Time<2009, Paper and pulp market price table(Time), Paper and pulp price *percentage increase in material cost F) Units: USD/Ton

indicated pasture land per capita= SMOOTH N(initial required pasture land per person*TOTAL FACTOR PRODUCTIVITY AGRICULTURE ^elasticity of factor productivity on desired pasture land , time for changes in productivity to affect pasture land demand,initial required pasture land per person ,1) Units: Ha/Person

indicated private car users population= private car users population-private car users population reduction Units: Person/Year

indicated rail travel volume[rail type]= indicated Share of travel volume BY rail[rail type]*rail travel Units: Km/Year

indicated ransportation emission abatement cost= if then else(indicated green economy investment fraction=0, 0, transportation emission abatement cost) Units: usd15/Year

indicated reduction in agriculture coal demand from electrification= electrification switch*indicated agriculture coal demand Units: qdbtu/Year

Indicated reduction in agriculture natural gas demand= electrification switch*indicated agriculture natural gas demand Units: qdbtu/Year

indicated reduction in agriculture petroleum demand from electrification= electrification switch*indicated agriculture petroleum demand Units: qdbtu/Year

indicated reduction in agriculture renewable resources demand from electrification = electrification switch*indicated agriculture renewable resources demand Units: qdbtu/Year

indicated reduction in commercial renewable resources demand from electrification = electrification switch*indicated commercial renewable resources demand Units: qdbtu/Year

indicated reduction in commercial coal demand from electrification= electrification switch*indicated commercial coal demand Units: qdbtu/Year

indicated reduction in commercial petroleum demand from electrification= electrification switch*indicated commercial petroleum demand Units: qdbtu/Year

Indicated reduction in commericla natural gas demand= electrification switch*indicated commercial natural gas demand Units: qdbtu/Year

indicated reduction in fishing coal demand from electrification= electrification switch*indicated Fishing coal demand Units: qdbtu/Year

Indicated reduction in fishing natural gas demand= electrification switch*indicated Fishing natural gas demand Units: qdbtu/Year

indicated reduction in fishing petroleum demand from electrification= electrification switch*indicated Fishing petroleum demand Units: qdbtu/Year

indicated reduction in fishing renewable resources demand from electrification = electrification switch*indicated Fishing renewable resources demand Units: qdbtu/Year

indicated reduction in industrial coal demand from electrification= electrification switch*Indicated industrial coal demand Units: qdbtu/Year

Indicated reduction in industrial natural gas demand= electrification switch*Indicated industrial natural gas demand Units: qdbtu/Year

indicated reduction in industrial petroleum demand from electrification= electrification switch*Indicated industrial petroleum demand Units: qdbtu/Year

indicated reduction in industrial renewable resources demand from electrification = electrification switch*indicated Industrial renewable resources demand Units: qdbtu/Year

indicated reduction in nonenergy coal demand from electrification= electrification switch*"indicated non-energy use coal demand" Units: qdbtu/Year

Indicated reduction in nonenergy natural gas demand= electrification switch*"indicated non-energy use natural gas demand" Units: qdbtu/Year

indicated reduction in nonenergy petroleum demand from electrification= electrification switch*"indicated non-energy use petroleum demand" Units: qdbtu/Year

indicated reduction in nonenergy renewable resources demand from electrification = electrification switch*"indicated non-energy use renewable resources demand" Units: qdbtu/Year

indicated reduction in others coal demand from electrification= electrification switch*indicated Others coal demand Units: qdbtu/Year

Indicated reduction in others natural gas demand= electrification switch*indicated Others natural gas demand Units: qdbtu/Year

indicated reduction in others petroleum demand from electrification= electrification switch*indicated Others petroleum demand Units: qdbtu/Year

indicated reduction in others renewable resources demand from electrification = electrification switch*indicated Others renewable resources demand Units: qdbtu/Year

indicated reduction in residental coal demand from electrification= electrification switch*indicated residential coal demand Units: qdbtu/Year

indicated reduction in residental renewable resources demand from electrification = electrification switch*indicated residential renewable resources demand Units: qdbtu/Year

Indicated reduction in residential natural gas demand= electrification switch*indicated residential natural gas demand Units: qdbtu/Year

indicated reduction in residential petroleum demand from electrification= electrification switch*indicated residential petroleum demand Units: qdbtu/Year

indicated reduction in transport coal demand from electrification= electrification switch*indicated transportation coal demand Units: qdbtu/Year

Indicated reduction in transport natural gas demand= electrification switch*indicated transportation natural gas demand Units: qdbtu/Year

indicated reduction in transport petroleum demand from electrification= electrification switch*indicated transportation petroleum demand Units: qdbtu/Year

indicated reduction in transport renewable resources demand from electrification = electrification switch*indicated transportation renewable resources demand Units: qdbtu/Year

indicated residential coal demand= real gross domestic product*indicated residential coal gdp intensity Units: qdbtu/Year

indicated residential coal demand 0= indicated residential coal demand-indicated reduction in residental coal demand from electrification Units: qdbtu/Year

indicated residential coal gdp intensity= initial indicated residential coal gdp intensity(Time)/energy efficiency switch Units: qdbtu/usd15

indicated residential electricity GDP Intensity= initial indicated residential electricity GDP Intensity(Time)/energy efficiency switch Units: qdbtu/usd15

indicated residential electricity net demand= real gross domestic product*indicated residential electricity GDP Intensity Units: qdbtu/Year

indicated residential electricity net demand 0= indicated residential electricity net demand+additional residential electricity demand from electrification Units: qdbtu/Year

indicated residential natural gas demand= real gross domestic product*indicated residential natural gas GDP Intensity Units: qdbtu/Year

indicated residential natural gas demand 0= indicated residential natural gas demand-Indicated reduction in residential natural gas demand Units: qdbtu/Year

indicated residential natural gas GDP Intensity= (initial indicated residential natural gas GDP Intensity(Time)*1.1)/energy efficiency switch Units: qdbtu/usd15

indicated residential petroleum demand= real gross domestic product*indicated residential petroleum gdp intensity Units: qdbtu/Year

indicated residential petroleum demand 0= indicated residential petroleum demand-indicated reduction in residential petroleum demand from electrification Units: qdbtu/Year

indicated residential petroleum gdp intensity= (initial indicated residential petroleum gdp intensity(Time)*CORRECTION FACTOR OIL CONSUMPTION)/energy efficiency switch Units: qdbtu/usd15

indicated residential renewable resources demand= real gross domestic product*indicated residential renewable resources GDP intensity Units: qdbtu/Year

indicated residential renewable resources demand 0= indicated residential renewable resources demand-indicated reduction in residental renewable resources demand from electrification Units: qdbtu/Year

indicated residential renewable resources GDP intensity= Initial indicated residential renewable resources GDP intensity(Time)/energy efficiency switch Units: qdbtu/usd15

INDICATED ROAD TRAVEL= travel volume by travel modes[road] Units: Km/Year

indicated row Coal demand= DELAY N(coal demand*effect of Coal price on ROW demand, 1, 2500,3) Units: MST/Year

indicated row natural gas demand= DELAY N(natural gas demand*effect of natural gas price on ROW demand, 1, 35090 ,3) Units: BCF/Year

indicated services employment demand= labor availability*services labor demand Units: Person

indicated share of disel and fuel maintenance cost= 0.1 Units: Dmnl

indicated share of gas maintenance cost= 0.1 Units: Dmnl

indicated share of hydro maintenance cost= 0.05 Units: Dmnl

INDICATED Share of travel volume BY BUS[bus type]= REFERENCE Share of travel volume BY BUS[bus type](Time) Units: Dmnl

INDICATED Share of travel volume BY CAR[vehicle tech type]= REFERENCE Share of travel volume BY CAR[vehicle tech type](Time) Units: Dmnl

indicated Share of travel volume BY rail[rail type]= REFERENCE Share of travel volume BY rail[rail type](Time) Units: Dmnl

INDICATED share of travel volume BY TRAVEL MODES[travel modes]= REFERENCE share of travel volume BY TRAVEL MODES[travel modes](Time) Units: Dmnl

INDICATED Share of travel volume BY TRUCK[truck type]= REFERENCE Share of travel volume BY TRUCK[truck type](Time) Units: Dmnl

INDICATED share of travel volume BY VEHICLE["2or3 wheel type"]= REFERENCE share of travel volume BY VEHICLE["2or3 wheel type"](Time) Units: Dmnl

indicated share of wind maintenance cost= 0.05 Units: Dmnl

indicated steel material cost= if then else(Time<2009, steel unit cost(Time), steel material cost*percentage increase in material cost F) Units: USD/Ton

indicated steel price= if then else(Time<2009, steel market price table(Time), steel price*percentage increase in material cost F) Units: USD/Ton

indicated tech progress= INTEG (tech progress rate of change, 1) Units: Dmnl

indicated Textile material cost= if then else(Time<2009, textile unit cost(Time), Textile material cost*percentage increase in material cost F) Units: USD/Ton

indicated Textile price= if then else(Time<2009, Textile market price table(Time), Textile price*percentage increase in material cost F) Units: USD/Ton

indicated total co2 emission from power generation= DELAY N(total co2 emission from power generation, 1, 2.84142e+009 , 3) Units: Ton/Year

indicated total industry co2 emissions= DELAY N(ind fossil fuel GHGas emissions in Tons, 1,3.88397e+009, 3) Units: Ton/Year

indicated total transportation emissions in tons= total transport co2 emissions in tons 1pct Units: Ton/Year

INDICATED total water demand= DELAY N(total water demand, 1, 2203, 3) Units: Km3/Year

indicated transport model share[transport modal share]= if then else(Time<=2010, INITIAL TRANSPORT MODaL SHARE[transport modal share], trasport modal share policy[transport modal share]) Units: Dmnl/Year

indicated transportation coal demand= indicated transportation coal gdp intensity*real gross domestic product Units: qdbtu/Year

indicated transportation coal demand 0= indicated transportation coal demand-indicated reduction in transport coal demand from electrification Units: qdbtu/Year

indicated transportation coal gdp intensity= initial indicated commercial coal gdp intensity 0(Time)/energy efficiency switch Units: qdbtu/usd15

indicated transportation electricity GDP Intensity= initial indicated transportation electricity GDP Intensity(Time)/energy efficiency switch Units: qdbtu/usd15

indicated transportation electricity net demand= indicated transportation electricity GDP Intensity*real gross domestic product Units: qdbtu/Year

indicated transportation electricity net demand 0= indicated transportation electricity net demand+additional transport electricity demand from electrification Units: qdbtu/Year

indicated transportation emission abatement= cummulative transportation efficiency green investment/transportation cost of co2 emission abatement per ton of co2 (Time) Units: Ton/Year

indicated transportation natural gas demand= indicated transportation natural gas GDP Intensity*real gross domestic product Units: qdbtu/Year

indicated transportation natural gas demand 0= indicated transportation natural gas demand-Indicated reduction in transport natural gas demand Units: qdbtu/Year

indicated transportation natural gas GDP Intensity= initial indicated transportation natural gas GDP Intensity(Time)/energy efficiency switch Units: qdbtu/usd15

indicated transportation oil demand= (air energy consumption+freight rail energy consumption*share of freight rail fuel consumption time series [diesel](Time)+passenger rail energy consumption *share of passenger rail fuel consumption time series[diesel](Time)+((total buses energy consumption +total cars energy consumption)*(1-share of cars that are EVs))+total trucks energy consumption +total vehicle energy consumption+total water transport energy consumption) *(1-electrification switch) Units: mtoe/Year

indicated transportation petroleum demand= (indicated transportation petroleum gdp intensity*real gross domestic product)+CE oil consumption transport in QDBTU Units: qdbtu/Year

indicated transportation petroleum demand 0= indicated transportation petroleum demand-indicated reduction in transport petroleum demand from electrification Units: qdbtu/Year

indicated transportation petroleum gdp intensity= initial indicated transportation petroleum gdp intensity(Time)/energy efficiency switch Units: qdbtu/usd15

indicated transportation renewable resources demand= indicated transportation renewable resources GDP intensity*real gross domestic product Units: qdbtu/Year

indicated transportation renewable resources demand 0= indicated transportation renewable resources demand-indicated reduction in transport renewable resources demand from electrification Units: qdbtu/Year

indicated transportation renewable resources GDP intensity= Initial indicated transportation renewable resources GDP intensity(Time)/energy efficiency switch Units: qdbtu/usd15

INDICATED TRUCK TRAVEL= INDICATED ROAD TRAVEL*SHARE OF TRUCK TRAVEL Units: Km/Year

INDICATED TRUCK travel volume[truck type]= INDICATED Share of travel volume BY TRUCK[truck type]*INDICATED TRUCK TRAVEL Units: Km/Year

indicated urban car travel volume[vehicle tech type]= urban car travel volume*INDICATED Share of travel volume BY CAR[vehicle tech type] Units: Km/Year

indicated urban gdp= DELAY N(URBAN GDP, 1, 8.309e+012 , 3) Units: usd15/Year

indicated urban green investment fraction= urban green investment fraction(Time) Units: Dmnl

INDICATED VEHICLE TRAVEL= INDICATED ROAD TRAVEL*SHARE OF VEHICLE TRAVEL Units: Km/Year

INDICATED vehicles travel volume["2or3 wheel type"]= INDICATED VEHICLE TRAVEL*INDICATED share of travel volume BY VEHICLE["2or3 wheel type"] Units: Km/Year

INDICATED waste collection fraction increase= waste collection increase from green investment/municipal waste generated Units: 1

indicated water demand reduction fraction= if then else(indicated green economy investment fraction=0, 0, water demand reduction fraction) Units: Dmnl

INDICATED water demand reduction from management= DELAY N(water demand reduction from management, 1, 0, 3) Units: Km3/Year

indicated wind maintenance cost per kwh= indicated share of wind maintenance cost*indicated wind production cost Units: usd15/kWh

indicated wind production cost= 4 Units: usd15/kWh

indicated world Coal demand= world Coal demand Units: MST/Year

indicated world natural gas demand= natural gas demand Units: BCF/Year

Indicated World Oil Potential Production from Reserves= World Oil Recoverable Reserves/world oil reference reserve production ratio Units: MB/Year

indirect employment from fish catch= 1.73 Units: Person/Ton

indirect fisheries employment= fish catch*indirect employment from fish catch Units: Person/Year

industrial abatement expenditure per year= cost of industrial emission abatement-cost of industrial emission abatement delayed Units: usd15/Year

industrial abatement fraction indicated= if then else(indicated green economy investment fraction=0, 0, industrial emission abatement reduction fraction) Units: Dmnl

industrial coal demand= DELAY N((Indicated industrial coal demand 0*Coal Price Substitutability^industrial elasticity of coal demand to coal price

), time to adapt demand to price changes, (Indicated industrial coal demand 0 *Coal Price Substitutability^industrial elasticity of coal demand to coal price), 3) Units: qdbtu/Year

industrial Coal GDP Intensity= normalized industrial coal demand/real gross domestic product Units: qdbtu/usd15

INDUSTRIAL DESIRED WATER WITHDRAWAL RATE= INITIAL INDUSTRIAL WATER WITHDRAWAL RATE/total factor productivity industry ^ELASTICITY OF INDUSTRIAL WATER WITHDRAWAL RATE ON TOTAL FACTOR PRODUCTIVITY Units: Km3/usd15/Year

industrial elasticity of coal demand to coal price= -0.05 Units: Dmnl

industrial elasticity of customers to GDP= 0.45 Units: Dmnl

industrial elasticity of electricity demand to electricity price= -0.05 Units: Dmnl

industrial elasticity of natural gas demand to natural gas price= -0.05 Units: Dmnl

industrial elasticity of petroleum demand to oil price= 2.98023e-008 Units: Dmnl

Industrial elasticity of renewable resources demand to renewable resources price = -0.025 Units: Dmnl

industrial electricity customers= GENERAL INDUSTRIAL ELECTRICITY CUSTOMERS*relative industry production ^industrial elasticity of customers to GDP Units: customers

industrial electricity demand= DELAY N((Indicated industrial electricity net demand 0*Electricity Price Substitutability ^industrial elasticity of electricity demand to electricity price

), time to adapt demand to price changes, (Indicated industrial electricity net demand 0 *Electricity Price Substitutability ^industrial elasticity of electricity demand to electricity price), 3) Units: qdbtu/Year

industrial electricity GDP Intensity= normalized industrial electricity net demand/real gross domestic product Units: qdbtu/usd15

industrial emission abatement= ind fossil fuel GHGas emissions in Tons*industrial abatement fraction indicated Units: Ton/Year

industrial emission abatement fraction([(1970,0)-(2050,1)],(1970,0),(2010,0),(2011,0),(2050,0)) Units: Dmnl

industrial emission abatement reduction fraction= industrial emission abatement fraction(Time) Units: Dmnl

industrial energy efficiency([(1990,0.8)-(2025,1.2)],(1990,1),(2005,1),(2008,1),(2010,1),(2015,1),(2020 ,1),(2025,1),(2040,1)) Units: Dmnl

industrial natural gas demand= DELAY N((Indicated industrial natural gas demand 0*Natural Gas Price Substitutability ^industrial elasticity of natural gas demand to natural gas price

), time to adapt demand to price changes, (Indicated industrial natural gas demand 0 *Natural Gas Price Substitutability^ industrial elasticity of natural gas demand to natural gas price), 3) Units: qdbtu/Year

industrial natural gas GDP Intensity= normalized industrial natural gas demand/real gross domestic product Units: qdbtu/usd15

industrial petroleum demand= DELAY N((Indicated industrial petroleum demand 0*Oil Price Substitutability ^industrial elasticity of petroleum demand to oil price

), time to adapt demand to price changes, (Indicated industrial petroleum demand 0 *Oil Price Substitutability^industrial elasticity of petroleum demand to oil price), 3) Units: qdbtu/Year

industrial petroleum GDP Intensity= normalized industrial petroleum demand/real gross domestic product Units: qdbtu/usd15

Industrial renewable resources demand= DELAY N((indicated Industrial renewable resources demand 0*Renewable Resources Price Substitutability ^Industrial elasticity of renewable resources demand to renewable resources price

), time to adapt demand to price changes, (indicated Industrial renewable resources demand 0 *Renewable Resources Price Substitutability ^ Industrial elasticity of renewable resources demand to renewable resources price), 3) Units: qdbtu/Year

Industrial renewable resources GDP intensity= Normalized Industrial renewable resources demand/real gross domestic product Units: qdbtu/usd15

industrial waste= waste per unit of industrial production*industry production Units: Ton/Year

industrial waste for energy recovery= industrial waste*fraction of industry waste to uses[ienergy recovery] Units: Ton/Year

industrial waste for incineration= industrial waste*fraction of industry waste to uses[iincineration] Units: Ton/Year

industrial waste for other disposal= industrial waste*fraction of industry waste to uses[iothers] Units: Ton/Year

industrial waste landfill= industrial waste*fraction of industry waste to uses[ilandfill] Units: Ton/Year

industrial waste recycled= industrial waste*fraction of industry waste to uses[irecycle] Units: Ton/Year

industrial waste recycled from green investment= fraction of industrial waste to uses increase[irecycle]*industrial waste Units: Ton/Year

industrial waste upstream cost= industrial waste*total upstream cost Units: USD/Year

industrial waste upstream employment= industrial waste*total upstream employment factor per ton Units: Person/Year

Industries: Mining and quarrying, Construction, Manufacturing, Utilities

industries cost of co2 emission abatement per ton of co2([(2011,0)-(2050,1000)],(2011,580),(2030,710),(2050,1000)) Units: usd15/Ton

industries emissions= Aluminum total emissions in tons+Chemical and plastics total emissions in tons +Leather total emissions in tons+Paper and pulp total emissions in tons+steel total emissions in tons +Textile total emissions in tons Units: Ton/Year

industries emissions one= DELAY FIXED (industries emissions, 1 , industries emissions) Units: Ton/Year

industries emissions two= DELAY FIXED (industries emissions, 2 ,industries emissions) Units: Ton/Year

industries green investment= green economy investment*industries green investment fraction(Time) Units: usd15/Year

industries green investment after co2 abatement= industries green investment-industrial abatement expenditure per year Units: usd15/Year

industries green investment fraction([(2011,0)-(2050,0.3)],(2011,0),(2050,0)) Units: Dmnl

industry abatenment= indicated industrial emission abatement Units: Ton/Year

industry capital elasticity= 0.15 Units: Dmnl

industry capital life= 25 Units: Year

industry desired capital labor ratio= SMOOTH N(initial industry capital labor ratio*relative average years of schooling ^elasticity of capital labour ration to average years of schooling industry *relative average life expectancy^elasticity of capital labour ration to average life expectancy industry *relative employment ratio ^elasticity of capital labor ratio to relative employment ratio, time for technology changes to affect average capital labor ratio , initial industry capital labor ratio,1) Units: usd15/Person

industry employment= INTEG (net change in industry employment, initial industry employment) Units: Person

industry labor demand= (capital industry/industry desired capital labor ratio)-total employment in CE sectors Units: Person

industry power demand= (industrial electricity customers*average general industrial power units per customer)/KWH to gwh*(1-efficiency factor power generation) Units: GWh/Year

industry production= CE impacted industry production+residual industry production Units: usd15/Year

Industry share of GDP= industry production/SUM GDP Units: 1

industry technology= INTEG (change in industry technology, 1) Units: Dmnl

INDUSTRY WATER DEMAND= (INDUSTRIAL DESIRED WATER WITHDRAWAL RATE*relative industry production^elasticity of relative production on water demand *(1-WATER EFFICIENCY FROM INVESTMENT))-(total water use from CE sectors/m3 to km3)+(total water use from CE sectors/m3 to km3) Units: Km3/Year

infant mortality= SUM(deaths[sex!, AGE 0]) /SUM(births[sex!]) *1000 Units: Dmnl

infiltration= fraction of rain infiltrating*total water internally produced Units: Km3/Year

inflection point= 0.12 Units: Dmnl

inital GDP growth rate= 0.02995 Units: Dmnl/Year

initial 2nd gen biofuel capital= 2.04881e+009 Units: lge

initial agric land= INITIAL(Agricultural Land) Units: Ha

initial agric water demand= 1750 Units: Km3/Year

initial AGRICLTURAL LAND= INITIAL(Agricultural Land) Units: Ha

initial agriculture capital labor ratio= 2650 Units: usd15/Person

initial agriculture employment= 5.72294e+008 Units: Person

initial agriculture production= INITIAL(agriculture production) Units: usd15/Year

INITIAL AIR TRAVEL VOLUME= 1.4e+012 Units: Km/Year

initial Aluminum demand= 9.64556e+006 Units: Ton/Year

initial Aluminum total unit cost= INITIAL(Aluminum total real unit cost) Units: usd15/Ton

initial Arable Land= 1.25283e+009 Units: Ha

initial average electricity production cost= 0.0621 Units: Rs/kWh

initial average life expectancy= INITIAL(average life expectancy) Units: Year

initial average oil price= INITIAL(average oil price) Units: usd15/bl/Year

Initial average other units per customer= 48000 Units: kWh/customers/Year

initial average SO2 emissions per TJ of petroleum= INITIAL(average SO2 emissions per TJ of petroleum[transport]) Units: Ton/Tj

initial average years of schooling= INITIAL(average years of schooling) Units: Year

initial biomas electricity generation cost= 0.08 Units: usd15/kWh

initial brown agriculture capital labor ratio= 300 Units: usd15/Person

initial brown agriculture employment= 5.72294e+008 Units: Person

initial building waste in landfills[Materials]= building material waste to landfills[Materials] Units: Ton/Year

initial buildings in use= INITIAL(Desired stock of buildings-(1.05e+009*0.95)) Units: sqm

"initial built-up land footprint"= 0.2 Units: Dmnl

initial bus stock[bus type]= 2.3e+006,5.25e+006 Units: vehicle

initial campaign expenditure= INITIAL(1.26274e+010) Units: USD/Year

initial capital agriculture= 2e+012 Units: usd15

initial capital industry= 1e+013 Units: usd15

initial capital services= 1.225e+013 Units: usd15

INITIAL CAR STOCKS[vehicle tech type]= 2.9e+008,684314,8.05852e+007,5387.8,1.4792e+007,68.3 Units: vehicle

initial carbon footprint= 3.75 Units: Dmnl

initial carbon uptake land= INITIAL(22) Units: tons/Year

initial catch per unit vessel= 7.254 Units: Ton/vessel

initial Chemical and plastics demand= 2.94e+010 Units: Ton/Year

initial Chemical and plastics total unit cost= INITIAL(Chemical and plastics total real unit cost) Units: usd15/Ton

initial chemical fertilizer use= INITIAL(fertilizer use by type[chemical]) Units: Ton/Year

initial clothing in use= INITIAL(Desired stock of clothing-7e+006) Units: clothing

initial clothing waste in landfills[Materials]= clothing material waste to landfills[Materials] Units: Ton/Year

initial co2 emissions per hectare= INITIAL(co2 emissions per hectare) Units: Ton/Ha

initial coal electricity generation cost= 0.09 Units: usd15/kWh

Initial Coal Price per MBTU= INITIAL(real coal price per MBTU) Units: usd15/Mbtu

initial coal ROW price= 45 Units: usd15/Mbtu

initial Coal undiscovered resources= 1.7309e+006 Units: MST

initial commercial electricity customers= 8.25e+007 Units: customers

initial contraceptive prevalence rate= 0.485 Units: Dmnl

initial conversion factor= 246 Units: Dmnl

initial cropland footprint= 3.4 Units: Dmnl

initial cumulative forest production= INITIAL(3.39906e+009) Units: m3/Year

initial desired number of children per woman= 3.25 Units: Dmnl

initial diesel and fuel oil electricity generation cost= 0.09 Units: usd15/kWh

initial education expenditure per pupil= INITIAL(education expenditure per pupil) Units: usd15/Year/Person

initial effect of energy price on electricity price= INITIAL(effect of energy price on electricity price) Units: usd15/Mbtu

initial electricity price= INITIAL(exogenous electricity price) Units: usd15/kWh

initial employment industry= INITIAL(industry employment) Units: Person

initial employment ratio= INITIAL(employment ratio) Units: Dmnl

initial employment services= INITIAL(services employment) Units: Person

initial energy bill as share of GDP= INITIAL(energy bill as share of total real gdp) Units: Dmnl

initial energy emissions= INITIAL(total emissions from energy) Units: Ton/Year

initial EVs in use= 0 Units: vehicle

initial fertilizer= 8e+007 Units: Ton/Year

initial fish catch= INITIAL(stock ratio) Units: Ton/Year

INITIAL FISH STOCK[FISH FEMALE, fish age]=
0,6.4e+007,3.37e+008,3.63e+008,4.43e+008,4.93e+008,4.84e+008,4.76e+008
,4.67e+008,4.58e+008,4.49e+008,4.4e+008,4.31e+008,4.22e+008,4.13e+008
,4.04e+008,2.04e+008 INITIAL FISH STOCK[FISH MALE,fish age]=

0,6.4e+007,3.37e+008,3.63e+008,4.43e+008,4.93e+008,4.84e+008,4.76e+008
,4.67e+008,4.58e+008,4.49e+008,4.4e+008,4.31e+008,4.22e+008,4.13e+008
,4.04e+008,2.04e+008 Units: Ton

initial fishing ground footprint= 0.35 Units: Dmnl

initial forest footprint= 1.2 Units: Dmnl

initial forest land= 4.23643e+009*1.04 Units: Ha

initial forest production= INITIAL(forest production) Units: m3/Year

initial fossil fuel CO2 emission= INITIAL(fossil fuel CO2 emission) Units: Ton/Year

initial fossil fuel emissions= INITIAL(FF GHG emissions in ton) Units: Ton/Year

initial fraction investment agriculture= 0.1 Units: Dmnl

initial fraction investment industry= 0.25 Units: Dmnl

initial fraction investment services= 0.6 Units: Dmnl

initial fraction of ag land in use= 0.304105 Units: Dmnl

initial fraction of biomass waste to uses[bwaste]= 0.7, 0.2, 0.1 Units: Dmnl

"initial fraction of c&d waste to uses 0"[cwaste]= 0.2, 0.2, 0.6 Units: dmnl

"initial fraction of c&d waste to uses"[cwaste]= if then else(CE policy switch=3,"CE policy fraction for c&D waste flows HA" [cwaste],if then else(CE policy switch=2,"CE policy fraction for c&D waste flows CA" [cwaste],if then else(CE policy switch=1,"CE policy fraction for c&D waste flows LA" [cwaste],"initial fraction of c&d waste to uses 0"[cwaste]))) Units: Dmnl/Year

initial fraction of chemical fertilizer use([(1970,0)-(2100,10)],(1970,0.7),(1990,0.7),(2000,0.7),(2050,0.7)) Units: Dmnl

"initial fraction of e- waste to uses 0"[ewaste]= 0.15, 0.85 Units: Dmnl

"initial fraction of e- waste to uses"[ewaste]= if then else(CE policy switch=3,CE policy fraction for ewaste flows HA[ewaste],if then else(CE policy switch=2,CE policy fraction for ewaste waste flows CA [ewaste],if then else(CE policy switch=1,CE policy fraction for ewaste waste flows LA [ewaste],"initial fraction of e- waste to uses 0"[ewaste]))) Units: Dmnl/Year

initial fraction of industry waste to uses[iwaste]= if then else(CE policy switch=3,CE policy fraction for industrial waste flows HA [iwaste],if then else(CE policy switch=2,CE policy fraction for industrial waste flows CA [iwaste],if then else(CE policy switch=2,CE

policy fraction for industrial waste flows LA [iwaste],initial fraction of industry waste to uses 0[iwaste]))) Units: Dmnl/Year

initial fraction of industry waste to uses 0[iwaste]= 0.07, 0.118, 0.126, 0.109, 0.577 Units: dmnl

initial fraction of municipal waste to uses[mwaste]= if then else(CE policy switch=3,CE policy fraction for waste flows CA[mwaste],if then else(CE policy switch=2,CE policy fraction for waste flows CA[mwaste],if then else(CE policy switch=1,CE policy fraction for waste flows LA[mwaste],initial fraction of municipal waste to uses 0[mwaste]))) Units: Dmnl

initial fraction of municipal waste to uses 0[mwaste]= 0.1, 0.1, 0.106, 0.604 Units: dmnl

initial gas turbine electricity generation cost= 0.08 Units: usd15/kWh

INITIAL GDP GROWTH RATE= 0.029 Units: Dmnl/Year

initial geothermal capacity= 502.5 Units: MW

initial geothermal electricity generation cost= 0.055 Units: usd15/kWh

initial ghg emissions per capita= INITIAL(ghg emissions per capita) Units: Ton/Person/Year

initial grazingland footprint= 1.35 Units: Dmnl

initial green agriculture capital labor ratio= 500 Units: usd15/Person

initial green agriculture employment= 5.72294e+008 Units: Person

initial gross domestic product= INITIAL(real gross domestic product) Units: usd15/Year

initial ground water= 30000 Units: Km3

initial harvested area= INITIAL(Agricultural Land*initial fraction of ag land in use) Units: Ha/Year

initial hydro capacity= 390000 Units: MW

initial hydro electricity generation cost= 0.035 Units: usd15/kWh

initial indicated agriculture coal gdp intensity([(1971,0)-(2022,3e-014)],(1971,2.28921e-014),(1972,2.2727e-014),(1973,2.22384e-014),(1974,2.11663e-014),(1975,2.20645e-014),(1976,2.12184e-014),(1977,2.16264e-014),(1978,2.12848e-014),(1979,2.09864e-014),(1980,1.94196e-014),(1981,1.99068e-014),(1982,2.13815e-014),(1983,2.26843e-014),(1984,2.40737e-014),(1985,2.5275e-014),(1986,2.56552e-014),(1987,2.50706e-014),(1988,2.51354e-014),(1989,2.25214e-014),(1990,1.52719e-014),(1991,1.49527e-

014),(1992,1.27818e-014),(1993,1.19218e-014),(1994,1.29896e-014),(1995,1.24459e-014),(1996,1.20925e-014),(1997,1.15167e-014),(1998,1.13041e-014),(1999,1.01015e-014),(2000,8.79975e-015),(2001,8.31755e-015),(2002,8.21291e-015),(2003,8.05004e-015),(2004,9.55417e-015),(2005,9.75031e-015),(2006,8.66786e-015),(2007,8.29117e-015),(2008,1.15323e-014),(2009,1.19497e-014),(2010,1.22648e-014),(2011,1.25991e-014),(2012,1.24784e-014),(2013,1.21466e-014),(2014,1.20066e-014),(2015,1.14598e-014),(2016,1.07181e-014),(2017,1.00624e-014),(2018,9.4689e-015),(2019,9.0189e-015),(2020,9.1852e-015),(2021,8.60098e-015),(2022,8.18076e-015)) Units: qdbtu/usd15

initial indicated agriculture electricity GDP Intensity([(1971,0)-(2022,4e-014)],(1971,1.77403e-014),(1972,1.86699e-014),(1973,1.99404e-014),(1974,1.98042e-014),(1975,1.6107e-014),(1976,1.7037e-014),(1977,1.79308e-014),(1978,1.91583e-014),(1979,2.03747e-014),(1980,2.12901e-014),(1981,2.19993e-014),(1982,2.36937e-014),(1983,2.40905e-014),(1984,2.44417e-014),(1985,2.39997e-014),(1986,2.43993e-014),(1987,2.5286e-014),(1988,2.5303e-014),(1989,2.58307e-014),(1990,3.08158e-014),(1991,3.24929e-014),(1992,3.07477e-014),(1993,3.02122e-014),(1994,3.00894e-014),(1995,2.9094e-014),(1996,2.79598e-014),(1997,2.66252e-014),(1998,2.60978e-014),(1999,2.48669e-014),(2000,2.28518e-014),(2001,2.27277e-014),(2002,2.23254e-014),(2003,2.18263e-014),(2004,2.12876e-014),(2005,2.14213e-014),(2006,2.17841e-014),(2007,2.16731e-014),(2008,1.81182e-014),(2009,1.83027e-014),(2010,1.8079e-014),(2011,1.78005e-014),(2012,1.76919e-014),(2013,1.75548e-014),(2014,1.71932e-014),(2015,1.68136e-014),(2016,1.67657e-014),(2017,1.66347e-014),(2018,1.67694e-014),(2019,1.66396e-014),(2020,1.73205e-014),(2021,1.70638e-014),(2022,1.69252e-014)) Units: qdbtu/usd15

initial indicated agriculture natural gas GDP Intensity([(1971,0)-(2022,2e-014)],(1971,1.73467e-015),(1972,2.10066e-015),(1973,2.41937e-015),(1974,2.76932e-015),(1975,2.8607e-015),(1976,2.86665e-015),(1977,2.99968e-015),(1978,3.5069e-015),(1979,3.74395e-015),(1980,3.78236e-015),(1981,7.0651e-015),(1982,7.84501e-015),(1983,8.3111e-015),(1984,1.15606e-014),(1985,1.30434e-014),(1986,1.35769e-014),(1987,1.44762e-014),(1988,1.48461e-014),(1989,1.5254e-014),(1990,6.60264e-015),(1991,7.12195e-015),(1992,6.07382e-015),(1993,6.6789e-015),(1994,5.86508e-015),(1995,6.18995e-015),(1996,5.83579e-015),(1997,5.58915e-015),(1998,5.14765e-015),(1999,4.94295e-015),(2000,4.59756e-015),(2001,4.46304e-015),(2002,4.39215e-015),(2003,4.23163e-015),(2004,4.34238e-015),(2005,4.22692e-015),(2006,3.90384e-015),(2007,4.28531e-015),(2008,4.47246e-015),(2009,4.33648e-015),(2010,4.5357e-015),(2011,4.50918e-015),(2012,4.42227e-015),(2013,4.50601e-015),(2014,4.41e-015),(2015,4.32863e-015),(2016,4.35714e-015),(2017,4.4019e-015),(2018,4.54347e-015),(2019,4.58044e-015),(2020,4.68067e-015),(2021,4.6975e-015),(2022,4.51257e-015)) Units: qdbtu/usd15

initial indicated agriculture petroleum gdp intensity([(1971,0)-(2022,2e-013)],(1971,1.59699e-013),(1972,1.59946e-013),(1973,1.65808e-013),(1974,1.61058e-

013),(1975,1.75047e-013),(1976,1.77261e-013),(1977,1.77951e-013),(1978,1.79711e-013),(1979,1.80255e-013),(1980,1.75958e-013),(1981,1.70221e-013),(1982,1.7341e-013),(1983,1.71707e-013),(1984,1.6845e-013),(1985,1.68426e-013),(1986,1.63623e-013),(1987,1.60388e-013),(1988,1.56799e-013),(1989,1.51951e-013),(1990,9.88661e-014),(1991,9.80433e-014),(1992,9.27029e-014),(1993,8.83266e-014),(1994,8.78794e-014),(1995,8.78923e-014),(1996,8.54298e-014),(1997,8.44151e-014),(1998,7.98206e-014),(1999,7.84641e-014),(2000,7.5713e-014),(2001,7.51271e-014),(2002,7.25594e-014),(2003,7.0277e-014),(2004,7.32631e-014),(2005,7.1182e-014),(2006,6.99115e-014),(2007,6.68855e-014),(2008,7.04368e-014),(2009,7.00905e-014),(2010,6.98724e-014),(2011,6.79534e-014),(2012,6.74691e-014),(2013,6.73539e-014),(2014,6.70414e-014),(2015,6.72008e-014),(2016,6.69325e-014),(2017,6.69367e-014),(2018,6.65436e-014),(2019,6.55219e-014),(2020,6.16393e-014),(2021,6.16032e-014),(2022,6.13817e-014)) Units: qdbtu/usd15

Initial indicated agriculture renewable resources GDP intensity([(1971,0)-(2051,2e-014)],(1971,1.12302e-014),(1972,1.09875e-014),(1973,1.01286e-014),(1974,9.62347e-015),(1975,9.849e-015),(1976,9.68406e-015),(1977,9.22193e-015),(1978,8.90531e-015),(1979,8.32892e-015),(1980,7.80184e-015),(1981,7.62578e-015),(1982,7.94298e-015),(1983,7.46001e-015),(1984,7.12889e-015),(1985,6.79986e-015),(1986,6.90494e-015),(1987,6.83276e-015),(1988,7.1887e-015),(1989,6.88786e-015),(1990,8.13071e-015),(1991,7.75117e-015),(1992,7.43528e-015),(1993,1.41956e-014),(1994,1.42087e-014),(1995,1.36204e-014),(1996,1.13549e-014),(1997,1.0114e-014),(1998,9.1358e-015),(1999,8.54762e-015),(2000,7.953e-015),(2001,7.65132e-015),(2002,7.61667e-015),(2003,7.26774e-015),(2004,6.80801e-015),(2005,6.75438e-015),(2006,6.62027e-015),(2007,6.36162e-015),(2008,7.36751e-015),(2009,7.41723e-015),(2010,7.58179e-015),(2011,7.64343e-015),(2012,7.71706e-015),(2013,7.81087e-015),(2014,7.84767e-015),(2015,7.75965e-015),(2016,7.85538e-015),(2017,7.91744e-015),(2018,8.01884e-015),(2019,7.97128e-015),(2020,8.27296e-015),(2021,8.27499e-015),(2022,8.25446e-015)) Units: qdbtu/usd15

initial indicated commercial coal gdp intensity([(1971,0)-(2051,2e-013)],(1971,1.34279e-013),(1972,1.33295e-013),(1973,1.32141e-013),(1974,1.32181e-013),(1975,1.27766e-013),(1976,1.26986e-013),(1977,1.25096e-013),(1978,1.24933e-013),(1979,1.24922e-013),(1980,1.22285e-013),(1981,1.14958e-013),(1982,1.12726e-013),(1983,1.0651e-013),(1984,1.04106e-013),(1985,9.61001e-014),(1986,8.95981e-014),(1987,8.62487e-014),(1988,8.29613e-014),(1989,7.77412e-014),(1990,4.84978e-014),(1991,4.67919e-014),(1992,2.5551e-014),(1993,1.93909e-014),(1994,1.73768e-014),(1995,1.59597e-014),(1996,1.57573e-014),(1997,1.40255e-014),(1998,1.1458e-014),(1999,1.12038e-014),(2000,9.55916e-015),(2001,9.60899e-015),(2002,1.06914e-014),(2003,1.07206e-014),(2004,1.08413e-014),(2005,1.10758e-014),(2006,1.06207e-014),(2007,9.89478e-015),(2008,1.37627e-014),(2009,1.42609e-014),(2010,1.4637e-014),(2011,1.50359e-014),(2012,1.48919e-014),(2013,1.44959e-014),(2014,1.43289e-014),(2015,1.36762e-014),(2016,1.27911e-014),(2017,1.20086e-014),(2018,1.13003e-014),(2019,1.07633e-

014),(2020,1.09617e-014),(2021,1.02645e-014),(2022,9.76301e-015)) Units: qdbtu/usd15

initial indicated commercial coal gdp intensity 0([(1971,0)-(2051,7e-014)],(1971,6.71575e-014),(1972,6.21648e-014),(1973,5.6911e-014),(1974,5.29225e-014),(1975,5.14138e-014),(1976,4.59737e-014),(1977,4.41512e-014),(1978,4.09994e-014),(1979,3.78325e-014),(1980,3.50687e-014),(1981,3.41089e-014),(1982,3.35653e-014),(1983,3.176e-014),(1984,2.95928e-014),(1985,2.76874e-014),(1986,2.52549e-014),(1987,2.32479e-014),(1988,2.11103e-014),(1989,1.95633e-014),(1990,1.32625e-014),(1991,1.22929e-014),(1992,1.08965e-014),(1993,9.2496e-015),(1994,7.16573e-015),(1995,6.10461e-015),(1996,5.02786e-015),(1997,5.82134e-015),(1998,5.62354e-015),(1999,5.05515e-015),(2000,4.27966e-015),(2001,3.87696e-015),(2002,3.77275e-015),(2003,3.64227e-015),(2004,2.93072e-015),(2005,2.79212e-015),(2006,2.3588e-015),(2007,2.10767e-015),(2008,2.93158e-015),(2009,3.03768e-015),(2010,3.11779e-015),(2011,3.20278e-015),(2012,3.1721e-015),(2013,3.08775e-015),(2014,3.05217e-015),(2015,2.91315e-015),(2016,2.72461e-015),(2017,2.55794e-015),(2018,2.40706e-015),(2019,2.29266e-015),(2020,2.33494e-015),(2021,2.18643e-015),(2022,2.0796e-015)) Units: qdbtu/usd15

initial indicated commercial electricity GDP Intensity([(1971,0)-(2051,3e-013)],(1971,1.01047e-013),(1972,1.07335e-013),(1973,1.15431e-013),(1974,1.17015e-013),(1975,1.33453e-013),(1976,1.34615e-013),(1977,1.37928e-013),(1978,1.39982e-013),(1979,1.40607e-013),(1980,1.4478e-013),(1981,1.48937e-013),(1982,1.57035e-013),(1983,1.60407e-013),(1984,1.61278e-013),(1985,1.65657e-013),(1986,1.69251e-013),(1987,1.72623e-013),(1988,1.72979e-013),(1989,1.74136e-013),(1990,1.76778e-013),(1991,1.82374e-013),(1992,1.82621e-013),(1993,1.86426e-013),(1994,1.8772e-013),(1995,1.89424e-013),(1996,1.91011e-013),(1997,1.9202e-013),(1998,1.94314e-013),(1999,1.94364e-013),(2000,1.95695e-013),(2001,1.98661e-013),(2002,1.93197e-013),(2003,1.98416e-013),(2004,1.97555e-013),(2005,2.00055e-013),(2006,1.98818e-013),(2007,1.96874e-013),(2008,1.64582e-013),(2009,1.66258e-013),(2010,1.64226e-013),(2011,1.61696e-013),(2012,1.60709e-013),(2013,1.59464e-013),(2014,1.5618e-013),(2015,1.52732e-013),(2016,1.52296e-013),(2017,1.51106e-013),(2018,1.5233e-013),(2019,1.51151e-013),(2020,1.57335e-013),(2021,1.55004e-013),(2022,1.53745e-013)) Units: qdbtu/usd15

initial indicated commercial natural gas GDP Intensity([(1971,9e-014)-(2022,2e-013)],(1971,1.26948e-013),(1972,1.29612e-013),(1973 ,1.25889e-013),(1974,1.22868e-013),(1975,1.34614e-013),(1976,1.40615e-013), (1977,1.34429e-013),(1978,1.37361e-013),(1979,1.43386e-013),(1980,1.35576e-013),(1981,1.33896e-013),(1982,1.40025e-013),(1983,1.33518e-013),(1984,1.3875e-013),(1985,1.35905e-013),(1986,1.32387e-013),(1987,1.31799e-013),(1988,1.37947e-013),(1989,1.36031e-013),(1990,1.18388e-013),(1991,1.2356e-013),(1992,1.21291e-013),(1993,1.22516e-013),(1994,1.19958e-013),(1995,1.23571e-013),(1996,1.2559e-013),(1997,1.21204e-013),(1998,1.15392e-

013),(1999,1.12663e-013),(2000,1.0922e-013),(2001,1.06634e-013),(2002,1.06074e-013),(2003,1.07644e-013),(2004,1.0629e-013),(2005,1.02663e-013),(2006,9.81629e-014),(2007,9.81188e-014),(2008,1.02404e-013),(2009,9.92905e-014),(2010,1.03852e-013),(2011,1.03245e-013),(2012,1.01255e-013),(2013,1.03172e-013),(2014,1.00974e-013),(2015,9.91108e-014),(2016,9.97636e-014),(2017,1.00788e-013),(2018,1.0403e-013),(2019,1.04876e-013),(2020,1.07171e-013),(2021,1.07557e-013),(2022,1.03322e-013)) Units: qdbtu/usd15

initial indicated commercial petroleum gdp intensity([(1971,0)-(2051,3e-013)],(1971,2.35055e-013),(1972,2.46539e-013),(1973,2.48125e-013),(1974,2.20114e-013),(1975,1.99199e-013),(1976,2.14426e-013),(1977,2.06074e-013),(1978,2.08507e-013),(1979,1.88965e-013),(1980,1.64291e-013),(1981,1.49452e-013),(1982,1.38434e-013),(1983,1.36932e-013),(1984,1.32415e-013),(1985,1.12391e-013),(1986,1.1217e-013),(1987,1.06406e-013),(1988,1.04529e-013),(1989,9.57103e-014),(1990,1.00866e-013),(1991,1.00733e-013),(1992,1.02865e-013),(1993,1.05653e-013),(1994,1.01518e-013),(1995,1.00463e-013),(1996,1.03324e-013),(1997,9.4748e-014),(1998,8.73153e-014),(1999,8.76936e-014),(2000,8.32946e-014),(2001,8.60338e-014),(2002,8.37351e-014),(2003,8.20602e-014),(2004,7.95005e-014),(2005,7.59448e-014),(2006,6.80297e-014),(2007,6.07567e-014),(2008,6.39826e-014),(2009,6.3668e-014),(2010,6.34699e-014),(2011,6.17267e-014),(2012,6.12869e-014),(2013,6.11822e-014),(2014,6.08983e-014),(2015,6.10431e-014),(2016,6.07994e-014),(2017,6.08032e-014),(2018,6.04461e-014),(2019,5.95181e-014),(2020,5.59912e-014),(2021,5.59585e-014),(2022,5.57573e-014)) Units: qdbtu/usd15

Initial indicated Commercial renewable resources GDP intensity([(1971,0)-(2022,4e-014)],(1971,1.1687e-014),(1972,1.20081e-014),(1973,1.13921e-014),(1974,1.16491e-014),(1975,1.80305e-014),(1976,1.18331e-014),(1977,1.17968e-014),(1978,1.17994e-014),(1979,1.18929e-014),(1980,1.60544e-014),(1981,1.62341e-014),(1982,1.66186e-014),(1983,1.89815e-014),(1984,1.927e-014),(1985,1.97783e-014),(1986,1.82798e-014),(1987,1.79037e-014),(1988,1.66789e-014),(1989,1.70147e-014),(1990,1.87413e-014),(1991,1.86895e-014),(1992,1.86848e-014),(1993,3.32229e-014),(1994,3.5635e-014),(1995,3.14415e-014),(1996,3.16033e-014),(1997,2.85137e-014),(1998,2.96645e-014),(1999,3.10929e-014),(2000,2.67681e-014),(2001,2.42145e-014),(2002,2.39409e-014),(2003,2.45199e-014),(2004,2.38057e-014),(2005,2.85191e-014),(2006,2.81285e-014),(2007,2.74969e-014),(2008,3.18447e-014),(2009,3.20596e-014),(2010,3.27708e-014),(2011,3.30373e-014),(2012,3.33555e-014),(2013,3.3761e-014),(2014,3.39201e-014),(2015,3.35396e-014),(2016,3.39534e-014),(2017,3.42216e-014),(2018,3.46599e-014),(2019,3.44543e-014),(2020,3.57583e-014),(2021,3.5767e-014),(2022,3.56783e-014)) Units: qdbtu/usd15

initial indicated Fishing coal gdp intensity([(1971,0)-(2051,9e-017)],(1971,0),(1972,0),(1973,0),(1974,0),(1975,0),(1976,0),(1977,0),(1978,0),(1979,0),(1980,0),(1981,0),(1982,0),(1983,0),(1984,0)

,(1985,0),(1986,0),(1987,0),(1988,0),(1989,0),(1990,4.22365e-017),(1991,8.50144e-017
),(1992,7.322e-017),(1993,5.87342e-017),(1994,5.05646e-017),(1995,2.95919e-017
),(1996,6.86648e-017),(1997,4.74249e-017),(1998,2.25146e-017),(1999,1.48314e-017
),(2000,7.0935e-018),(2001,6.95168e-018),(2002,7.76367e-018),(2003,5.17644e-018
),(2004,1.73039e-017),(2005,7.63928e-018),(2006,1.03135e-017),(2007,7.81034e-018
),(2008,1.08635e-017),(2009,1.12567e-017),(2010,1.15535e-017),(2011,1.18684e-017
),(2012,1.17548e-017),(2013,1.14422e-017),(2014,1.13103e-017),(2015,1.07952e-017
),(2016,1.00965e-017),(2017,9.47889e-018),(2018,8.91977e-018),(2019,8.49587e-018
),(2020,8.65253e-018),(2021,8.10219e-018),(2022,7.70633e-018)) Units: qdbtu/usd15

initial indicated Fishing electricity GDP Intensity([(1971,0)-(2022,3e-
016)],(1971,0),(1972,0),(1973,0),(1974,0),(1975,0),(1976
,0),(1977,0),(1978,0),(1979,0),(1980,0),(1981,0),(1982,6.1059e-017),(1983,7.46809e-017
),(1984,8.84708e-017),(1985,9.92963e-017),(1986,1.18907e-016),(1987,1.53689e-016
),(1988,1.50755e-016),(1989,1.36739e-016),(1990,1.3523e-016),(1991,1.40483e-016
),(1992,1.34444e-016),(1993,1.33346e-016),(1994,1.37134e-016),(1995,1.40003e-016
),(1996,1.47906e-016),(1997,1.47459e-016),(1998,7.93191e-017),(1999,7.97187e-017
),(2000,7.97302e-017),(2001,7.69153e-017),(2002,8.52726e-017),(2003,9.64645e-017
),(2004,2.06913e-016),(2005,2.14007e-016),(2006,2.12569e-016),(2007,2.10317e-016
),(2008,1.7582e-016),(2009,1.77611e-016),(2010,1.7544e-016),(2011,1.72737e-016
),(2012,1.71683e-016),(2013,1.70353e-016),(2014,1.66844e-016),(2015,1.63161e-016
),(2016,1.62695e-016),(2017,1.61425e-016),(2018,1.62731e-016),(2019,1.61472e-016
),(2020,1.68079e-016),(2021,1.65588e-016),(2022,1.64244e-016)) Units: qdbtu/usd15

initial indicated Fishing natural gas GDP Intensity([(1971,0)-(2051,6e-
017)],(1971,0),(1972,0),(1973,0),(1974,0),(1975,0),(1976
,0),(1977,0),(1978,0),(1979,0),(1980,0),(1981,0),(1982,0),(1983,0),(1984,0)
,(1985,0),(1986,0),(1987,0),(1988,0),(1989,0),(1990,0),(1991,0),(1992,0),(1993
,0),(1994,4.05482e-020),(1995,0),(1996,0),(1997,0),(1998,0),(1999,0),(2000,
0),(2001,1.06136e-017),(2002,2.28931e-017),(2003,4.54713e-017),(2004,5.87827e-017
),(2005,1.54968e-017),(2006,2.11725e-017),(2007,1.87293e-017),(2008,1.95472e-017
),(2009,1.89529e-017),(2010,1.98237e-017),(2011,1.97077e-017),(2012,1.93279e-017
),(2013,1.96939e-017),(2014,1.92742e-017),(2015,1.89186e-017),(2016,1.90432e-017
),(2017,1.92389e-017),(2018,1.98576e-017),(2019,2.00192e-017),(2020,2.04573e-017
),(2021,2.05308e-017),(2022,1.97226e-017)) Units: qdbtu/usd15

initial indicated Fishing petroleum gdp intensity([(1971,0)-(2051,8e-015)],(1971,2.1283e-
016),(1972,2.1565e-016),(1973,2.25246e-016),(1974,2.25421e-016),(1975,2.28741e-
016),(1976,2.38173e-016),(1977,2.40492e-016),(1978,2.42457e-016),(1979,2.47087e-
016),(1980,9.00048e-016),(1981,8.64568e-016),(1982,1.22729e-015),(1983,1.27893e-
015),(1984,1.26425e-015),(1985,1.21468e-015),(1986,1.13978e-015),(1987,1.15689e-
015),(1988,1.1413e-015),(1989,1.54472e-015),(1990,7.41571e-015),(1991,7.50021e-
015),(1992,7.17805e-015),(1993,6.71212e-015),(1994,6.11889e-015),(1995,5.82224e-

015),(1996,5.83634e-015),(1997,5.36463e-015),(1998,4.7175e-015),(1999,4.46376e-015),(2000,4.13081e-015),(2001,3.88673e-015),(2002,3.77179e-015),(2003,4.29137e-015),(2004,4.0726e-015),(2005,4.00992e-015),(2006,3.39088e-015),(2007,3.29776e-015),(2008,3.47285e-015),(2009,3.45578e-015),(2010,3.44502e-015),(2011,3.35041e-015),(2012,3.32653e-015),(2013,3.32085e-015),(2014,3.30544e-015),(2015,3.3133e-015),(2016,3.30007e-015),(2017,3.30028e-015),(2018,3.2809e-015),(2019,3.23053e-015),(2020,3.03909e-015),(2021,3.03732e-015),(2022,3.02639e-015)) Units: qdbtu/usd15

Initial indicated Fishing renewable resources GDP intensity([(1971,-2e-031)-(2022,8e-017)],(1971,0),(1972,0),(1973,0),(1974,0),(1975,4.61288e-032),(1976,-4.47473e-032),(1977,4.34072e-032),(1978,0),(1979,0),(1980,0),(1981 ,-1.55473e-031),(1982,0),(1983,0),(1984,0),(1985,0),(1986,-1.68367e-031),(1987 ,0),(1988,0),(1989,0),(1990,3.47597e-018),(1991,2.73234e-018),(1992,0),(1993 ,1.80042e-030),(1994,4.52631e-020),(1995,1.08834e-019),(1996,1.68629e-019),(1997,3.44797e-019),(1998,5.32581e-019),(1999,6.85458e-019),(2000,1.63919e-019),(2001,1.60642e-019),(2002,1.39458e-019),(2003,4.05759e-019),(2004,7.60419e-019),(2005,8.27572e-018),(2006,9.3214e-018),(2007,5.7744e-017),(2008,6.68744e-017),(2009,6.73257e-017),(2010,6.88194e-017),(2011,6.93789e-017),(2012,7.00472e-017),(2013,7.08987e-017),(2014,7.12328e-017),(2015,7.04338e-017),(2016,7.13027e-017),(2017,7.18661e-017),(2018,7.27865e-017),(2019,7.23548e-017),(2020,7.50931e-017),(2021,7.51115e-017),(2022,7.49251e-017)) Units: qdbtu/usd15

initial indicated industrial Coal GDP Intensity([(1971,0)-(2047,4e-013)],(1971,3.79589e-013),(1972,3.69022e-013),(1973,3.6372e-013),(1974,3.44169e-013),(1975,3.4148e-013),(1976,3.31559e-013),(1977,3.4543e-013),(1978,3.58841e-013),(1979,3.60987e-013),(1980,3.51458e-013),(1981,3.41635e-013),(1982,3.26519e-013),(1983,3.19354e-013),(1984,3.37522e-013),(1985,3.14787e-013),(1986,2.99639e-013),(1987,3.02091e-013),(1988,3.05845e-013),(1989,2.86637e-013),(1990,2.7326e-013),(1991,2.58946e-013),(1992,2.33428e-013),(1993,2.23287e-013),(1994,2.17073e-013),(1995,2.3324e-013),(1996,2.20191e-013),(1997,1.93879e-013),(1998,1.8911e-013),(1999,1.40439e-013),(2000,1.22189e-013),(2001,1.01345e-013),(2002,9.83712e-014),(2003,1.00361e-013),(2004,1.12374e-013),(2005,1.12511e-013),(2006,1.03086e-013),(2007,1.08949e-013),(2008,2.54479e-013),(2009,2.33286e-013),(2010,2.37301e-013),(2011,1.66337e-013),(2012,2.04981e-013),(2013,2.22095e-013),(2014,2.17803e-013),(2015,2.01482e-013),(2016,1.33831e-013),(2017,1.63407e-014),(2046.55,1.254e-015)) Units: qdbtu/usd15

initial indicated industrial electricity GDP Intensity([(1971,2e-013)-(2022,4e-013)],(1971,2.93928e-013),(1972,3.07987e-013),(1973 ,3.25879e-013),(1974,3.26991e-013),(1975,3.16647e-013),(1976,3.37209e-013), (1977,3.40236e-013),(1978,3.47586e-013),(1979,3.54297e-013),(1980,3.4171e-013),(1981,3.39327e-013),(1982,3.23525e-013),(1983,3.28839e-013),(1984,3.40537e-013),(1985,3.34443e-013),(1986,3.29571e-

013),(1987,3.32408e-013),(1988,3.37071e-013),(1989,3.34632e-013),(1990,3.24029e-013),(1991,3.25173e-013),(1992,3.15159e-013),(1993,3.07433e-013),(1994,3.01949e-013),(1995,3.02146e-013),(1996,2.98517e-013),(1997,2.94154e-013),(1998,2.86865e-013),(1999,2.85765e-013),(2000,2.89942e-013),(2001,2.82436e-013),(2002,2.82072e-013),(2003,2.83702e-013),(2004,2.89381e-013),(2005,2.92064e-013),(2006,2.96987e-013),(2007,3.07887e-013),(2008,2.50983e-013),(2009,2.49781e-013),(2010,2.4717e-013),(2011,2.46332e-013),(2012,2.4528e-013),(2013,2.41137e-013),(2014,2.33081e-013),(2015,2.24626e-013),(2016,2.21233e-013),(2017,2.08185e-013),(2018,2.09557e-013),(2019,2.08162e-013),(2020,2.15542e-013),(2021,2.17838e-013),(2022,2.16395e-013)) Units: qdbtu/usd15

initial indicated industrial natural gas GDP Intensity([(1971,-3e-014)-(2022,3e-013)],(1971,1.66827e-013),(1972,1.77426e-013),(1973 ,2.13057e-013),(1974,2.08745e-013),(1975,1.57657e-013),(1976,1.74919e-013), (1977,1.8297e-013),(1978,1.79153e-013),(1979,1.9416e-013),(1980,2.04945e-013),(1981,1.9747e-013),(1982,1.48252e-013),(1983,1.39182e-013),(1984,1.58502e-013),(1985,1.34016e-013),(1986,1.2038e-013),(1987,1.35867e-013),(1988,1.4191e-013),(1989,1.32747e-013),(1990,2.37016e-014),(1991,8.56684e-015),(1992,-8.77086e-015),(1993,-1.77812e-014),(1994,-2.09688e-014),(1995,-6.19638e-017),(1996,3.56622e-015),(1997,6.16642e-015),(1998,-1.81979e-015),(1999,-1.40697e-015),(2000,1.95372e-014),(2001,-4.86102e-015),(2002,1.6684e-016),(2003,-1.85857e-014),(2004,-1.68399e-014),(2005,-1.99069e-014),(2006,-1.42673e-014),(2007,1.34678e-015),(2008,1.87467e-014),(2009,-2.34708e-015),(2010,1.44601e-014),(2011,2.86926e-014),(2012,2.04844e-014),(2013,2.24413e-014),(2014,1.80433e-014),(2015,6.8455e-015),(2016,1.83846e-014),(2017,1.49787e-014),(2018,2.71372e-014),(2019,3.12133e-014),(2020,1.52068e-014),(2021,3.81431e-014),(2022,3.11557e-014)) Units: qdbtu/usd15

initial indicated industrial petroleum GDP Intensity([(1971,0)-(2022,6e-013)],(1971,5.31332e-013),(1972,5.40801e-013),(1973,5.67553e-013),(1974,5.40578e-013),(1975,4.86657e-013),(1976,5.13707e-013),(1977,5.42822e-013),(1978,5.16223e-013),(1979,5.4396e-013),(1980,4.68622e-013),(1981,3.92877e-013),(1982,3.70361e-013),(1983,3.12087e-013),(1984,2.79292e-013),(1985,2.56625e-013),(1986,2.46826e-013),(1987,2.37989e-013),(1988,2.23297e-013),(1989,2.11234e-013),(1990,1.65321e-013),(1991,1.59832e-013),(1992,1.42613e-013),(1993,1.29982e-013),(1994,1.2361e-013),(1995,1.08505e-013),(1996,1.13481e-013),(1997,1.10433e-013),(1998,1.01162e-013),(1999,9.61424e-014),(2000,9.84819e-014),(2001,9.26875e-014),(2002,8.37641e-014),(2003,6.76266e-014),(2004,7.11882e-014),(2005,6.71446e-014),(2006,6.01395e-014),(2007,5.64469e-014),(2008,6.94064e-014),(2009,6.22295e-014),(2010,6.3596e-014),(2011,6.60118e-014),(2012,6.33008e-014),(2013,6.12532e-014),(2014,6.12369e-014),(2015,5.87154e-014),(2016,6.27918e-014),(2017,5.9662e-014),(2018,6.00515e-014),(2019,5.79442e-014),(2020,3.54817e-014),(2021,4.63045e-014),(2022,4.8116e-014)) Units: qdbtu/usd15

Initial indicated Industrial renewable resources GDP intensity([(1971,1e-013)-(2022,3e-013)],(1971,2.40717e-013),(1972,2.43266e-013),(1973 ,2.46507e-013),(1974,2.4722e-013),(1975,2.31879e-013),(1976,2.45993e-013),(1977,2.48121e-013),(1978,2.51354e-013),(1979,2.51123e-013),(1980,2.30369e-013),(1981,2.30967e-013),(1982,2.37011e-013),(1983,2.41301e-013),(1984,2.49511e-013),(1985,2.41502e-013),(1986,2.55284e-013),(1987,2.42527e-013),(1988,2.3353e-013),(1989,1.90614e-013),(1990,2.7484e-013),(1991,2.76254e-013),(1992,2.77238e-013),(1993,2.67529e-013),(1994,2.4172e-013),(1995,2.29789e-013),(1996,2.09375e-013),(1997,1.99946e-013),(1998,1.87323e-013),(1999,2.0711e-013),(2000,2.04302e-013),(2001,1.96237e-013),(2002,1.93358e-013),(2003,1.97042e-013),(2004,1.92582e-013),(2005,1.9058e-013),(2006,1.91987e-013),(2007,1.84756e-013),(2008,2.13969e-013),(2009,2.15413e-013),(2010,2.20193e-013),(2011,2.21983e-013),(2012,2.24121e-013),(2013,2.26846e-013),(2014,2.27914e-013),(2015,2.25358e-013),(2016,2.28138e-013),(2017,2.29941e-013),(2018,2.32886e-013),(2019,2.31504e-013),(2020,2.40266e-013),(2021,2.40324e-013),(2022,2.39728e-013)) Units: qdbtu/usd15

"initial indicated non-energy use coal gdp intensity"([(1971,0)-(2051,3e-014)],(1971,1.09243e-014),(1972,1.07205e-014),(1973,1.03772e-014),(1974,1.00828e-014),(1975,9.53134e-015),(1976,1.04757e-014),(1977,1.09708e-014),(1978,1.1911e-014),(1979,1.20574e-014),(1980,1.37413e-014),(1981,1.35387e-014),(1982,1.24982e-014),(1983,1.19918e-014),(1984,1.15869e-014),(1985,2.05829e-014),(1986,2.19737e-014),(1987,2.34197e-014),(1988,2.35381e-014),(1989,2.60453e-014),(1990,2.52192e-014),(1991,2.38628e-014),(1992,2.39922e-014),(1993,2.2561e-014),(1994,2.11795e-014),(1995,1.86537e-014),(1996,1.8665e-014),(1997,1.63185e-014),(1998,1.44327e-014),(1999,1.29032e-014),(2000,1.32219e-014),(2001,1.29843e-014),(2002,1.34122e-014),(2003,1.40076e-014),(2004,1.89268e-014),(2005,1.85745e-014),(2006,1.84941e-014),(2007,1.89629e-014),(2008,2.63756e-014),(2009,2.73303e-014),(2010,2.8051e-014),(2011,2.88156e-014),(2012,2.85396e-014),(2013,2.77808e-014),(2014,2.74606e-014),(2015,2.62099e-014),(2016,2.45136e-014),(2017,2.3014e-014),(2018,2.16565e-014),(2019,2.06273e-014),(2020,2.10076e-014),(2021,1.96715e-014),(2022,1.87103e-014)) Units: qdbtu/usd15

"initial indicated non-energy use electricity GDP Intensity"([(1971,0)-(2010,10)],(1971,0),(1972,0),(1973,0),(1974,0),(1975,0),(1976,0) ,(1977,0),(1978,0),(1979,0),(1980,0),(1981,0),(1982,0),(1983,0),(1984,0),(1985 ,0),(1986,0),(1987,0),(1988,0),(1989,0),(1990,0),(1991,0),(1992,0),(1993,0) ,(1994,0),(1995,0),(1996,0),(1997,0),(1998,0),(1999,0),(2000,0),(2001,0),(2002 ,0),(2003,0),(2004,0),(2005,0),(2006,0),(2007,0)) Units: qdbtu/usd15

"initial indicated non-energy use natural gas GDP Intensity"([(1971,0)-(2051,1e-013)],(1971,2.48414e-014),(1972,2.80163e-014),(1973,3.16819e-014),(1974,3.43462e-014),(1975,4.00989e-014),(1976,4.61289e-014),(1977,4.99028e-014),(1978,5.70622e-014),(1979,5.85777e-014),(1980,5.94321e-014),(1981,6.58208e-014),(1982,6.76179e-

014),(1983,7.05096e-014),(1984,7.43497e-014),(1985,7.90673e-014),(1986,8.53343e-014),(1987,8.6834e-014),(1988,8.79123e-014),(1989,8.83467e-014),(1990,9.48508e-014),(1991,9.43324e-014),(1992,9.59412e-014),(1993,9.73322e-014),(1994,9.14825e-014),(1995,8.74935e-014),(1996,8.51866e-014),(1997,8.72424e-014),(1998,8.65498e-014),(1999,8.46489e-014),(2000,8.67382e-014),(2001,8.30324e-014),(2002,8.19969e-014),(2003,8.09207e-014),(2004,8.51714e-014),(2005,8.64344e-014),(2006,8.74173e-014),(2007,8.66687e-014),(2008,9.04537e-014),(2009,8.77036e-014),(2010,9.17328e-014),(2011,9.11963e-014),(2012,8.94386e-014),(2013,9.11322e-014),(2014,8.91904e-014),(2015,8.75449e-014),(2016,8.81214e-014),(2017,8.90267e-014),(2018,9.18898e-014),(2019,9.26376e-014),(2020,9.46648e-014),(2021,9.50051e-014),(2022,9.1265e-014)) Units: qdbtu/usd15

"initial indicated non-energy use petroleum gdp intensity"([(1971,0)-(2051,5e-013)],(1971,3.92815e-013),(1972,4.18035e-013),(1973,4.47594e-013),(1974,4.29404e-013),(1975,3.96563e-013),(1976,4.14541e-013),(1977,4.25262e-013),(1978,4.43736e-013),(1979,4.46815e-013),(1980,4.12624e-013),(1981,3.94456e-013),(1982,3.79973e-013),(1983,3.80832e-013),(1984,3.82287e-013),(1985,3.67329e-013),(1986,3.66198e-013),(1987,3.73116e-013),(1988,3.81844e-013),(1989,3.70557e-013),(1990,3.66909e-013),(1991,3.76647e-013),(1992,3.78984e-013),(1993,3.60118e-013),(1994,3.6666e-013),(1995,3.80649e-013),(1996,3.81766e-013),(1997,3.88497e-013),(1998,3.71857e-013),(1999,3.74416e-013),(2000,3.62887e-013),(2001,3.62324e-013),(2002,3.673e-013),(2003,3.68116e-013),(2004,3.78204e-013),(2005,3.65041e-013),(2006,3.60161e-013),(2007,3.54287e-013),(2008,3.73098e-013),(2009,3.71263e-013),(2010,3.70108e-013),(2011,3.59943e-013),(2012,3.57378e-013),(2013,3.56768e-013),(2014,3.55113e-013),(2015,3.55957e-013),(2016,3.54536e-013),(2017,3.54558e-013),(2018,3.52476e-013),(2019,3.47064e-013),(2020,3.26498e-013),(2021,3.26307e-013),(2022,3.25134e-013)) Units: qdbtu/usd15

"Initial indicated non-energy use renewable resources GDP intensity"([(1971,0)-(2010,10)],(1971,0),(1972,0),(1973,0),(1974,0),(1975,0),(1976,0)
,(1977,0),(1978,0),(1979,0),(1980,0),(1981,0),(1982,0),(1983,0),(1984,0),(1985
,0),(1986,0),(1987,0),(1988,0),(1989,0),(1990,0),(1991,0),(1992,0),(1993,0)
,(1994,0),(1995,0),(1996,0),(1997,0),(1998,0),(1999,0),(2000,0),(2001,0),(2002
,0),(2003,0),(2004,0),(2005,0),(2006,0),(2007,0)) Units: qdbtu/usd15

initial indicated Others coal gdp intensity([(1971,0)-(2051,5e-014)],(1971,4.62427e-014),(1972,3.95413e-014),(1973,3.76354e-014),(1974,4.14073e-014),(1975,4.34924e-014),(1976,4.1224e-014),(1977,3.61115e-014),(1978,3.68513e-014),(1979,4.28441e-014),(1980,3.04687e-014),(1981,3.643e-014),(1982,3.57707e-014),(1983,4.10195e-014),(1984,4.15196e-014),(1985,3.53285e-014),(1986,3.52156e-014),(1987,3.45277e-014),(1988,3.56863e-014),(1989,3.15194e-014),(1990,3.99744e-014),(1991,3.3994e-014),(1992,2.33972e-014),(1993,2.83213e-014),(1994,2.3613e-014),(1995,2.01406e-014),(1996,1.61319e-014),(1997,1.1056e-014),(1998,8.0301e-015),(1999,8.75374e-

015),(2000,8.45406e-015),(2001,8.22196e-015),(2002,8.48551e-015),(2003,8.64508e-015),(2004,8.63951e-015),(2005,8.13498e-015),(2006,7.86952e-015),(2007,7.29425e-015),(2008,1.01456e-014),(2009,1.05128e-014),(2010,1.07901e-014),(2011,1.10842e-014),(2012,1.0978e-014),(2013,1.06861e-014),(2014,1.0563e-014),(2015,1.00819e-014),(2016,9.42937e-015),(2017,8.85254e-015),(2018,8.33037e-015),(2019,7.93447e-015),(2020,8.08078e-015),(2021,7.56681e-015),(2022,7.19711e-015)) Units: qdbtu/usd15

initial indicated Others electricity GDP Intensity([(1971,0)-(2022,3e-014)],(1971,2.34045e-014),(1972,2.46141e-014),(1973,2.43884e-014),(1974,2.45662e-014),(1975,7.41766e-015),(1976,7.57544e-015),(1977,8.03614e-015),(1978,8.53496e-015),(1979,8.93452e-015),(1980,9.50499e-015),(1981,9.9411e-015),(1982,1.09659e-014),(1983,9.03251e-015),(1984,8.59836e-015),(1985,7.83379e-015),(1986,8.52635e-015),(1987,8.60502e-015),(1988,8.75198e-015),(1989,9.01383e-015),(1990,1.22729e-014),(1991,1.23872e-014),(1992,1.37794e-014),(1993,1.21331e-014),(1994,1.28567e-014),(1995,1.23843e-014),(1996,1.2274e-014),(1997,1.16619e-014),(1998,1.30041e-014),(1999,1.3291e-014),(2000,1.33149e-014),(2001,1.35434e-014),(2002,2.43347e-014),(2003,2.46377e-014),(2004,2.43596e-014),(2005,2.45248e-014),(2006,2.43498e-014),(2007,2.59224e-014),(2008,2.16706e-014),(2009,2.18913e-014),(2010,2.16237e-014),(2011,2.12905e-014),(2012,2.11607e-014),(2013,2.09966e-014),(2014,2.05642e-014),(2015,2.01102e-014),(2016,2.00528e-014),(2017,1.98962e-014),(2018,2.00573e-014),(2019,1.99021e-014),(2020,2.07164e-014),(2021,2.04094e-014),(2022,2.02437e-014)) Units: qdbtu/usd15

initial indicated Others natural gas GDP Intensity([(1971,0)-(2051,8e-014)],(1971,5.7258e-014),(1972,6.47052e-014),(1973,6.99615e-014),(1974,7.33256e-014),(1975,3.02344e-014),(1976,3.39856e-014),(1977,3.53216e-014),(1978,3.73908e-014),(1979,4.01651e-014),(1980,3.92233e-014),(1981,3.92902e-014),(1982,3.78577e-014),(1983,3.96156e-014),(1984,1.87817e-014),(1985,1.84929e-014),(1986,1.95628e-014),(1987,2.04777e-014),(1988,1.32166e-014),(1989,1.24758e-014),(1990,6.11574e-014),(1991,5.42068e-014),(1992,4.93236e-014),(1993,4.06934e-014),(1994,3.82104e-014),(1995,1.98262e-014),(1996,1.77771e-014),(1997,1.64858e-014),(1998,1.60843e-014),(1999,1.67023e-014),(2000,1.70348e-014),(2001,1.62058e-014),(2002,1.61262e-014),(2003,1.79301e-014),(2004,1.70222e-014),(2005,1.88802e-014),(2006,1.99407e-014),(2007,2.01939e-014),(2008,2.10758e-014),(2009,2.04351e-014),(2010,2.13739e-014),(2011,2.12489e-014),(2012,2.08393e-014),(2013,2.12339e-014),(2014,2.07815e-014),(2015,2.03981e-014),(2016,2.05324e-014),(2017,2.07433e-014),(2018,2.14105e-014),(2019,2.15847e-014),(2020,2.2057e-014),(2021,2.21363e-014),(2022,2.12649e-014)) Units: qdbtu/usd15

initial indicated Others petroleum gdp intensity([(1971,0)-(2051,9e-014)],(1971,7.95317e-014),(1972,8.21739e-014),(1973,8.65321e-014),(1974,7.49507e-014),(1975,7.36937e-014),(1976,6.76407e-014),(1977,6.5942e-014),(1978,5.6292e-

014),(1979,5.69782e-014),(1980,5.23147e-014),(1981,4.73161e-014),(1982,3.51734e-014),(1983,3.11904e-014),(1984,2.72135e-014),(1985,2.43694e-014),(1986,2.30509e-014),(1987,2.37281e-014),(1988,1.89444e-014),(1989,1.28642e-014),(1990,3.75435e-014),(1991,4.02761e-014),(1992,2.85264e-014),(1993,2.67743e-014),(1994,2.1283e-014),(1995,1.96326e-014),(1996,1.8569e-014),(1997,1.71671e-014),(1998,1.2064e-014),(1999,1.15684e-014),(2000,9.91613e-015),(2001,1.05519e-014),(2002,1.05629e-014),(2003,1.16872e-014),(2004,1.02131e-014),(2005,8.40903e-015),(2006,7.64296e-015),(2007,8.26302e-015),(2008,8.70175e-015),(2009,8.65896e-015),(2010,8.63202e-015),(2011,8.39495e-015),(2012,8.33512e-015),(2013,8.32089e-015),(2014,8.28228e-015),(2015,8.30197e-015),(2016,8.26882e-015),(2017,8.26935e-015),(2018,8.22078e-015),(2019,8.09457e-015),(2020,7.6149e-015),(2021,7.61045e-015),(2022,7.58308e-015)) Units: qdbtu/usd15

Initial indicated Others renewable resources GDP intensity([(1971,0)-(2022,2e-013)],(1971,1.05208e-013),(1972,1.01118e-013),(1973,9.75537e-014),(1974,9.95381e-014),(1975,7.88679e-014),(1976,1.01156e-013),(1977,1.02809e-013),(1978,1.05547e-013),(1979,1.09374e-013),(1980,8.60699e-014),(1981,8.56394e-014),(1982,8.74145e-014),(1983,8.59034e-014),(1984,7.75373e-014),(1985,7.74638e-014),(1986,7.65263e-014),(1987,7.67884e-014),(1988,7.07773e-014),(1989,7.11431e-014),(1990,1.60805e-013),(1991,1.62624e-013),(1992,1.63606e-013),(1993,3.77358e-014),(1994,3.46651e-014),(1995,3.31052e-014),(1996,3.23293e-014),(1997,2.97879e-014),(1998,2.95478e-014),(1999,2.90892e-014),(2000,2.63774e-014),(2001,2.60943e-014),(2002,2.59608e-014),(2003,3.14167e-014),(2004,3.40978e-014),(2005,3.46999e-014),(2006,3.39367e-014),(2007,3.33736e-014),(2008,3.86506e-014),(2009,3.89114e-014),(2010,3.97747e-014),(2011,4.00981e-014),(2012,4.04843e-014),(2013,4.09765e-014),(2014,4.11695e-014),(2015,4.07078e-014),(2016,4.121e-014),(2017,4.15356e-014),(2018,4.20675e-014),(2019,4.1818e-014),(2020,4.34006e-014),(2021,4.34113e-014),(2022,4.33036e-014)) Units: qdbtu/usd15

initial indicated residential coal gdp intensity([(1971,0)-(2050,3e-013)],(1971,2.21214e-013),(1972,2.06026e-013),(1973,1.96362e-013),(1974,1.87878e-013),(1975,1.86403e-013),(1976,1.82069e-013),(1977,1.86561e-013),(1978,1.82942e-013),(1979,1.82492e-013),(1980,1.68031e-013),(1981,1.66303e-013),(1982,1.69769e-013),(1983,1.65456e-013),(1984,1.64414e-013),(1985,1.76003e-013),(1986,1.69455e-013),(1987,1.68631e-013),(1988,1.6305e-013),(1989,1.49527e-013),(1990,1.56196e-013),(1991,1.45899e-013),(1992,1.28423e-013),(1993,1.25148e-013),(1994,1.05985e-013),(1995,1.03148e-013),(1996,9.81244e-014),(1997,8.49712e-014),(1998,6.52744e-014),(1999,6.13121e-014),(2000,5.54326e-014),(2001,5.38557e-014),(2002,4.91089e-014),(2003,4.90821e-014),(2004,4.74505e-014),(2005,4.55359e-014),(2006,4.44178e-014),(2007,4.03451e-014),(2008,5.61164e-014),(2009,5.81475e-014),(2010,5.9681e-014),(2011,6.13077e-014),(2012,6.07205e-014),(2013,5.9106e-014),(2014,5.84248e-014),(2015,5.57637e-014),(2016,5.21547e-014),(2017,4.89642e-014),(2018,4.6076e-014),(2019,4.38863e-

014),(2020,4.46955e-014),(2021,4.18527e-014),(2022,3.98079e-014),(2049.28,1.263e-015)) Units: qdbtu/usd15

initial indicated residential electricity GDP Intensity([(1971,1e-013)-(2022,3e-013)],(1971,1.56617e-013),(1972,1.68635e-013),(1973 ,1.74272e-013),(1974,1.72592e-013),(1975,1.83296e-013),(1976,1.87977e-013), (1977,1.94625e-013),(1978,2.00609e-013),(1979,2.02341e-013),(1980,2.05391e-013),(1981,2.0681e-013),(1982,2.12404e-013),(1983,2.17966e-013),(1984,2.18377e-013),(1985,2.18812e-013),(1986,2.20427e-013),(1987,2.22911e-013),(1988,2.20472e-013),(1989,2.19326e-013),(1990,2.2386e-013),(1991,2.30297e-013),(1992,2.30322e-013),(1993,2.38678e-013),(1994,2.38049e-013),(1995,2.39544e-013),(1996,2.41812e-013),(1997,2.36336e-013),(1998,2.39248e-013),(1999,2.37496e-013),(2000,2.35352e-013),(2001,2.35818e-013),(2002,2.38417e-013),(2003,2.38434e-013),(2004,2.35495e-013),(2005,2.35327e-013),(2006,2.31527e-013),(2007,2.29784e-013),(2008,1.92095e-013),(2009,1.94051e-013),(2010,1.91679e-013),(2011,1.88726e-013),(2012,1.87575e-013),(2013,1.86121e-013),(2014,1.82288e-013),(2015,1.78263e-013),(2016,1.77754e-013),(2017,1.76366e-013),(2018,1.77794e-013),(2019,1.76418e-013),(2020,1.83637e-013),(2021,1.80915e-013),(2022,1.79446e-013)) Units: qdbtu/usd15

initial indicated residential natural gas GDP Intensity([(1971,0)-(2051,4e-013)],(1971,2.76379e-013),(1972,2.86099e-013),(1973,2.73045e-013),(1974,2.68081e-013),(1975,3.14377e-013),(1976,3.05395e-013),(1977,2.92139e-013),(1978,2.96324e-013),(1979,2.99371e-013),(1980,3.03897e-013),(1981,2.96477e-013),(1982,3.02238e-013),(1983,2.92873e-013),(1984,3.08034e-013),(1985,3.07606e-013),(1986,2.98337e-013),(1987,2.93632e-013),(1988,2.9133e-013),(1989,2.8807e-013),(1990,2.81433e-013),(1991,2.94329e-013),(1992,2.90595e-013),(1993,3.12459e-013),(1994,2.9852e-013),(1995,3.01358e-013),(1996,3.21641e-013),(1997,2.96169e-013),(1998,2.81225e-013),(1999,2.83152e-013),(2000,2.82387e-013),(2001,2.7807e-013),(2002,2.78982e-013),(2003,2.84826e-013),(2004,2.72648e-013),(2005,2.63399e-013),(2006,2.49875e-013),(2007,2.4475e-013),(2008,2.55439e-013),(2009,2.47673e-013),(2010,2.59051e-013),(2011,2.57536e-013),(2012,2.52572e-013),(2013,2.57355e-013),(2014,2.51871e-013),(2015,2.47224e-013),(2016,2.48853e-013),(2017,2.51409e-013),(2018,2.59494e-013),(2019,2.61606e-013),(2020,2.67331e-013),(2021,2.68292e-013),(2022,2.5773e-013)) Units: qdbtu/usd15

initial indicated residential petroleum gdp intensity([(1971,0)-(2022,5e-013)],(1971,3.90593e-013),(1972,4.01447e-013),(1973,3.98041e-013),(1974,3.56023e-013),(1975,3.49087e-013),(1976,3.60392e-013),(1977,3.45323e-013),(1978,3.4311e-013),(1979,3.15232e-013),(1980,2.76053e-013),(1981,2.55469e-013),(1982,2.49022e-013),(1983,2.40363e-013),(1984,2.38257e-013),(1985,2.46792e-013),(1986,2.41391e-013),(1987,2.33114e-013),(1988,2.2378e-013),(1989,2.13704e-013),(1990,2.03162e-013),(1991,2.04311e-013),(1992,2.05567e-013),(1993,2.04951e-013),(1994,1.95266e-013),(1995,1.97293e-013),(1996,1.97366e-013),(1997,1.90247e-013),(1998,1.83408e-

013),(1999,1.81933e-013),(2000,1.76567e-013),(2001,1.76457e-013),(2002,1.68195e-013),(2003,1.6521e-013),(2004,1.58982e-013),(2005,1.52652e-013),(2006,1.42766e-013),(2007,1.31789e-013),(2008,1.38787e-013),(2009,1.38104e-013),(2010,1.37675e-013),(2011,1.33894e-013),(2012,1.32939e-013),(2013,1.32712e-013),(2014,1.32097e-013),(2015,1.32411e-013),(2016,1.31882e-013),(2017,1.3189e-013),(2018,1.31116e-013),(2019,1.29103e-013),(2020,1.21452e-013),(2021,1.21381e-013),(2022,1.20945e-013)) Units: qdbtu/usd15

Initial indicated residential renewable resources GDP intensity([(1971,5e-013)-(2022,9e-013)],(1971,8.47468e-013),(1972,8.40394e-013),(1973 ,8.32139e-013),(1974,8.21932e-013),(1975,8.50592e-013),(1976,8.07697e-013), (1977,7.95374e-013),(1978,7.85444e-013),(1979,7.76373e-013),(1980,8.14974e-013),(1981,8.18288e-013),(1982,8.32957e-013),(1983,8.28554e-013),(1984,8.12162e-013),(1985,8.03934e-013),(1986,7.88001e-013),(1987,7.72912e-013),(1988,7.50054e-013),(1989,7.36809e-013),(1990,6.94473e-013),(1991,6.92712e-013),(1992,6.85996e-013),(1993,7.75968e-013),(1994,7.48337e-013),(1995,7.2906e-013),(1996,7.04302e-013),(1997,6.79069e-013),(1998,6.66727e-013),(1999,6.45858e-013),(2000,6.24758e-013),(2001,6.20972e-013),(2002,6.07329e-013),(2003,5.96875e-013),(2004,5.76102e-013),(2005,5.5102e-013),(2006,5.31928e-013),(2007,5.13055e-013),(2008,5.94179e-013),(2009,5.98188e-013),(2010,6.1146e-013),(2011,6.16431e-013),(2012,6.22369e-013),(2013,6.29935e-013),(2014,6.32903e-013),(2015,6.25804e-013),(2016,6.33524e-013),(2017,6.3853e-013),(2018,6.46708e-013),(2019,6.42872e-013),(2020,6.67201e-013),(2021,6.67365e-013),(2022,6.6571e-013)) Units: qdbtu/usd15

initial indicated transportation electricity GDP Intensity([(1971,0)-(2022,3e-014)],(1971,1.77967e-014),(1972,1.80774e-014),(1973,1.82695e-014),(1974,1.83274e-014),(1975,1.93461e-014),(1976,1.86673e-014),(1977,1.87201e-014),(1978,1.86216e-014),(1979,1.89159e-014),(1980,1.93208e-014),(1981,1.89581e-014),(1982,1.9057e-014),(1983,1.89629e-014),(1984,1.88441e-014),(1985,1.89062e-014),(1986,1.87864e-014),(1987,1.85782e-014),(1988,1.83533e-014),(1989,1.80386e-014),(1990,2.15497e-014),(1991,2.07849e-014),(1992,1.95699e-014),(1993,1.8445e-014),(1994,1.73394e-014),(1995,1.67376e-014),(1996,1.62727e-014),(1997,1.57325e-014),(1998,1.51749e-014),(1999,1.47707e-014),(2000,1.43661e-014),(2001,1.42861e-014),(2002,1.45064e-014),(2003,1.49263e-014),(2004,1.48615e-014),(2005,1.4442e-014),(2006,1.3992e-014),(2007,1.38812e-014),(2008,1.16044e-014),(2009,1.17226e-014),(2010,1.15793e-014),(2011,1.14009e-014),(2012,1.13313e-014),(2013,1.12435e-014),(2014,1.1012e-014),(2015,1.07688e-014),(2016,1.07381e-014),(2017,1.06543e-014),(2018,1.07405e-014),(2019,1.06574e-014),(2020,1.10935e-014),(2021,1.09291e-014),(2022,1.08403e-014)) Units: qdbtu/usd15

initial indicated transportation natural gas GDP Intensity([(1971,0)-(2051,6e-014)],(1971,3.3147e-014),(1972,3.32197e-014),(1973,3.05624e-014),(1974,2.76817e-014),(1975,2.3696e-014),(1976,2.19409e-014),(1977,2.07648e-014),(1978,2.03166e-

014),(1979,2.48018e-014),(1980,2.51162e-014),(1981,2.51597e-014),(1982,2.35168e-014),(1983,1.92041e-014),(1984,2.05568e-014),(1985,2.06964e-014),(1986,2.04553e-014),(1987,2.22468e-014),(1988,2.49219e-014),(1989,2.51534e-014),(1990,5.47376e-014),(1991,5.58036e-014),(1992,5.6163e-014),(1993,5.67298e-014),(1994,5.54655e-014),(1995,5.37788e-014),(1996,5.21754e-014),(1997,4.73901e-014),(1998,5.0192e-014),(1999,4.85135e-014),(2000,4.34847e-014),(2001,4.31956e-014),(2002,4.45213e-014),(2003,4.5075e-014),(2004,4.54263e-014),(2005,4.54603e-014),(2006,4.42947e-014),(2007,4.46639e-014),(2008,4.66144e-014),(2009,4.51972e-014),(2010,4.72736e-014),(2011,4.69971e-014),(2012,4.60913e-014),(2013,4.69641e-014),(2014,4.59634e-014),(2015,4.51154e-014),(2016,4.54125e-014),(2017,4.58791e-014),(2018,4.73545e-014),(2019,4.77399e-014),(2020,4.87846e-014),(2021,4.896e-014),(2022,4.70325e-014)) Units: qdbtu/usd15

initial indicated transportation petroleum gdp intensity([(1971,1e-012)-(2022,2e-012)],(1971,1.4389e-012),(1972,1.49475e-012),(1973 ,1.55275e-012),(1974,1.48955e-012),(1975,1.49e-012),(1976,1.51662e-012),(1977 ,1.53044e-012),(1978,1.55745e-012),(1979,1.53482e-012),(1980,1.46522e-012), (1981,1.42786e-012),(1982,1.41224e-012),(1983,1.39091e-012),(1984,1.36977e-012),(1985,1.34744e-012),(1986,1.36042e-012),(1987,1.35915e-012),(1988,1.36719e-012),(1989,1.35715e-012),(1990,1.35176e-012),(1991,1.34926e-012),(1992,1.35256e-012),(1993,1.34209e-012),(1994,1.32927e-012),(1995,1.32885e-012),(1996,1.31748e-012),(1997,1.29787e-012),(1998,1.29664e-012),(1999,1.29002e-012),(2000,1.25822e-012),(2001,1.23343e-012),(2002,1.23071e-012),(2003,1.21201e-012),(2004,1.21524e-012),(2005,1.19338e-012),(2006,1.17095e-012),(2007,1.15372e-012),(2008,1.22494e-012),(2009,1.21208e-012),(2010,1.20987e-012),(2011,1.18081e-012),(2012,1.17015e-012),(2013,1.16621e-012),(2014,1.16107e-012),(2015,1.16116e-012),(2016,1.16084e-012),(2017,1.15778e-012),(2018,1.15172e-012),(2019,1.13285e-012),(2020,1.04669e-012),(2021,1.05692e-012),(2022,1.0551e-012)) Units: qdbtu/usd15

Initial indicated transportation renewable resources GDP intensity([(1971,0)-(2051,3e-014)],(1971,6.03203e-016),(1972,7.22816e-016),(1973,5.65632e-016),(1974,4.18197e-016),(1975,3.18575e-016),(1976,2.98307e-016),(1977,7.08428e-016),(1978,1.40817e-015),(1979,1.91295e-015),(1980,2.16282e-015),(1981,1.99484e-015),(1982,2.86601e-015),(1983,3.77217e-015),(1984,4.59139e-015),(1985,5.37139e-015),(1986,6.82903e-015),(1987,6.72656e-015),(1988,6.78464e-015),(1989,7.06365e-015),(1990,6.17878e-015),(1991,6.42096e-015),(1992,6.11598e-015),(1993,8.36719e-015),(1994,8.81012e-015),(1995,8.99125e-015),(1996,8.35975e-015),(1997,8.36019e-015),(1998,8.27391e-015),(1999,8.14144e-015),(2000,7.92069e-015),(2001,7.37588e-015),(2002,8.40437e-015),(2003,9.22424e-015),(2004,1.06165e-014),(2005,1.21311e-014),(2006,1.55567e-014),(2007,2.04571e-014),(2008,2.36918e-014),(2009,2.38517e-014),(2010,2.43809e-014),(2011,2.45791e-014),(2012,2.48159e-014),(2013,2.51175e-014),(2014,2.52359e-014),(2015,2.49528e-014),(2016,2.52607e-014),(2017,2.54602e-014),(2018,2.57863e-

014),(2019,2.56334e-014),(2020,2.66035e-014),(2021,2.661e-014),(2022,2.6544e-014))
Units: qdbtu/usd15

INITIAL INDUSTRIAL WATER WITHDRAWAL RATE= 40 Units: Km3/usd15/Year

initial industry capital labor ratio= 23500 Units: usd15/Person

initial industry employment= 3.1531e+008 Units: Person

initial industry production= 2.1e+012*0.75 Units: usd15/Year

Initial International Coal Price= INITIAL(real coal price per MBTU) Units: usd15/Mbtu

Initial International Natural Gas Price= INITIAL(real natural gas price per MBTU) Units: usd15/Mbtu

INITIAL INTERNATIONAL WATER TRAVEL ENERGY CONSUMPTION= 7.5e+010 Units: litre/Year

initial labor= INITIAL(1) Units: Dmnl

initial landfill gas electricity generation cost= 0.1 Units: usd15/kWh

initial Leather demand= 1.09e+010 Units: Ton/Year

initial Leather total unit cost= INITIAL(Leather total real unit cost) Units: usd15/Ton

initial material waste from buildings[Materials]= Material waste generated from buildings[Materials]*share of building waste collected [Materials](Time) Units: Ton/Year

initial material waste from clothing[Materials]= Material waste generated from clothing[Materials]*share of clothing waste collected [Materials](Time) Units: Ton/Year

initial material waste from plastic[Materials]= Material waste generated from plastic[Materials]*share of material waste from plastic collected [Materials](Time) Units: Ton/Year

initial material waste from vehicles[Materials]= Material waste generated from vehicles[Materials]*share of material waste collected [Materials](Time) Units: Ton/Year

initial medium term average pc gdp= 3300 Units: usd15/(Year*Person)

initial municipal waste collection coverage= 0.75 Units: Dmnl

initial natural forest area= 4.05643e+009*1.04 Units: Ha

Initial Natural Gas Price per MBTU= INITIAL(real natural gas price per MBTU) Units: usd15/Mbtu

Initial natural gas ROW price= 3.5 Units: usd15/Mbtu

initial Natural Gas undiscovered resources= 1.30009e+006 Units: BCF

initial nuclear electricity generation cost= 0.075 Units: usd15/kWh

Initial Oil Cumulative Production= 130820 Units: MB

Initial Oil Price per MBTU= INITIAL(real oil price per Mbtu) Units: usd15/Mbtu

Initial Oil Proved Reserve= 232155 Units: MB

initial organic fertilizer use= INITIAL(fertilizer use by type[organic]) Units: Ton/Year

initial other electricity customers= 875000 Units: customers

initial others= total land area-initial Arable Land-initial Pasture Land-initial forest land - initial Settlement Land Units: Ha

initial Paper and pulp demand= 1.3e+010 Units: Ton/Year

initial Paper and pulp total unit cost= INITIAL(Paper and pulp total real unit cost) Units: usd15/Ton

initial Pasture Land= 3.1389e+009 Units: Ha

INITIAL PC DISPOSABLE INCOME= PC DISPOSABLE INCOME Units: usd15/Person/Year

INITIAL PC GDP= INITIAL(pc gdp) Units: usd15/(Year*Person)

initial planted forest= 1e+008 Units: Ha

initial plastic in use= INITIAL(Desired stock of plastic-8e+007) Units: plastic

initial plastic waste in landfills[Materials]= plastic material waste to landfills[Materials] Units: Ton/Year

"initial pm2.5 emissions for 2016"= INTEG ("change in initial pm2.5 emissions for 2016", 0) Units: Ton/Year

INITIAL POPULATION[FEMALE, age]=
0,5.57e+007,5.2e+007,5.08e+007,4.96e+007,4.59e+007,
4.91e+007,4.58e+007,4.47e+007,4.36e+007,4.03e+007,
4.2e+007,3.99e+007,3.92e+007,3.85e+007,3.64e+007,
4.07e+007,3.69e+007,3.57e+007,3.44e+007,3.06e+007,
3.31e+007,3.02e+007,2.93e+007,2.83e+007,2.55e+007,
2.55e+007,2.48e+007,2.45e+007,2.43e+007,2.35e+007,
2.5e+007,2.37e+007,2.33e+007,2.29e+007,2.16e+007,

2.25e+007,2.15e+007,2.12e+007,2.09e+007,2e+007,
2.16e+007,2.01e+007,1.96e+007,1.92e+007,1.77e+007,
1.97e+007,1.79e+007,1.72e+007,1.66e+007,1.47e+007,
1.45e+007,1.42e+007,1.41e+007,1.4e+007,1.37e+007,
1.52e+007,1.4e+007,1.36e+007,1.32e+007,1.2e+007,
1.35e+007,1.21e+007,1.16e+007,1.11e+007,9.66e+006,
1.14e+007,9.72e+006,9.18e+006,8.63e+006,7.01e+006,
8.22e+006,6.9e+006,6.46e+006,6.02e+006,4.71e+006,
5e+006,4.45e+006,4.27e+006,4.09e+006,3.54e+006,1.68e+007 INITIAL
POPULATION[MALE, age]= 0, 5.81e+007,5.44e+007,5.31e+007,5.19e+007,4.82e+007,
5.15e+007,4.81e+007,4.69e+007,4.58e+007,4.23e+007,
4.42e+007,4.19e+007,4.12e+007,4.04e+007,3.81e+007,
4.28e+007,3.87e+007,3.73e+007,3.6e+007,3.19e+007,
3.47e+007,3.16e+007,3.05e+007,2.95e+007,2.64e+007,
2.63e+007,2.56e+007,2.53e+007,2.51e+007,2.43e+007,
2.58e+007,2.45e+007,2.41e+007,2.37e+007,2.24e+007,
2.36e+007,2.24e+007,2.2e+007,2.16e+007,2.04e+007,
2.25e+007,2.06e+007,2e+007,1.93e+007,1.74e+007,
1.93e+007,1.74e+007,1.67e+007,1.61e+007,1.41e+007,
1.44e+007,1.37e+007,1.35e+007,1.33e+007,1.26e+007,
1.41e+007,1.28e+007,1.24e+007,1.19e+007,1.06e+007,
1.23e+007,1.07e+007,1.01e+007,9.59e+006,8e+006,
9.61e+006,8e+006,7.46e+006,6.93e+006,5.32e+006,
6.17e+006,5.13e+006,4.78e+006,4.44e+006,3.4e+006,
3.9e+006,3.26e+006,3.05e+006,2.84e+006,2.2e+006,9.93e+006 Units: Person

initial population below poverty line= INITIAL(0.5) Units: Person

initial Primary solid biomass= 550982 Units: ktoe/Year

initial probability to become recyclers due to pollution= 0.1 Units: Dmnl

initial probability to get informed via campaign= 0.05 Units: Dmnl

initial probability to inform a person about waste recycling= 0.2 Units: Dmnl

initial quality of nutrition= INITIAL(quality of nutrition) Units: Dmnl

Initial real electricity price= 25.81 Units: usd15/Mbtu

initial real gross domestic product= INITIAL(real gross domestic product) Units: usd15/Year

initial real pc gdp= INITIAL(real pc gdp) Units: usd15/Person/Year

initial recycling capacity time series:= 0 Units: Ton/Year

initial relative energy bill= 1 Units: Dmnl

Initial Renewable Resources Price per MBTU= INITIAL(Renewable Resources price) Units: usd15/Mbtu

initial required arable land per person= 0.385 Units: Ha/Person

initial required pasture land per person= 0.86 Units: Ha/Person

initial Research and development= INITIAL(Research and development) Units: usd15/Year

initial reservoirs water= 1590 Units: Km3

initial residential electricity customers= 7.4e+008 Units: customers

"initial residential pm2.5 emissions for 2016"= INTEG ("change in initial residential pm2.5 emissions for 2016", 0) Units: Ton/Year

initial services capital labor ratio= 28000 Units: usd15/Person

initial services employment= 6.38828e+008 Units: Person

initial services production= 1.22e+013*0.85 Units: usd15/Year

initial Settlement Land= 4.8e+007 Units: Ha

initial share of coal= 0.41 Units: Dmnl

initial share of forest land= INITIAL(share of forest land) Units: Dmnl

initial share of gas= 0.08 Units: Dmnl

initial share of oil= 0.27 Units: Dmnl

initial share of population under water stress= 0.45 Units: Dmnl

initial share of recyclers= share recycling Units: Dmnl

initial share of treated wastewater reused= 0.03 Units: Dmnl

initial soil quality= INITIAL(soil quality) Units: Dmnl

initial solar electricity generation cost= 0.15 Units: usd15/kWh

initial steel demand= 1.23e+009 Units: Ton/Year

initial steel total unit cost= INITIAL(steel total real unit cost) Units: usd15/Ton

initial surface water= 700000 Units: Km3

initial target years of schooling= 6 Units: Year

initial Textile demand= 2.63e+010 Units: Ton/Year

initial Textile total unit cost= INITIAL(Textile total real unit cost) Units: usd15/Ton

initial tidal electricity generation cost= 0.1 Units: usd15/kWh

INITIAL TIME = 1970 Units: Year

initial total GHG emissions= INITIAL(total annual co2e emissions) Units: Ton/Year

initial total population= INITIAL(total population) Units: Person

initial total travel volume= 1.2e+013 Units: Km/Year

INITIAL TRANSPORT MODaL SHARE[transport modal share]= 0.266, 0.365, 0.369 Units: Dmnl

initial trucks stock[truck type]= 5e+006,5e+006 Units: vehicle

initial vehicle stock["2or3 wheel type"]= 8.75e+007,6e+006 Units: vehicle

initial vehicle waste in landfills[Materials]= vehicle material waste to landfills[Materials] Units: Ton/Year

initial vehicles in use= INITIAL(Desired ownership for vehicles-2.3e+007) Units: vehicle

initial vessel capacity= 6.75e+006 Units: vessel

initial waste electricity generation cost= 0.1 Units: usd15/kWh

INITIAL WASTE TO RECYCLE= INITIAL(waste to recycle) Units: Ton/Year

initial wastewater produced per capita= 1.24193e-007 Units: Km3/Person/Year

initial water stress= INITIAL(water stress) Units: Dmnl

initial wave electricity generation cost= 0.1 Units: usd15/kWh

Initial Weighted Average Energy Price= INITIAL(Weighted Average Energy Price) Units: usd15/Mbtu

initial wind electricity generation cost= 0.065 Units: usd15/kWh

initial World Coal undiscovered resources= 669100 Units: MST

initial World Natural Gas undiscovered resources= INITIAL(9.50631e+006) Units: BCF

initial world oil demand supply balance= INITIAL(world oil demand supply balance) Units: Dmnl

initial World Oil undiscovered resources= 1.7896e+006 Units: MB

international water travel energy consumption= (INITIAL INTERNATIONAL WATER TRAVEL ENERGY CONSUMPTION*relative gdp^elasticity of international water travel energy consumption on relative gdp)*convert LITRE to mtoe*(1-efficiency ratio transport from green investment) Units: mtoe/Year

intial municpal water demand= 215 Units: Km3/Person/Year

intial nucelar energy capacity= 12000 Units: MW

intial oil price= INITIAL(oil price) Units: usd15/Barrel

investment= private investment+public investment+(green economy investment*0.25) Units: usd15/Year

investment agriculture= normalized agriculture investment fraction*investment Units: usd15/Year

investment effect of biofuel production from crops= 1 Units: USD/gallon

investment effect of electricity from LFG= 1 Units: kWh/usd15

investment effect on biofuel from waste= 1 Units: gallon/usd15

investment effect on bioproduct from crops investment= 1 Units: USD/Ton

investment effect on bioproduct from waste= 1 Units: Ton/usd15

"investment effect on by-product recovery"= 0.001 Units: kWh/usd15

investment effect on electricity from biomass= 1 Units: kWh/usd15

investment effect on electricity from biomass cofiring new plant= 1 Units: kWh/usd15

investment effect on recycling= 1 Units: Ton/usd15

investment for power efficiency= industries green investment after co2 abatement+(buildings green investment)+tourism green investment Units: usd15/Year

investment industry= normalized industry investment fraction*investment Units: usd15/Year

investment services= normalized services investment fraction*investment Units: usd15/Year

investmet effect of natural gas generation from LFG= 1 Units: Ton/usd15

IPPU emissions per GDP= WITH LOOKUP (Time, ([(1970,0)-(2023,0.0009)],(1970,0.000899266),(1971,0.000817942),(1972,0.000789259),(1973,0.000787964),(1974,0.000743944),(1975,0.000684323),(1976,0.000696098),(1977,0.000727079),(1978,0.000767983),(1979,0.000813316),(1980,0.000804411),(1981,0.00075458),(1982,0.000692677),(1983,0.00065521),(1984,0.000641022),(1985,0.000607696),(1986,0.000628171),(1987,0.000650895),(1988,0.000656834),(1989,0.000620481),(1990,0.000612427),(1991,0.000584051),(1992,0.000553863),(1993,0.000524656),(1994,0.000511608),(1995,0.00052789),(1996,0.00050595),(1997,0.00049235),(1998,0.000472598),(1999,0.000445078),(2000,0.000441195),(2001,0.000432842),(2002,0.000429394),(2003,0.000428165),(2004,0.000451742),(2005,0.000478651),(2006,0.000493587),(2007,0.000511255),(2008,0.000522829),(2009,0.000524952),(2010,0.000554465),(2011,0.000557664),(2012,0.000549556),(2013,0.000543683),(2014,0.000530343),(2015,0.000491412),(2016,0.000479023),(2017,0.000461228),(2018,0.000455563),(2019,0.00046246),(2020,0.000462297),(2021,0.000452092),(2022,0.000417656),(2023,0.000426655))) Units: Ton/usd15

iwaste: irecycle, ienergy recovery,ilandfill, iincineration,iothers

juvenile predation= fraction for predation*recruitment Units: Ton/Year

kg of aluminium in a building= 3.5 Units: Kg/building

kg of aluminium in a vehicle= 25 Units: Kg/vehicle

KG PER TON = 1000 Units: Kg/Ton

kg to ton= 907.2 Units: kg/ton

KILOTONE TO GALLON= 26441.3 Units: gallon/ktoe

ktoe to MB= 0.006841 Units: ktoe/MB

KTOE TO MBTU= 39683.2 Units: Mbtu/ktoe

ktoe to mtoe= 0.001 Units: ktoe/mtoe

ktoe to TJ= 41.868 Units: Tj/ktoe

Kwh per MWH= 1000 Units: kWh/MWh

kwh per ton of waste= 550 Units: kWh/Ton

KWH to gwh= 1e+006 Units: kWh/GWh

kwh to mbtu= 0.00341214 Units: kWh/Mbtu

labor= initial labor*effect of life expectancy on labor*effect of schooling on labor *effect of agriculture employment on labor Units: Dmnl

labor availability= 1 Units: Dmnl

labor supply= SUM(Population[sex!, working age!]) Units: Person

Land demand from building construction= ha of land use per sqm*Sale of buildings Units: Ha/Year

Land demand from clothing production= ha of land use per ton of clothing*Sale of clothing Units: Ha/Year

Land demand from plastic production= ha of land use per ton of plastic*Sale of plastic Units: Ha/Year

Land demand from vehicle production= ha of land use per vehicle*Sale of vehicle Units: Ha/Year

land filling cost= treatment and disposal land filling cost per ton(Time)*waste to Landfill Units: USD/Year

land for 1st generation biofuel= Harvested area*land for1st generation biofuel production(Time) Units: Ha

land for1st generation biofuel production([(1970,0)-(2050,1)],(1970,0.001),(1988,0.00184211),(1995,0.00210526),(2003,0.00394737),(2012,0.0242105),(2031,0.0521053),(2050,0.07)) Units: Ha/lge

land type: arable, pasture, forest, settlement, other

Land use for critical minerals= cobalt land use+copper land use+lithium land use+nickel land use Units: Ha/Year

land used for coal mining= Coal land use per mb of demand*world coal final consumption in mb Units: Ha/Year

Landfill= INTEG (waste to Landfill-usable waste for LFG, 3.5e+009) Units: Ton

landfill gas capacity= INTEG (landfill gas construction-landfill gas discard, 0) Units: MW

landfill gas construction= if then else(Time<2010, landfill gas investment/landfill gas cost per mw(Time)/landfill gas construction time, (future landfill gas investment /landfill gas cost per mw(Time)/landfill gas construction time)) Units: MW/Year

landfill gas construction employment= landfill gas construction*(landfill gas construction employment factor(Time)+landfill gas manufacturing employment factor(Time)) Units: Person/Year

landfill gas construction employment factor([(2010,0)-(2030,10)],(2010,8.2668),(2011,8.0818),(2012,7.8997),(2013,7.7205),(2014,7.544),(2015,7.3703),(2016,7.1993),(2017,7.031),(2018,6.8653),(2019,6.7023),(2020,6.5418),(2021,6.4161),(2022,6.2915),(2023,6.168),(2024,6.0455),(2025,5.9242),(2026,5.8039),(2027,5.6846),(2028,5.5664),(2029,5.4492),(2030,5.3331)) Units: Person/MW

landfill gas construction time= 1 Units: Year

landfill gas cost per mw([(2015,0)-(2030,2e+007)],(2015,5.74e+006),(2030,5.38e+006)) Units: usd15/MW

landfill gas discard= landfill gas capacity/landfill gascapital life time Units: MW/Year

landfill gas electricity generation= min((TOTAL electricity demand accounting for distribution losses-hydro electricity generation -wind electricity generation-solar electricity generation-geothermal electricity generation -tidal energy electricity generation-wave energy electricity generation), landfill gas power capacity use/mwh to gwh) Units: GWh/Year

landfill gas investment Units: usd15

landfill gas load factor= 0.2 Units: Dmnl

landfill gas maintenance cost= landfill gas capacity*landfill gas maintenance cost per mw Units: Rs/Year

landfill gas maintenance cost per mw= 50000 Units: Rs/MW/Year

landfill gas manufacturing employment factor([(2010,0)-(2030,10)],(2010,0.8479),(2011,0.8289),(2012,0.8102),(2013,0.7918),(2014,0.7737),(2015,0.7559),(2016,0.7384),(2017,0.7211),(2018,0.7041),(2019,0.6874),(2020,0.671),(2021,0.6581),(2022,0.6453),(2023,0.6326),(2024,0.6201),(2025,0.6076),(2026,0.5953),(2027,0.583),(2028,0.5709),(2029,0.5589),(2030 ,0.547)) Units: Person/MW

landfill gas operation and maintenance employment= landfill gas capacity*landfill gas operation and maintenance employment factor (Time) Units: Person/Year

landfill gas operation and maintenance employment factor([(2010,0)-(2030,10)],(2010,3.2907),(2011,3.217),(2012,3.1446),(2013,3.0732),(2014,3.003),(2015,2.9338),(2016,2.8657),(2017,2.7987),(2018,2.7328),(2019,2.6679),(2020,2.604),(2021,2.554),(2022,2.5044),(2023,2.4552),(2024,2.4065),(2025,2.3582),(2026,2.3103),(2027,2.2628),(2028,2.2158),(2029,2.1691),(2030,2.1229)) Units: Person/MW

landfill gas power capacity use= landfill gas load factor*potential electricity generation landfill gas Units: MWh/Year

landfill gas share of power generation= landfill gas electricity generation/total electricity generation Units: Dmnl

landfill gas to natural gas= 0.6 Units: Dmnl

landfill gascapital life time= 30 Units: Year

last income class[IncClass]= if then else(IncClass=(ELMCOUNT(IncClass)), 1,0)*income distribution[IncClass] Units: Dmnl

LCD policy reduction in air pollution from thermal power generation= WITH LOOKUP (Time, ([(2020,0.8)-(2030,1)],(2020,1),(2030,0.875))) Units: Dmnl

Leather allowance share of EITE= Leather average two years emissions*total allowances share of eite/average two years emissions Units: Dmnl

Leather average two years emissions= (Leather emission one+Leather emission two)/2 Units: Ton/Year

Leather average two years production= (Leather production one+Leather production two)/2 Units: Ton/Year

Leather carbon intensity= Leather average two years emissions/Leather average two years production Units: Dmnl

Leather coal consumption= total Leather production*Leather energy Intensity[coal energy]*(1-energy efficiency ratio from green investment industry) Units: ktoe/Year

Leather coal consumption IN MBTU= Leather coal consumption*KTOE TO MBTU Units: Mbtu/Year

Leather coal emissions= Leather coal consumption IN MBTU*coal emission factor*MBTU TO TJ Units: Kg/Year

Leather coal intensity([(1971,0)-(2010,10)],(1971,2.89682e-007),(1972,3.27805e-007),(1973,3.06895e-007),(1974,2.6909e-007),(1975,2.64772e-007),(1976,2.72303e-007),(1977,2.70095e-007),(1978,2.48139e-007),(1979,2.35699e-007),(1980,5.61945e-007),(1981,5.7665e-007),(1982,5.75099e-007),(1983,5.73036e-007),(1984,5.71903e-007),(1985,5.34804e-007),(1986,5.34686e-007),(1987,5.62842e-007),(1988,5.68358e-007),(1989,5.42826e-007),(1990,5.28986e-007),(1991,5.03461e-007),(1992,4.94929e-007),(1993,4.45477e-007),(1994,4.605e-007),(1995,4.96152e-007),(1996,5.24102e-007),(1997,6.65754e-007),(1998,1.11603e-006),(1999,1.05798e-006),(2000,6.00599e-007),(2001,2.05128e-007),(2002,2.00642e-007),(2003,2.26119e-007),(2004,2.41817e-007),(2005,2.00741e-007),(2006,1.77033e-007),(2007,1.8232e-007)) Units: Mbtu/Ton

Leather coal price= REFERENCE Leather COAL PRICE(Time) Units: USD/Mbtu

Leather demand over supply= total Leather demand/total Leather production Units: Dmnl

Leather demand per unit of GDP([(1995,0)-(2006,0.0004)],(1995,0.000238332),(1996,0.000180943),(1997,0.000126734),(1998,7.49563e-005),(1999,5.86654e-005),(2000,9.14443e-005),(2001,0.000256572),(2002,0.000243587),(2003,0.000223417),(2004,0.000243144),(2005,0.000289424),(2006,0.000318916)) Units: Ton/usd15

Leather ELECTRICITY consumption= total Leather production*Leather energy Intensity[electricity]*(1-energy efficiency ratio from green investment industry) Units: ktoe/Year

Leather ELECTRICITY consumption IN MBTU= Leather ELECTRICITY consumption*KTOE TO MBTU Units: Mbtu/Year

Leather electricity emissions= Leather ELECTRICITY consumption IN MBTU*electricity emission factor Units: Kg/Year

Leather ELECTRICITY intensity([(1971,0)-(2010,10)],(1971,4.55278e-007),(1972,4.78854e-007),(1973,5.07451e-007),(1974,5.05841e-007),(1975,4.94052e-007),(1976,5.06583e-007),(1977,4.90627e-007),(1978,4.86696e-007),(1979,4.7485e-007),(1980,4.58376e-007),(1981,4.45694e-007),(1982,4.32676e-007),(1983,4.33673e-007),(1984,4.47648e-007),(1985,4.45225e-007),(1986,4.41744e-007),(1987,4.64162e-007),(1988,4.60384e-007),(1989,4.55774e-007),(1990,4.7741e-007),(1991,4.68135e-007),(1992,4.49413e-007),(1993,4.43149e-007),(1994,4.43634e-007),(1995,4.42916e-007),(1996,5.51979e-007),(1997,8.02009e-007),(1998,1.30659e-006),(1999,1.59595e-006),(2000,1.06364e-006),(2001,3.73139e-007),(2002,3.90592e-007),(2003,4.31796e-007),(2004,4.15963e-007),(2005,3.53009e-007),(2006,3.43754e-007),(2007,3.56714e-007)) Units: Mbtu/Ton

Leather electricity price= Coal Price per MBTU Units: USD/kWh

Leather electricity price in mbtu= Leather electricity price*kwh to mbtu Units: USD/Mbtu

Leather emission one= DELAY FIXED (Leather emissions, 1 , Leather emissions) Units: Ton/Year

Leather emission two= DELAY FIXED (Leather emissions, 2 ,Leather emissions) Units: Ton/Year

Leather emissions= Leather total emissions in tons Units: Ton/Year

Leather employment per unit of output([(1995,0)-(2010,0.001)],(1995,0.0002625),(1996,0.0003388),(1997,0.0004428)

,(1998,0.0009394),(1999,0.0008088),(2000,0.0004826),(2001,0.0001433),(2002, 0.0001496),(2003,0.000175),(2004,0.0001554),(2005,0.0001377),(2006,0.0001403)) Units: Person/Ton

Leather energy cost= Leather coal consumption IN MBTU*Leather coal price+Leather oil consumption IN MBTU *Leather oil price+Leather natural gas consumption IN MBTU *Leather natural gas price+Leather residual fuel consumption IN MBTU*Leather reNEWABLES price +Leather ELECTRICITY consumption IN MBTU *Leather electricity price in mbtu Units: USD/Year

Leather energy cost over total cost= Leather energy cost/Leather total production cost Units: Dmnl

Leather energy intensity change[electricity]= Leather indicated energy intensity[electricity]-Leather energy Intensity[electricity] Leather energy intensity change[diesel]= Leather indicated energy intensity[diesel]-Leather energy Intensity[diesel] Leather energy intensity change[natural gas]= Leather indicated energy intensity[natural gas]-Leather energy Intensity[natural gas] Leather energy intensity change[ethanol]= Leather indicated energy intensity[ethanol]-Leather energy Intensity[ethanol] Leather energy intensity change[coal energy]= Leather indicated energy intensity[coal energy]-Leather energy Intensity[coal energy] Units: Mbtu/Ton

Leather energy Intensity[electricity]= INTEG (Leather energy intensity change[electricity], Leather ELECTRICITY intensity(Time)) Leather energy Intensity[diesel]= INTEG (Leather energy intensity change[diesel], Leather oil intensity(Time)) Leather energy Intensity[natural gas]= INTEG (Leather energy intensity change[natural gas], Leather natural gas intensity(Time)) Leather energy Intensity[ethanol]= INTEG (Leather energy intensity change[ethanol], Leather renewables intensity(Time)) Leather energy Intensity[coal energy]= INTEG (Leather energy intensity change[coal energy], Leather coal intensity(Time)) Units: Mbtu/Ton

Leather indicated energy intensity[electricity]= if then else(Time<2008, Leather ELECTRICITY intensity(Time), Leather energy Intensity [electricity]/percentage increase in efficiency) Leather indicated energy intensity[diesel]= if then else(Time<2008, Leather oil intensity(Time), Leather energy Intensity [diesel]/percentage increase in efficiency) Leather indicated energy intensity[natural gas]= if then else(Time<2008, Leather natural gas intensity(Time), Leather energy Intensity [natural gas]/percentage increase in efficiency) Leather indicated energy intensity[ethanol]= if then else(Time<2008, Leather renewables intensity(Time), Leather energy Intensity [ethanol]/percentage increase in efficiency) Leather indicated energy intensity[coal energy]= if then else(Time<2008, Leather coal intensity(Time), Leather energy Intensity [coal energy]/percentage increase in efficiency) Units: Mbtu/Ton

Leather labor cost= total Leather employment*Leather labor cost table(Time) Units: USD/Year

Leather labor cost table([(1995,0)-(2010,100000)],(1995,10600),(1996,10500),(1997,10100),(1998,8990),(1999,7860),(2000,6200),(2001,6370),(2002,6810),(2003,8710),(2004,10300),(2005,9270),(2006,4940)) Units: USD/Person

Leather market price= Leather market price table(Time) Units: USD/Ton

Leather market price table([(1995,0)-(2010,100)],(1995,15.66),(1996,17.99),(1997,24.27),(1998,47.76),(1999,37.91),(2000,19.42),(2001,5.9),(2002,6.19),(2003,8.2),(2004,8.49),(2005,8.21),(2006,8.39)) Units: USD/Ton

Leather material and capital production cost= total Leather production*Leather unit cost(Time) Units: USD/Year

Leather material cost= INTEG (Leather material cost change, Leather unit cost(Time)) Units: USD/Ton

Leather material cost change= indicated Leather material cost-Leather material cost Units: USD/Ton

Leather natural gas consumption= total Leather production*Leather energy Intensity[natural gas]*(1-energy efficiency ratio from green investment industry) Units: ktoe/Year

Leather natural gas consumption IN MBTU= Leather natural gas consumption*KTOE TO MBTU Units: Mbtu/Year

Leather natural gas emissions= Leather natural gas consumption IN MBTU*natural gas emission factor*MBTU TO TJ Units: Kg/Year

Leather natural gas intensity([(1971,0)-(2010,10)],(1971,4.12966e-008),(1972,5.56009e-008),(1973,5.72722e-008),(1974,6.17591e-008),(1975,6.12207e-008),(1976,6.68298e-008),(1977,6.84345e-008),(1978,9.2184e-008),(1979,9.55749e-008),(1980,1.06223e-007),(1981,1.02117e-007),(1982,9.75399e-008),(1983,9.81719e-008),(1984,9.16765e-008),(1985,8.61069e-008),(1986,8.63791e-008),(1987,8.99332e-008),(1988,9.34422e-008),(1989,9.72129e-008),(1990,1.09818e-007),(1991,1.19629e-007),(1992,1.15981e-007),(1993,1.28689e-007),(1994,1.26186e-007),(1995,2.26612e-007),(1996,2.98702e-007),(1997,4.28266e-007),(1998,7.05909e-007),(1999,8.50893e-007),(2000,6.68094e-007),(2001,2.21607e-007),(2002,2.35186e-007),(2003,2.45053e-007),(2004,2.07185e-007),(2005,1.39652e-007),(2006,1.23707e-007),(2007,1.17384e-007)) Units: Mbtu/Ton

Leather natural gas price= Natural Gas Price per MBTU Units: USD/Mbtu

Leather net allocations variable shares= min(Leather production based allocation,Leather upper limit allocation variable shares) Units: USD/Year

Leather oil consumption= total Leather production*Leather energy Intensity[diesel]*(1-energy efficiency ratio from green investment industry) Units: ktoe/Year

Leather oil consumption IN MBTU= Leather oil consumption*KTOE TO MBTU Units: Mbtu/Year

Leather oil emissions= Leather oil consumption IN MBTU*distillate fuel oil emission factor*MBTU TO TJ Units: Kg/Year

Leather oil intensity([(1971,0)-(2010,10)],(1971,6.22165e-007),(1972,6.68407e-007),(1973,7.7459e-007),(1974,7.45349e-007),(1975,7.16406e-007),(1976,7.3748e-007),(1977,6.67813e-007),(1978,6.38146e-007),(1979,5.8505e-007),(1980,6.27957e-007),(1981,6.71639e-007),(1982,6.16239e-007),(1983,5.31984e-007),(1984,4.61825e-007),(1985,3.9473e-007),(1986,3.8903e-007),(1987,3.72139e-007),(1988,3.60355e-007),(1989,3.85543e-007),(1990,2.97408e-007),(1991,2.85252e-007),(1992,2.82424e-007),(1993,2.7854e-007),(1994,2.7161e-007),(1995,3.16195e-007),(1996,4.00304e-007),(1997,5.55932e-007),(1998,9.5821e-007),(1999,1.2686e-006),(2000,7.51508e-007),(2001,2.54083e-007),(2002,2.47803e-007),(2003,2.39326e-007),(2004,2.11873e-007),(2005,1.63432e-007),(2006,1.27461e-007),(2007,1.15594e-007)) Units: Mbtu/Ton

Leather oil price= Oil Price per MBtu Units: USD/Mbtu

Leather operating margin= Leather operating surplus/Leather revenues Units: Dmnl

Leather operating surplus= Leather revenues-Leather total production cost Units: USD/Year

Leather price= INTEG (Leather price change, Leather market price table(Time)) Units: USD/Ton

Leather price change= indicated Leather price-Leather price Units: USD/Ton

Leather production based allocation= Leather average two years production*Leather carbon intensity*allowance price per ton Units: USD/Year

Leather production one= DELAY FIXED (total Leather production, 1 , total Leather production) Units: Ton/Year

Leather production two= DELAY FIXED (total Leather production, 2 , total Leather production) Units: Ton/Year

Leather profit share([(1992,-0.8)-(2030,1)],(2000,0),(2001,-0.51),(2002,-0.1814),(2003,-0.2286) ,(2004,0.3487),(2005,0.3981),(2006,0.5337),(2007,0.6042)) Units: Dmnl

Leather profits over revenues= real Leather profit/real Leather revenues Units: Dmnl

Leather reNEWABLES emissions= Leather residual fuel consumption IN MBTU*residual fuel oil emission factor *MBTU TO TJ Units: Kg/Year

Leather renewables intensity([(1971,0)-(2010,10)],(1971,6.0749e-008),(1972,5.97411e-008),(1973,5.66201e-008),(1974,5.32501e-008),(1975,5.35196e-008),(1976,5.02456e-008),(1977,5.36619e-008),(1978,5.80196e-008),(1979,6.04443e-008),(1980,5.6224e-008),(1981,4.11966e-008),(1982,4.19522e-008),(1983,4.48594e-008),(1984,4.83204e-008),(1985,5.37394e-008),(1986,5.37502e-008),(1987,5.18687e-008),(1988,4.63392e-008),(1989,4.22636e-008),(1990,9.4493e-008),(1991,9.15699e-008),(1992,1.12455e-007),(1993,2.19832e-007),(1994,1.87907e-007),(1995,1.5546e-007),(1996,1.57187e-007),(1997,2.07445e-007),(1998,3.53427e-007),(1999,3.89972e-007),(2000,2.88784e-007),(2001,1.02456e-007),(2002,1.02725e-007),(2003,1.11243e-007),(2004,1.16066e-007),(2005,1.1138e-007),(2006,1.07307e-007),(2007,1.14172e-007)) Units: Mbtu/Ton

Leather reNEWABLES price= Renewable Resource price per MBTU(Time) Units: USD/Mbtu

Leather residual fuel consumption= total Leather production*Leather energy Intensity[ethanol]*(1-energy efficiency ratio from green investment industry) Units: ktoe/Year

Leather residual fuel consumption IN MBTU= Leather residual fuel consumption*KTOE TO MBTU Units: Mbtu/Year

Leather revenues= Leather market price*total Leather production Units: USD/Year

Leather total demand growth rate= ((total Leather demand-previous Leather total demand)/previous Leather total demand)/GROWTH RATE base period Units: Dmnl/Year

Leather total emissions in tons= (Leather coal emissions+Leather oil emissions+Leather electricity emissions + +Leather natural gas emissions+Leather reNEWABLES emissions)/1000 Units: Ton/Year

Leather total production cost= Leather labor cost+Leather material and capital production cost+Leather energy cost -Leather net allocations variable shares Units: USD/Year

Leather total production cost growth rate= ((Leather total production cost-previous Leather total production cost)/previous Leather total production cost)/GROWTH RATE base period Units: Dmnl/Year

Leather total real unit cost= Leather total unit cost/gdp deflator Units: usd15/Ton

Leather total real unit cost growth rate= ((Leather total real unit cost-previous Leather total real unit cost)/previous Leather total real unit cost)/GROWTH RATE base period Units: Dmnl/Year

Leather total unit cost= Leather total production cost/total Leather production Units: USD/Ton

Leather unit cost([(1995,0)-(2010,100)],(1995,7.33),(1996,7.88),(1997,10.9),(1998,22.6),(1999,18),(2000,9.69),(2001,2.86),(2002,2.94),(2003,3.69),(2004,3.7),(2005,3.93) ,(2006,4.32)) Units: USD/Ton

Leather upper limit allocation variable shares= total allowance value*Leather allowance share of EITE Units: USD/Year

left saturation point= 25 Units: Year

LFG= usable waste for LFG*cubic feet of LFG per ton of waste Units: Cubic Feet/Year

LFG for Electricity= LFG*share of LFG for electricity Units: Cubic Feet/Year

LFG to electricity= 0.00185185 Units: kWh/Cubic Feet

lge to mtoe= 7.96e-010 Units: mtoe/lge

life expectancy[sex]= SUM(measured le[sex,age group!]*age group weight[sex,age group!]) Units: Year

life expectancy at birth[FEMALE]= (indicated life expectancy at birth+MALE FEMALE LE DIFFERENCE/2)*effect of pollution on life expectancy *effect of nutrition on life expectancy life expectancy at birth[MALE]= (life expectancy at birth[FEMALE]-MALE FEMALE LE DIFFERENCE)*effect of pollution on life expectancy *effect of nutrition on life expectancy Units: Year

life expectancy at birth total= SUM(life expectancy at birth[sex!])/2 Units: Year

life expectancy index= (life expectancy at birth total-min life expectacny)/(max life expectancy- min life expectacny) Units: Dmnl

life expectancy tester[sex]= SUM(measured le[sex,age group!]*age group weight[sex,age group!]) Units: Year

life span of vessel= 6 Units: Year

LITERACY ADJUSTMENT TIME= 50 Units: Year

LITERACY RATE= 100-(100/(average years of schooling*0.1+1)^3.6) Units: Dmnl

lithium annual demand rate of change= 0.01 Units: 1/Year

lithium baseline demand= INTEG (lithium demand change, 22500*0.05) Units: Ton/Year

lithium CO2e emissions= lithium energy consumption*energy carbon intensity Units: TonCO2e/Year

lithium demand= MAX(0,annual number of batteries required*lithium required per battery/KG PER TON -lithium recycled) Units: Ton/Year

lithium demand change= lithium annual demand rate of change*lithium baseline demand Units: Ton/(Year*Year)

lithium demand supply balance= if then else(mining for EV switch=1, (lithium baseline demand+lithium demand)/lithium production, lithium baseline demand/lithium production) Units: 1

lithium energy consumption= lithium production*"energy consumption per unit (extraction and processing)" Units: Tj/Year

lithium exploration= lithium resource*lithium resource development rate Units: Ton/Year

lithium extracted= INTEG (lithium production, 0) Units: Ton

lithium import cost= lithium demand*lithium demand-lithium revenues Units: USD/Year

lithium land use= lithium demand*Lithium land use per ton of demand Units: Ha/Year

Lithium land use per ton of demand= 0.12 Units: Ha/Ton

lithium price per ton= 13500 Units: USD/Ton

lithium production= if then else(mining for EV switch=0, min(lithium baseline demand,lithium reserve), min(lithium baseline demand+lithium demand, lithium reserve)) Units: Ton/Year

lithium recycled= annual number of batteries discarded*lithium required per battery/KG PER TON *battery recycling Units: Ton/Year

lithium required per battery= 6 Units: Kg/Battery

lithium reserve= INTEG (lithium exploration-lithium production, 78579) Units: Ton

lithium resource= INTEG (-lithium exploration, 230575) Units: Ton

lithium resource development rate= 0.02 Units: 1/Year

lithium revenues= lithium production*lithium price per ton Units: USD/Year

lithium water consumption= lithium production*water consumption per unit Units: liter/Year

litre ge per hectare 1st generation biofuels([(1970,0)-(2100,4000)],(1970,1995.45),(2050,2888.18)) Units: lge/Ha

livestock c02 emission= (meat production*livestock co2 emission factor)/ton to mtoe Units: mtoe/Year

livestock co2 emission factor= 0.1 Units: Ton/Ton

livestock production= meat production*meat value added per ton(Time) Units: usd15/Year

livestock production per capita([(2000,0.3)-(2050,0.5)],(2000,0.300625),(2001,0.301882),(2002,0.305813),(2003,0.308206),(2004,0.311177),(2005,0.315856),(2006,0.319568),(2007,0.32293),(2008,0.327088),(2009,0.329061),(2010,0.332839),(2011,0.335904),(2012,0.34011),(2013,0.341755),(2014,0.348317),(2015,0.351405),(2016,0.351627),(2017,0.356559),(2018,0.360414),(2019,0.361893),(2020,0.366769),(2021,0.373377),(2022,0.375923),(2023,0.379425),(2050,0.457018)) Units: Ton/Year

local conditions pollution adjustment= if then else(Time<2005, 0.1, 0.1) Units: Dmnl

Lookup for change in fuel quality([(2000,0.9)-(2050,1)],(2000,1),(2020,1),(2030,4),(2040,4),(2050,4)) Units: Dmnl

Lookup for change in fuel quality ambitious([(2000,0)-(2050,5)],(2000,1),(2020,1),(2022,4),(2030,5),(2040,5),(2050,5)) Units: Dmnl

LOW IMPACT DEVELOPMENT POLICY SWITCH= CE policy switch Units: Dmnl

m3 to km3= 1e+009 Units: m3/Km3

magnitude of impact= 0.5 Units: Dmnl

MALE FEMALE LE DIFFERENCE= 4 Units: Year

male life expectancy index= life expectancy[MALE]-22.5/82.5-22.5 Units: Dmnl

management cost per ton= 312 Units: usd15/Ton

management effect on fish stock= fisheries management investment/management cost per ton Units: Ton/Year

Master Material efficiency switch= 0 Units: Dmnl

Material Consumption for building production[metallic minerals material]= Metallic minerals demand for buildings Material Consumption for building production[non metallic mineral material] = "Non-metallic minerals for demand for buildings" Material Consumption for building production[fossil fuel material]= Fossil fuel demand for buildings Material Consumption for building production[biomass material]= Biomass demand for buildings Units: Ton/Year

Material Consumption for clothing production[metallic minerals material]= Metallic minerals demand for clothing Material Consumption for clothing production[non metallic mineral material] = "Non-metallic minerals for demand for clothing" Material Consumption for clothing production[fossil fuel material]= Fossil fuel demand for clothing Material Consumption for clothing production[biomass material]= Biomass demand for clothing Units: Ton/Year

Material Consumption for plastic production[metallic minerals material]= Metallic minerals demand for plastic Material Consumption for plastic production[non metallic mineral material]= "Non-metallic minerals for demand for plastic" Material Consumption for plastic production[fossil fuel material]= Fossil fuel demand for plastic Material Consumption for plastic production[biomass material]= Biomass demand for plastic Units: Ton/Year

Material Consumption for vehicle production[metallic minerals material]= Metallic minerals demand for vehicles Material Consumption for vehicle production[non metallic mineral material]= "Non-metallic minerals for demand for vehicles" Material Consumption for vehicle production[fossil fuel material]= Fossil fuel demand for vehicles Material Consumption for vehicle production[biomass material]= Biomass demand for vehicles Units: Ton/Year

Material efficiency for buildings= INTEG (change in material efficiency for buildings, 1) Units: 1

Material efficiency for clothing= INTEG (change in material efficiency for clothing, 1) Units: 1

Material efficiency for plastic= INTEG (change in material efficiency for plastic, 1) Units: 1

Material efficiency for vehicles= INTEG (change in material efficiency for vehicles, 1) Units: 1

material intensity= total ton of resource demand/(real gross domestic product/1e+006) Units: Ton/million usd15

material reuse= recycled waste/time delay to process material for reuse Units: Ton/Year

material waste collected[Materials]= if then else(CE policy switch=1,Material waste generated from vehicles[Materials]*CE share of material waste collected[Materials](Time),Material waste generated from vehicles [Materials]*share of material waste collected[Materials](Time)) Units: Ton/Year

Material waste collected from buildings[Materials]= INTEG (building waste collected[Materials]-Material waste from buildings to be recycled [Materials]-Building waste to be reused[Materials]-building material waste to landfills [Materials], initial material waste from buildings[Materials]) Units: Ton

Material waste collected from clothing[Materials]= INTEG (clothing waste collected[Materials]-Material waste from clothing to be recycled [Materials]-Clothing waste to be reused[Materials]-clothing material waste to landfills [Materials], initial material waste from clothing[Materials]) Units: Ton

Material waste collected from plastic[Materials]= INTEG (plastic waste collected[Materials]-Material waste from plastic to be recycled [Materials]-plastic waste to be reused[Materials]-plastic material waste to landfills [Materials], initial material waste from plastic[Materials]) Units: Ton

Material waste collected from vehicles[Materials]= INTEG (material waste collected[Materials]-Material waste from vehicles to be recycled [Materials]-Material waste to be reused[Materials]-vehicle material waste to landfills [Materials], initial material waste from vehicles[Materials]) Units: Ton

Material waste from buildings landfilled[Materials]= INTEG (building material waste to landfills[Materials]-building waste in landfills to be incinerated [Materials], initial building waste in landfills[Materials]) Units: Ton

Material waste from buildings to be recycled[Materials]= Material waste collected from buildings[Materials]*share of material waste from buildings to be recycled [Materials] Units: Ton/Year

Material waste from clothing landfilled[Materials]= INTEG (clothing material waste to landfills[Materials]-clothing waste in landfills to be incinerated [Materials], initial clothing waste in landfills[Materials]) Units: Ton

Material waste from clothing to be recycled[Materials]= if then else(CE policy switch=3:OR:S9 S10 recycling and reuse rates=3,MAX(0,Material waste collected from clothing[Materials]*S9 CE share of material waste from clothing to be recycled HA [Materials] (Time)),if then else(CE policy switch=2:OR:S9 S10 recycling and reuse rates =2,MAX(0,Material waste collected from clothing[Materials]*S9 CE share of material waste from clothing to be recycled CA [Materials](Time)),if then else(CE policy switch=1:OR:S9 S10 recycling and reuse rates =1,MAX(0,Material waste collected from clothing[Materials]*S9 CE share of material waste from clothing to be recycled LA

[Materials](Time)),MAX(0,Material waste collected from clothing[Materials]* share of material waste from clothing to be recycled[Materials](Time))))) Units: Ton/Year

Material waste from plastic landfilled[Materials]= INTEG (plastic material waste to landfills[Materials]-plastic waste in landfills to be incinerated [Materials]-reusing of plastic in landfills[Materials], initial plastic waste in landfills[Materials]) Units: Ton

Material waste from plastic to be recycled[Materials]= Material waste collected from plastic[Materials]*share of material waste from plastic to be recycled [Materials] Units: Ton/Year

Material waste from vehicles landfilled[Materials]= INTEG (vehicle material waste to landfills[Materials]-Materials recovered[Materials]-vehicle waste in landfills to be incinerated[Materials], initial vehicle waste in landfills[Materials]) Units: Ton

Material waste from vehicles to be recycled[Materials]= Material waste collected from vehicles[Materials]*materials from vehicles to be recycled share [Materials] Units: Ton/Year

Material waste generated from buildings[Materials]= Share of material waste for buildings[Materials]*waste generated from discarding buildings Units: Ton/Year

Material waste generated from clothing[Materials]= Share of material waste for clothing[Materials]*waste generated from discarding clothing Units: Ton/Year

Material waste generated from plastic[Materials]= Share of material waste for plastic[Materials]*waste generated from discarding plastic Units: Ton/Year

Material waste generated from vehicles[Materials]= Share of material waste for vehicles[Materials]*waste generated from discarding vehicles Units: Ton/Year

material waste generated per material[Materials]= Share of material consumption that is waste in vehicle production*Share of waste per material in vehicle production [Materials] Units: 1

material waste generated per material for plastic[Materials]= Share of material consumption that is waste in plastic production*Share of waste per material in plastic production [Materials] Units: 1

material waste generated per material of building[Materials]= Share of material consumption that is waste in building production*Share of waste per material in building production [Materials] Units: 1

material waste generated per material of clothing[Materials]= Share of material consumption that is waste in clothing production*Share of waste per material in clothing production [Materials] Units: 1

Material waste to be reused[Materials]= Material waste collected from vehicles[Materials]*materials from vehicles to be reused share [Materials] Units: Ton/Year

Materials: metallic minerals material, non metallic mineral material, fossil fuel material , biomass material

materials from vehicles to be recycled share[Materials]= if then else(CE policy switch=3:OR:recycling and reuse rate switch=3,vehicles material recycled HA [Materials], if then else(CE policy switch=2:OR:recycling and reuse rate switch=2,vehicles material recycled CA [Materials], if then else(CE policy switch=1:OR:recycling and reuse rate switch=1,vehicles material recycled LA [Materials], vehicles material recycled BAU[Materials]))) Units: 1/Year

materials from vehicles to be reused share[Materials]= if then else(CE policy switch=3:OR:recycling and reuse rate switch=3,vehicles material reused HA [Materials], if then else(CE policy switch=2:OR:recycling and reuse rate switch=2,vehicles material resued CA [Materials], if then else(CE policy switch=1:OR:recycling and reuse rate switch=1,vehicles material reused LA [Materials], vehicles material reused BAU[Materials]))) Units: 1/Year

Materials recovered[Materials]= if then else(CE policy switch=3:OR:S10 recovery switch=3,S10 recovery of materials for manufacturing HA , if then else(CE policy switch=2:OR:S10 recovery switch=2,S10 recovery of materials for manufacturing CA , if then else(CE policy switch=1:OR:S10 recovery switch=1,S10 recovery of materials for manufacturing LA ,0)))*Material waste from vehicles landfilled[Materials] Units: Ton/Year

max life expectancy= 85 Units: Year

max pc gdp= 40000 Units: usd15/(Year*Person)

max primary enrolment rate= 1 Units: Dmnl

maximum amount of carbon stored per heactare of forest land= 150 Units: tons/Ha

maximum forest yearly conversion= 0.025 Units: Dmnl/Year

mb to barrel= 1000 Units: Barrel/MB

mb to GWH= 1.7 Units: GWh/MB

mb to TJ= 6120 Units: Tj/MB

MBTU TO TJ= 0.001055 Units: Tj/Mbtu

MDGs investment water cost per m3= 0.1 Units: usd15/m3

mean income= PC DISPOSABLE INCOME/reference income Units: Dmnl

mean of income ln= LN(mean income)-LN(1+variance of per capita income/mean income^2)/2 Units: Dmnl

measured le [sex, age group]= LOOKUP INVERT(death rates table[sex,age group], effective death rates per age group [sex,age group]) Units: Year

meat production= ((livestock production per capita(Time)*0.98)*total population) Units: tons/Year

meat value added per ton([(2000,400)-(2023,500)],(2000,411.149),(2001,410.104),(2002,409.934),(2003,419.752),(2004,426.792),(2005,425.479),(2006,433.42),(2007,432.241),(2008,415.753),(2009,426.467),(2010,430.218),(2011,432.342),(2012,433.824),(2013,439.797),(2014,439.622),(2015,442.692),(2016,452.371),(2017,455.571),(2018,457.865),(2019,438.386),(2020,455.908),(2021,458.961),(2022,465.353),(2023,470.137)) Units: usd15/Ton

medium term average real pc gdp= SMOOTH N(pc gdp, time for income changes to affect life expectancy , initial medium term average pc gdp , 1) Units: usd15/(Year*Person)

medium truck energy consumed by energy type[gasoline power]= trucks energy consumption[medium truck]*share of energy consumption by medium truck energy type tABLE [gasoline power] medium truck energy consumed by energy type[ethanol]= trucks energy consumption[medium truck]*share of energy consumption by medium truck energy type tABLE [ethanol] medium truck energy consumed by energy type[diesel]= trucks energy consumption[medium truck]*share of energy consumption by medium truck energy type tABLE [diesel] medium truck energy consumed by energy type[biodiesel]= trucks energy consumption[medium truck]*share of energy consumption by medium truck energy type tABLE [biodiesel] medium truck energy consumed by energy type[hydrogen]= trucks energy consumption[medium truck]*share of energy consumption by medium truck energy type tABLE [hydrogen] Units: mtoe/Year

metallic mineral demand per building= WITH LOOKUP (Time, ([(2000,0)-(2050,2)],(2000,0.671143),(2001,0.673736),(2002,0.665236),(2003,0.627552),(2004,0.591597),(2005,0.570291),(2006,0.569211),(2007,0.523632),(2008,0.485615),(2009,0.554584),(2010,0.542828),(2011,0.91134),(2012,0.644683),(2013,0.589536),(2014,0.58506),(2015,0.627853),(2016,1.00686),(2017,1.04058),(2018,0.880261),(2019,0.849993),(2020,0.862499),(2021,0.754847),(2022,0.75522),(2023,0.745251),(2024,0.725663),(2050,0.7))) Units: Ton/building

metallic mineral demand per clothing= WITH LOOKUP (Time, ([(2000,0)-(2050,1)],(2000,0.881097),(2001,0.971864),(2002,0.927604),(2003

,0.914521),(2004,0.831191),(2005,0.800523),(2006,0.837265),(2007,0.75623),(
2008,0.64537),(2009,0.710053),(2010,0.656122),(2011,0.588476),(2012,0.56992
),(2013,0.615748),(2014,0.64407),(2015,0.712042),(2016,0.728654),(2017,0.701588
),(2018,0.639483),(2019,0.670993),(2020,0.710188),(2021,0.60815),(2022,0.552445
),(2051.68,0.416667))) Units: Dmnl

metallic mineral demand per plastic= WITH LOOKUP (Time, ([(2000,0)-
(2050,0.07)],(2000,0.0669925),(2001,0.0650141),(2002,0.0612608
),(2003,0.0444044),(2004,0.0434365),(2005,0.0422139),(2006,0.0392884),(2007
,0.0433747),(2008,0.0361949),(2009,0.0330173),(2010,0.0319383),(2011,0.0312404
),(2012,0.0293428),(2013,0.0309959),(2014,0.0299707),(2015,0.0285573),(2016
,0.0276998),(2017,0.0281381),(2018,0.0292898),(2019,0.0281264),(2020,0.0283013
),(2021,0.0312023),(2022,0.0303979),(2023,0.030317),(2024,0.0302356),(2050,
0.0270175))) Units: Dmnl

metallic mineral demand per vehicle= WITH LOOKUP (Time, ([(2000,1)-
(2050,2)],(2000,1.23521),(2001,1.21158),(2002,1.3011),(2003,1.28277
),(2004,1.18286),(2005,1.18397),(2006,1.16884),(2007,1.22578),(2008,1.12998
),(2009,1.16361),(2010,1.19073),(2011,1.21166),(2012,1.19605),(2013,1.27559
),(2014,1.28852),(2015,1.30124),(2016,1.32331),(2017,1.32458),(2018,1.24748
),(2019,1.21979),(2020,1.4012),(2021,1.295),(2022,1.40864),(2023,1.44759),(
2024,1.45413),(2050,1.55))) Units: Ton/vehicle

Metallic minerals demand for buildings= ((Sale of buildings*metallic mineral demand per building)/Material efficiency for buildings)-building materials to be reused[metallic minerals material] Units: Ton/Year

Metallic minerals demand for clothing= ((Sale of clothing*metallic mineral demand per clothing)/Material efficiency for clothing)-clothing materials to be reused[metallic minerals material] Units: Ton/Year

Metallic minerals demand for plastic= MAX(0,((Sale of plastic*metallic mineral demand per plastic)/Material efficiency for plastic)-plastic materials to be reused[metallic minerals material]) Units: Ton/Year

Metallic minerals demand for vehicles= ((Sale of vehicle*metallic mineral demand per vehicle)/Material efficiency for vehicles)-Vehicle materials to be reused[metallic minerals material] Units: Ton/Year

micronutrients per person per day= DELAY N(total micronutrients consumed/total population/days in one year,2, total micronutrients consumed/total population/days in one year,1) Units: gr/Person/day

micronutrients per ton of food vegetables= 0 Units: gr/Ton

micronutrients per ton of meat= 0 Units: gr/Ton

min life expectacny= 20 Units: Year

min pc gdp= 100 Units: usd15/(Year*Person)

min primary enrolment rate= 0.2 Units: Dmnl

minibus energy type[diesel]= (buses energy consumption[minibus]*share of minibuses fuel consumption time series [diesel](Time))/100 minibus energy type[gasoline power]= (buses energy consumption[minibus]*share of minibuses fuel consumption time series [gasoline power](Time))/100 minibus energy type[biodiesel]= (buses energy consumption[minibus]*share of minibuses fuel consumption time series [biodiesel](Time))/100 minibus energy type[ethanol]= (buses energy consumption[minibus]*share of minibuses fuel consumption time series [ethanol](Time))/100 Units: mtoe/Year

minibuses energy consumption by type[diesel]= urban public transport energy consumption buses[minibus]*(share of minibuses fuel consumption time series [diesel](Time)/100) minibuses energy consumption by type[gasoline power]= urban public transport energy consumption buses[minibus]*(share of minibuses fuel consumption time series [gasoline power](Time)/100) minibuses energy consumption by type[biodiesel]= urban public transport energy consumption buses[minibus]*(share of minibuses fuel consumption time series [biodiesel](Time)/100) minibuses energy consumption by type[ethanol]= urban public transport energy consumption buses[minibus]*(share of minibuses fuel consumption time series [ethanol](Time)/100) Units: mtoe/Year

minimum desired fertility rate= 1.33 Units: Dmnl

Minimum Extraction Time= 1 Units: Year

mining for EV switch= 0 Units: Dmnl

missing income classes= SUM(last income class[IncClass!])/SUM(second last income class[IncClass!]- last income class[IncClass!]) Units: Dmnl

molecular weight of C= 12 Units: dalton

molecular weight of CO2= 44 Units: dalton

Mortality rate attributed to household and ambient air pollution= death rate from ambient air pollution+death rate from indoor air pollution Units: 1/Year

MST to tonnes= 0.907185 Units: Ton/MST

mtoe of oil demand reduction= ((total buses energy consumption+total cars energy consumption)*(share of cars that are EVs)) Units: mtoe/Year

MTOE to MB= 6.841 Units: mtoe/MB

multiplier required pasture land([(1970,0.7)-(2020,1)],(1970,0.8),(2006,1.15),(2012,1.25)) Units: Dmnl

municipal solid waste= municipal waste collected+industrial waste Units: Ton/Year

municipal waste collected= municipal waste generated*municipal waste collection coverage Units: Ton/Year

municipal waste collection coverage= if then else(CE policy switch=3,Collection rate HA,if then else(CE policy switch =2,Collection rate CA,if then else(CE policy switch=1,Collection rate LA,initial municipal waste collection coverage))) Units: Dmnl

municipal waste collection coverage policy= if then else(indicated green economy investment fraction=0, 0.8, municipal waste collection coverage policy time series (Time)) Units: Dmnl

municipal waste collection coverage policy time series([(1970,0)-(2050,2)],(1970,0.8),(2010,0.8),(2050,1)) Units: Dmnl

municipal waste compost[mcompost]= municipal waste collected*fraction of municipal waste to uses[mcompost] Units: Ton/Year

municipal waste energy production in QDBTU= waste electricity generation in QDBTU table(Time) Units: qdbtu/Year

municipal waste for energy recovery[menergy recovery]= municipal waste collected*fraction of municipal waste to uses[menergy recovery] Units Ton/year

municipal waste generated= municipal waste per capita*total population Units: Ton/Year

municipal waste landfill[mlandfill]= municipal waste collected*fraction of municipal waste to uses[mlandfill] Units: Ton/Year

municipal waste per capita= municipal waste per capita time series(Time) Units: Ton/(Year*Person)

municipal waste per capita time series([(2020,0.2)-(2050,0.4)],(2020,0.269557),(2030,0.313218),(2040,0.351851),(2050 ,0.391541)) Units: Ton/Person/Year

municipal waste recycled from green investment= fraction of municipal waste to uses increase[mrecycle]*municipal waste collected Units: Ton/Year

municipal waste recyled[mrecycle]= municipal waste collected*fraction of municipal waste to uses[mrecycle] Units: Ton/Year

municipal waste upstream cost= municipal waste collected*total upstream cost Units: USD/Year

municipal waste upstream employment= municipal waste collected*total upstream employment factor per ton Units: Person/Year

municipal water demand= intial municpal water demand*(relative total population^ELASTICITY of MUNICIPAL WATER DEMAND to population)*(relative pc gdp ^ELASTICITY of MUNICIPAL WATER DEMAND to income pc)*(1-WATER EFFICIENCY FROM INVESTMENT) Units: Km3/Year

mwaste: mrecycle,mcompost,menergy recovery,mlandfill

mwh per tj= 277.778 Units: (MW*hr)/Tj

mwh to gwh= 1000 Units: MWh/GWh

N IN N2O TO C RATIO= 7e-005 Units: Dmnl

N TO N2O WEIGHT= 1.57 Units: Dmnl

N2O CO2 equivalent= fossil fuel N2O emission * N2O TO CO2 Units: Kg/Year

N2O emissions emissions per TJ of fuel combusted[power generation technology]= 0.6, 0.6, 0.1, 1.5, 0, 0, 0, 0, 0, 0, 0, 0, 4, 0 Units: Kg/Tj

N2O emissions from biomass= biomass and waste in TJ*N2O emissions per tj of biomass by sector/KG PER TON Units: Ton/Year

N2O emissions from coal[sector]= normalized coal demand[sector]*N2O emissions per tj of coal by sector[sector]/KG PER TON Units: Ton/Year

N2O emissions from natural gas[sector]= normalized natural gas demand[sector]*N2O emissions per tj of natural gas by sector [sector]/KG PER TON Units: Ton/Year

N2O emissions from petroleum[sector]= normalized petroleum demand[sector]*N2O emissions per tj of gasoline by sector [sector]/KG PER TON Units: Ton/Year

N2O emissions from power generation[power generation technology]= fuel use for power generation in TJ[power generation technology]*N2O emissions emissions per TJ of fuel combusted [power generation technology]/KG PER TON Units: Ton/Year

N2O emissions per tj of biomass by sector= 134.57 Units: Kg/Tj

N2O emissions per tj of coal by sector[sector]= 1.5, 0, 1.5, 0, 0 Units: Kg/Tj

N2O emissions per tj of gasoline by sector[sector]= 1.51, 0.6, 0.6, 3.2, 0 Units: Kg/Tj

N2O emissions per tj of natural gas by sector[sector]= 0.1, 2.72, 0.942, 0, 0.1 Units: Kg/Tj

N2O TO CO2= 295 Units: Dmnl

national water travel energy consumption[diesel]= (national water travel energy consumption time series[diesel](Time)*10^12) *0.0258665*convert LITRE to mtoe*(1-efficiency ratio transport from green investment) national water travel energy consumption[residual fuel]= (national water travel energy consumption time series[residual fuel](Time)*10^12)*0.0258665*convert LITRE to mtoe*(1-efficiency ratio transport from green investment) Units: mtoe/Year

national water travel energy consumption time series[diesel]([(1970,0)-(2050,10)],(1970,1.18421),(2000,2.19298),(2005,3.59649),(2013,3.94737),(2024,3.90351),(2035,3.81579),(2050,3.28947)) national water travel energy consumption time series[residual fuel]([(2000,0)-(2050,10)],(2000,0.532781),(2005,0.565944),(2010,0.606831),(2015,0.647818),(2020,0.687855),(2025,0.727927),(2030,0.76919),(2035,0.811003),(2040,0.855705),(2045,0.903531),(2050,0.954739)) Units: mJ/Year

natural crops yield per hectare= reference crops yield per hectare*effect of capital *"effect of R&D"*effect of soil quality*effect of labor*effect of fertilizer use on yield /effect of water stress on ag production Units: Ton/Ha

natural death[FISHSEX,fish age]= FISH STOCK[FISHSEX,fish age]*average natural death rate[FISHSEX,fish age] Units: Ton/Year

natural forest area= INTEG (forest regeneration-deforestation, initial natural forest area) Units: Ha

natural gas demand= natural gas final use+natural gas inventory and losses(Time) Units: BCF/Year

Natural Gas demand supply ratio= natural gas demand /world natural gas production Units: Dmnl

natural gas emission factor= 56100 Units: Kg/Tj

Natural Gas Energy Market Share= World Natural Gas Production in qdbtu/total energy production Units: Dmnl

natural gas extraction and conversion jobs= 0.09 Units: Person/GWh

natural gas final use= (normalized agriculture natural gas demand+normalized commercial natural gas demand +normalized Fishing natural gas demand+normalized industrial natural gas demand + "normalized non-energy use natural gas demand"

+normalized Others natural gas demand+normalized residential natural gas demand +normalized transportation natural gas demand+gas turbine demand for power generation in qdbtu)*QDBTU to BCF Units: BCF/Year

Natural Gas Fraction Developable([(1980,0)-(2050,0.4)],(1980,0.08),(1981,0.0800055),(1982,0.0800218),(1983,0.0800471),(1984,0.0800802),(1985,0.0801207),(1986,0.080167),(1987,0.0802258),(1988,0.0803117),(1989,0.0804195),(1990,0.0805425),(1991,0.0807283),(1992,0.0810244),(1993,0.081409),(1994,0.0818693),(1995,0.0823974),(1996,0.0829892),(1997,0.0836542),(1998,0.0843846),(1999,0.0851843),(2000,0.0860634),(2001,0.0869261),(2002,0.0877177),(2003,0.0884565),(2004,0.0891642),(2005,0.089852),(2006,0.0905146),(2007,0.0911526),(2008,0.0917911),(2009,0.0922912),(2010,0.0927236),(2011,0.0931668),(2012,0.0935858),(2013,0.0939563),(2014,0.0943101),(2015,0.0946567),(2016,0.0949962),(2017,0.0953213),(2018,0.0956574),(2019,0.0960127),(2020,0.0963866),(2021,0.0967732),(2022,0.0971716),(2023,0.097581),(2024,0.097988),(2025,0.0983902),(2026,0.0987881),(2027,0.0991805),(2028,0.0995662),(2029,0.0999452),(2030,0.1),(2031,0.1),(2032,0.1),(2033,0.1),(2034,0.1),(2035,0.1),(2036,0.1),(2037,0.1),(2038,0.1)) Units: Dmnl

Natural Gas Fraction Developable Table([(0,0)-(1.6,0.1)],(0,0),(0.2,0.02),(0.45,0.044),(0.7,0.064),(1,0.08),(1.25 ,0.092),(1.5,0.1)) Units: Dmnl

Natural Gas fraction discoverable([(1980,0)-(2050,10)],(1980,0.75),(1981,0.750023),(1982,0.750091),(1983,0.750196),(1984,0.750334),(1985,0.750503),(1986,0.750696),(1987,0.750941),(1988,0.751299),(1989,0.751748),(1990,0.752261),(1991,0.753035),(1992,0.754268),(1993,0.755871),(1994,0.757789),(1995,0.759989),(1996,0.762455),(1997,0.765226),(1998,0.768269),(1999,0.771601),(2000,0.775264),(2001,0.778859),(2002,0.782157),(2003,0.785235),(2004,0.788184),(2005,0.79105),(2006,0.793811),(2007,0.796469),(2008,0.79913),(2009,0.80052),(2010,0.801292),(2011,0.802084),(2012,0.802832),(2013,0.803493),(2014,0.804125),(2015,0.804744),(2016,0.80535),(2017,0.805931),(2018,0.806531),(2019,0.807166),(2020,0.807833),(2021,0.808524),(2022,0.809235),(2023,0.809966),(2024,0.810693),(2025,0.811411),(2026,0.812122),(2027,0.812822),(2028,0.813511),(2029,0.814188),(2030,0.814854),(2031,0.81551),(2032,0.816153),(2033,0.816784),(2034,0.817404),(2035,0.818014),(2036,0.818614),(2037,0.819205),(2038,0.819789)) Units: Dmnl

Natural Gas Fraction Discoverable Table([(0,0)-(6,1)],(0,0),(0.2,0.2),(0.45,0.44),(0.7,0.64),(1,0.75),(1.25,0.8),(3,0.9),(5,1)) Units: Dmnl

Natural Gas Fraction Recoverable([(1980,0)-(2050,10)],(1980,0.565),(1981,0.56503),(1982,0.565118),(1983,0.565255),(1984,0.565434),(1985,0.565654),(1986,0.565905),(1987,0.566223),(1988,0.566688

),(1989,0.567272),(1990,0.567939),(1991,0.568945),(1992,0.570549),(1993,0.572632
),(1994,0.575125),(1995,0.577986),(1996,0.581192),(1997,0.584794),(1998,0.58875
),(1999,0.593082),(2000,0.597843),(2001,0.602516),(2002,0.606804),(2003,0.610806
),(2004,0.61464),(2005,0.618365),(2006,0.621954),(2007,0.62541),(2008,0.628868
),(2009,0.632548),(2010,0.636331),(2011,0.64021),(2012,0.643876),(2013,0.647118
),(2014,0.650213),(2015,0.653246),(2016,0.656217),(2017,0.659061),(2018,0.662002
),(2019,0.665111),(2020,0.668382),(2021,0.671766),(2022,0.675252),(2023,0.678834
),(2024,0.682395),(2025,0.685915),(2026,0.689396),(2027,0.69283),(2028,0.696204
),(2029,0.699521),(2030,0.701194),(2031,0.70257),(2032,0.703921),(2033,0.705246
),(2034,0.706548),(2035,0.707828),(2036,0.709089),(2037,0.710331),(2038,0.711556))
Units: Dmnl

Natural Gas Fraction Recoverable Table([(0,0)-
(6,1)],(0,0),(1,0.565),(1.25,0.63),(1.5,0.7),(2,0.76)) Units: Dmnl

natural gas from LFG= min(natural gas generation from LFG capacity, residual LFG*landfill gas to natural gas) Units: Cubic Feet/Year

natural gas generation from LFG capacity= investmet effect of natural gas generation from LFG*natural gas generation from LFG total investment Units: Cubic Feet/Year

natural gas generation from LFG investment= natural gas generation from LFG investment time series(Time)/time delay for natural gas generation from LFG investment Units: usd15/Year/Year

natural gas generation from LFG investment time series([(0,0)-
(2000,10)],(1970,0),(2000,0)) Units: usd15/Year

natural gas generation from LFG total investment= INTEG (natural gas generation from LFG investment, 0) Units: usd15/Year

natural gas GHG emission coefficient= 55.64 Units: Ton/Tj

Natural Gas Initial Cumulative Production= 619377 Units: BCF

Natural Gas initial discovered resources= 840600 Units: BCF

natural gas inventory and losses([(1990,0)-
(2030,40000)],(1990,5023.11),(2006,9385.96),(2011,16228.1),(2017
,20175.4),(2023,22039.5),(2030,23245.6)) Units: BCF/Year

natural gas price over cost= (Natural Gas Price per MBTU/natural gas production cost per MBTU)-1 Units: Dmnl

Natural Gas Price per MBTU= real natural gas price per MBTU*gdp deflator Units: usd15/Mbtu

Natural Gas Price Substitutability= DELAY N((Relative Natural Gas Price/Relative Weighted Average Energy Price), 1, 1, 1) Units: Dmnl

natural gas production cost per MBTU= real natural gas production cost per MBTU*gdp deflator Units: USD/Mbtu

Natural Gas Production in QDBTU= World Natural Gas Production Rate/QDBTU to BCF Units: qdbtu/Year

natural gas recoverable reserves demand ratio= World Natural Gas Recoverable Reserves/ natural gas demand Units: Year

Natural Gas Reference Reserve Production Ratio for price= 25 Units: Year

"NET CAPITAL GROWTH (NCG)"= CHANGE IN CAPITAL-CAPITAL REQUIREMENT Units: Dmnl

net change in agriculture employment= (indicated agriculture employment demand-agriculture employment)/time to adjust agriculture employment Units: Person/Year

net change in carbon stock from land conversion= change in carbon stock from arable to pasture +change in carbon stock from arable to settlement +change in carbon stock from fallow to pasture +change in carbon stock from fallow to settlement +change in carbon stock from forest to arable +change in carbon stock from forest to pasture +change in carbon stock from forest to settlement +change in carbon stock from pasture to forest +change in carbon stock from pasture to others +change in carbon stock from pasture to settlement +change in carbon stock from arable land to forest Units: Ton/Year

net change in industry employment= (indicated industry employment demand-industry employment)/time to adjust industry employment Units: Person/Year

NET CHANGE IN LITERACY= TREND(LITERACY RATE, 1 , 0.01) Units: Dmnl

net change in services employment= (indicated services employment demand-services employment)/time to adjust services employment Units: Person/Year

net employment after relocation program= total fisheries employment-employment to be relocated Units: Person

net energy gain= total biofuels production*(biogasoline and biodiesel EROI-1) Units: gallon/Year

NET ENROLLMENT RATE= (NET CHANGE IN LITERACY*LITERACY ADJUSTMENT TIME)+LITERACY RATE+DROPOUT FRACTION Units: Dmnl

NET ENROLMENT RATE FRACTION= NET ENROLLMENT RATE/100 Units: Dmnl

net fisheries employment= total fisheries employment-employment to be relocated Units: Person

net forest increase due to policy= if then else(Time>=2011, afforestation-deforestation, 0) Units: Ha/Year

net industry employment= industry employment-biofuel employment-coal extraction employment-gas extraction employment -oil extraction employment-total power employment no fuel-total upstream employment from waste Units: Person

net services employment= services employment-total transportation employment-water employment Units: Person

net zero policy reduction in air pollution from thermal power generation= WITH LOOKUP (Time, ([(2020,0.8)-(2030,1)],(2020,1),(2030,0.75))) Units: Dmnl

new fishery employment= fish catch*new fishery employment factor Units: Person/Year

new fishery employment factor= WITH LOOKUP (Time, ([(1970,0)-(2050,1)],(1970,0.25),(1971,0.25),(1972,0.25),(1973,0.26),(1974,0.26),(1975,0.26),(1976,0.26),(1977,0.27),(1978,0.27),(1979,0.27),(1980,0.28),(1981,0.28),(1982,0.28),(1983,0.29),(1984,0.29),(1985,0.29),(1986,0.3),(1987,0.3),(1988,0.3),(1989,0.31),(1990,0.31),(1991,0.31),(1992,0.32),(1993,0.32),(1994,0.33),(1995,0.33),(1996,0.34),(1997,0.34),(1998,0.35),(1999,0.35),(2000,0.35),(2001,0.36),(2002,0.36),(2003,0.37),(2004,0.37),(2005,0.38),(2006,0.39),(2007,0.39),(2008,0.4))) Units: Person/Ton

new investment after policy= (vessel discard)*average cost per unit vessel Units: USD/Year

new recycling capacity= total recycling investment*investment effect on recycling Units: Ton/Year

new vessel= if then else(Time >=2021, new investment after policy/average cost per unit vessel /vessel acquisition time, (vessel investment(Time)/average cost per unit vessel)/vessel acquisition time) Units: vessel/Year

NH3 emissions from biomass= biomass and waste in TJ*NH3 emissions per tj of biomass by sector/KG PER TON Units: Ton/Year

NH3 emissions from coal[sector]= normalized coal demand[sector]*NH3 emissions per tj of coal by sector[sector]/KG PER TON Units: Ton/Year

NH3 emissions from natural gas[sector]= normalized natural gas demand[sector]*NH3 emissions per tj of natural gas by sector [sector]/KG PER TON Units: Ton/Year

NH3 emissions from petroleum[sector]= normalized petroleum demand[sector]*NH3 emissions per tj of gasoline by sector [sector]/KG PER TON Units: Ton/Year

NH3 emissions per tj of biomass by sector= 53.7 Units: Kg/Tj

NH3 emissions per tj of coal by sector[sector]= 0.0093, 0, 0.0093, 0, 38.74 Units: Kg/Tj

NH3 emissions per tj of gasoline by sector[sector]= 0.154, 31.03, 0.168, 0, 0.108 Units: Kg/Tj

NH3 emissions per tj of natural gas by sector[sector]= 1.214, 0, 1.214, 0, 0.1812 Units: Kg/Tj

nickel annual demand rate of change= 0.02 Units: 1/Year

nickel baseline demand= INTEG (nickel demand change, 10124) Units: Ton/Year

nickel CO2e emissions= nickel energy consumption*energy carbon intensity Units: TonCO2e/Year

nickel demand= MAX(0,annual number of batteries required*nickel required per battery/KG PER TON -nickel recycled) Units: Ton/Year

nickel demand change= nickel annual demand rate of change*nickel baseline demand Units: Ton/(Year*Year)

nickel demand supply balance= if then else(mining for EV switch=1, (nickel baseline demand+nickel demand)/nickel production, nickel baseline demand/nickel production) Units: 1

nickel energy consumption= nickel production*"energy consumption per unit (extraction and processing)" Units: Tj/Year

nickel exploration= nickel resource*nickel resource development rate Units: Ton/Year

nickel extracted= INTEG (nickel production, 0) Units: Ton

nickel import cost= nickel demand*nickel price per ton-nickel revenues Units: USD/Year

nickel land use= nickel demand*Nickel land use per ton of demand Units: Ha/Year

Nickel land use per ton of demand= 0.01 Units: Ha/Ton

nickel price per ton= 16500 Units: USD/Ton

nickel production= if then else(mining for EV switch=0, min(nickel baseline demand,nickel reserve), min(nickel baseline demand+nickel demand, nickel reserve)) Units: Ton/Year

nickel recycled= annual number of batteries discarded*nickel required per battery/KG PER TON *battery recycling Units: Ton/Year

nickel required per battery= 29 Units: Kg/Battery

nickel reserve= INTEG (nickel exploration-nickel production, 434706) Units: Ton

nickel resource= INTEG (-nickel exploration, 506213*100) Units: Ton

nickel resource development rate= 0.035 Units: 1/Year

nickel revenues= nickel price per ton*nickel production Units: USD/Year

nickel water consumption= nickel production*water consumption per unit Units: liter/Year

NMVOC emissions from biomass= biomass and waste in TJ*NMVOC emissions per tj of biomass by sector/KG PER TON Units: Ton/Year

NMVOC emissions from coal[sector]= normalized coal demand[sector]*NMVOC emissions per tj of coal by sector[sector]/KG PER TON Units: Ton/Year

NMVOC emissions from natural gas[sector]= normalized natural gas demand[sector]*NMVOC emissions per tj of natural gas by sector [sector]/KG PER TON Units: Ton/Year

NMVOC emissions from petroleum[sector]= normalized petroleum demand[sector]*NMVOC emissions per tj of gasoline by sector [sector]/KG PER TON Units: Ton/Year

NMVOC emissions from power generation[power generation technology]= fuel use for power generation in TJ[power generation technology]*NMVOC emissions per TJ of fuel combusted [power generation technology]/KG PER TON Units: Ton/Year

NMVOC emissions per tj of biomass by sector= 1654.3 Units: Kg/Tj

NMVOC emissions per tj of coal by sector[sector]= 88.8, 0, 88.8, 0, 484 Units: Kg/Tj

NMVOC emissions per TJ of fuel combusted[power generation technology]= 2.3, 2.3, 2.6, 1.4, 0, 0, 0, 0, 0, 0, 0, 0, 7.31, 0 Units: Kg/Tj

NMVOC emissions per tj of gasoline by sector[sector]= 25, 741.81, 50, 0, 30 Units: Kg/Tj

NMVOC emissions per tj of natural gas by sector[sector]= 23, 12.14, 23, 0, 1.9 Units: Kg/Tj

nominal base case allowance price per ton([(2010,0)-(2050,650)],(2011,0),(2012,19.11),(2013,21.01),(2014,23.09),(2015

,25.39),(2016,27.91),(2017,30.68),(2018,33.83),(2019,37.22),(2020,40.94),(2021
,45.06),(2022,49.63),(2023,54.65),(2024,59.99),(2025,65.83),(2026,72.2),(2027
,79.22),(2028,86.91),(2029,95.32),(2030,104.57),(2031,111.75),(2032,119.38)
,(2033,127.5),(2034,136.14),(2035,145.32),(2036,155.07),(2037,165.44),(2038
,176.46),(2039,188.17),(2040,200.6),(2041,213.81),(2042,227.84),(2043,242.74
),(2044,258.56),(2045,275.35),(2046,293.17),(2047,312.09),(2048,332.17),(2049
,353.48),(2050,376.08)) Units: usd15/Ton

Nominal Coal Expenditure= Coal Price per MBTU*Coal Production in QDBTU/qdbtu to mbtu Units: USD/Year

nominal cost of coal for electricity= Coal Price per MBTU*electricity coal demand in QDBTU/qdbtu to mbtu Units: USD/Year

Nominal Cost of Fuel for Electricity= nominal cost of oil for electricity+nominal cost of natural gas for electricity +nominal cost of coal for electricity+nominal cost of renewable resources for electricity Units: USD/Year

nominal cost of natural gas for electricity= electricity gas demand in QDBTU*Natural Gas Price per MBTU/qdbtu to mbtu Units: USD/Year

nominal cost of oil for electricity= electricity petroleum demand in QDBTU*Oil Price per MBtu/qdbtu to mbtu Units: USD/Year

nominal cost of renewable resources for electricity= total electricity generation from renewables in qdbtu*Renewable Resource price per MBTU (Time)/qdbtu to mbtu Units: USD/Year

nominal economic output from building= (Sale of buildings*economic output generated per building) Units: usd15/Year

nominal economic output from clothing production= (Sale of clothing*economic output generated per clothing) Units: usd15/Year

nominal economic output from plastic production= (Sale of plastic*economic output generated per plastic) Units: usd15/Year

nominal economic output from vehicile production= (Sale of vehicle*economic output generated per vehicle) Units: usd15/Year

Nominal Electricity Expenditure= (electricity price per Mbtu*total electricity generation in QDBTU/qdbtu to mbtu) Units: USD/Year

nominal emissions cost= fossil fuel CO2 emission*nominal base case allowance price per ton(Time) Units: usd15/Year

nominal GDP= real gross domestic product*gdp deflator Units: USD/Year

nominal industrial emissions cost= ind fossil fuel CO2 emission*nominal base case allowance price per ton(Time) Units: USD/Ton/Year

Nominal Natural Gas Expenditure= Natural Gas Price per MBTU*Natural Gas Production in QDBTU/qdbtu to mbtu Units: USD/Year

Nominal Net Electricity Expenditure= (electricity price per Mbtu*total electricity generation in QDBTU/qdbtu to mbtu)-Nominal Cost of Fuel for Electricity Units: USD/Year

Nominal Petroleum Expenditure= Oil Price per MBtu*total petroleum consumption in qdbtu/qdbtu to mbtu Units: USD/Year

Nominal Renewable Resources Expenditure= Renewable Resource price per MBTU(Time)*Renewable Resources Production non electric in QDBTU /qdbtu to mbtu Units: USD/Year

nominal VA added per ton= WITH LOOKUP (Time, ([(1990,0)-(2024,40000)],(1990,8719.37),(1991,9086.09),(1992,12855.7),(1993,15980.4),(1994,20156.5),(1995,23314.8),(1996,23877.6),(1997,24132.5),(1998,24857.6),(1999,24526.6),(2000,24698.5),(2001,24985.5),(2002,24752.2),(2003,29662.6),(2004,26795.4),(2005,28073),(2006,26671.1),(2007,27177.4),(2008,27139.4),(2009,28171.3),(2010,26786.4),(2011,27307.2),(2012,26451.9),(2013,25436.8),(2014,25054.2),(2015,23103.4),(2016,19676.5),(2017,17078.1),(2018,18288.9),(2019,19844.8),(2020,20586.7),(2021,23887),(2022,31081),(2023,34354.4),(2024,35433.7))) Units: USD/Ton

nominal VA from textile= WITH LOOKUP (Time, ([(1990,0)-(2050,30)],(1990,7.94712),(1991,8.06378),(1992,8.02632),(1993,7.82784),(1994,8.02808),(1995,8.5408),(1996,7.60993),(1997,6.95363),(1998,7.49235),(1999,7.71656),(2000,7.52951),(2001,6.76049),(2002,7.41572),(2003,7.4212),(2004,9.75467),(2005,12.28),(2006,11.6257),(2007,12.7829),(2008,13.6035),(2009,12.5278),(2010,13.4213),(2011,14.6628),(2012,14.9491),(2013,15.0822),(2014,15.3404),(2015,14.4602),(2016,14.0632),(2017,14.4745),(2018,15.0207),(2019,14.6127),(2020,14.1189),(2021,15.5661),(2022,16.4682),(2023,16.7142),(2024,17.0586),(2050,27))) Units: USD/Ton

nominal va per ton of chemicals= WITH LOOKUP (Time, ([(1970,0)-(2050,100)],(1970,40),(1990,73.46),(1991,74.04),(1992,77.94),(1993,78.68),(1994,81.17),(1995,86.95),(1996,82.01),(1997,79.23),(1998,72.58),(1999,79.85),(2000,74.59),(2001,76.26),(2002,57.3),(2003,49.51),(2004,41.98),(2005,52.95),(2006,51.62),(2007,55.57),(2008,57.26),(2009,58.26),(2010,60.86),(2011,64.59),(2012,65.33),(2013,66.03),(2014,67.53),(2015,64.65),(2016,64.11),(2017,65.49),(2018,67.85),(2019,68.32),(2020,70.51),(2021,71.1),(2022,75.8),(2023,76.62),(2024,78.2),(2050,95.1316))) Units: USD/Ton

non convertible forest land= 3.5e+009 Units: Ha

non convertible other land= 3.875e+009*multiplier required pasture land(Time) Units: Ha

NON FUEL ENERGY CONSUMPTION coal= 0 Units: Dmnl

NON FUEL ENERGY CONSUMPTION natural gas= 0.03 Units: Dmnl

NON FUEL ENERGY CONSUMPTION petroleum= 0.09 Units: Dmnl

non surface water use= if then else(TOTAL WATER consumption>usable discharge water,TOTAL WATER consumption -usable discharge water,0) Units: Km3/Year

"non-energy use coal demand"= DELAY N(("indicated non-energy use coal demand 0"*Coal Price Substitutability ^"non-energy use elasticity of coal demand to coal price"), time to adapt demand to price changes,("indicated non-energy use coal demand 0" *Coal Price Substitutability^"non-energy use elasticity of coal demand to coal price"), 3) Units: qdbtu/Year

"non-energy use coal gdp intensity"= "normalized non-energy use coal demand"/real gross domestic product Units: qdbtu/usd15

"non-energy use elasticity of coal demand to coal price"= -0.1 Units: Dmnl

"non-energy use elasticity of coal demand to price"= 1 Units: Dmnl

"non-energy use elasticity of electricity demand to electricity price"= -0.05 Units: Dmnl

"non-energy use elasticity of electricity to gdp"= 0.4 Units: Dmnl

"non-energy use elasticity of natural gas demand to natural gas price"= -0.02 Units: Dmnl

"non-energy use Elasticity of natural gas demand to price"= 0.1 Units: Dmnl

"non-energy use elasticity of oil demand to price"= 0.6 Units: Dmnl

"non-energy use elasticity of petroleum demand to oil price"= -0.02 Units: Dmnl

"non-energy use elasticity of renewable resources demand to price"= 1 Units: Dmnl

"non-energy use elasticity of renewable resources demand to renewable resources price" = -0.3 Units: Dmnl

"non-energy use electricity demand"= DELAY N(("indicated non-energy use electricity net demand 0"*Electricity Price Substitutability ^"non-energy use elasticity of electricity demand to electricity price"), time to adapt demand to price changes,("indicated non-energy use electricity net demand 0" *Electricity Price Substitutability ^"non-energy use elasticity of electricity demand to electricity price"), 3) Units: qdbtu/Year

"non-energy use electricity GDP Intensity"= "normalized non-energy use electricity net demand"/real gross domestic product Units: qdbtu/usd15

"non-energy use natural gas demand"= DELAY N(("indicated non-energy use natural gas demand 0"*Natural Gas Price Substitutability ^"non-energy use elasticity of natural gas demand to natural gas price"), time to adapt demand to price changes,("indicated non-energy use natural gas demand 0" *Natural Gas Price Substitutability ^"non-energy use elasticity of natural gas demand to natural gas price"), 3) Units: qdbtu/Year

"non-energy use natural gas GDP Intensity"= "normalized non-energy use natural gas demand"/real gross domestic product Units: qdbtu/usd15

"non-energy use petroleum demand"= DELAY N(("indicated non-energy use petroleum demand 0"*Oil Price Substitutability ^"non-energy use elasticity of petroleum demand to oil price"), time to adapt demand to price changes ,("indicated non-energy use petroleum demand 0" *Oil Price Substitutability^"non-energy use elasticity of petroleum demand to oil price"), 3) Units: qdbtu/Year

"non-energy use petroleum gdp intensity"= "normalized non-energy use petroleum demand"/real gross domestic product Units: qdbtu/usd15

"non-energy use renewable resources demand"= DELAY N(("indicated non-energy use renewable resources demand 0"*Renewable Resources Price Substitutability ^"non-energy use elasticity of renewable resources demand to renewable resources price"), time to adapt demand to price changes, ("indicated non-energy use renewable resources demand 0" *Renewable Resources Price Substitutability ^ "non-energy use elasticity of renewable resources demand to renewable resources price"), 3) Units: qdbtu/Year

"non-energy use renewable resources GDP intensity"= "normalized non-energy use renewable resources demand"/real gross domestic product Units: qdbtu/usd15

"non-metallic mineral demand per building"= WITH LOOKUP (Time, ([(2000,7)-(2050,20)],(2000,14.9441),(2001,14.9442),(2002,14.6229),(2003,14.596),(2004,14.0816),(2005,13.4922),(2006,12.9862),(2007,11.939),(2008,10.6248),(2009,11.8381),(2010,11.7959),(2011,11.6453),(2012,11.9682),(2013,12.0942),(2014,11.72),(2015,11.6405),(2016,11.5375),(2017,11.4143),(2018,10.4914),(2019,10.6401),(2020,11.2429),(2021,10.068),(2022,10.1572),(2023,10.1185),(2024,9.91624),(2050,8))) Units: Ton/building

"non-metallic mineral demand per clothing"= WITH LOOKUP (Time, ([(2000,1)-(2050,3)],(2000,2.15009),(2001,2.34397),(2002,2.50751),(2003,2.50796),(2004,2.3671),(2005,2.25711),(2006,2.60552),(2007,2.54988),(2008,1.90442),(2009,2.04878),(2010,1.87934),(2011,1.6781),(2012,1.6352),(2013,1.65305),(2014,1.61007),(2015,1.77928),(2016,1.97264),(2017,1.81971),(2018,1.78474),(2019,1.87557),(2020,2.03243),(2021,1.70637),(2022,1.56238),(2050,1.2))) Units: Dmnl

"non-metallic mineral demand per plastic"= WITH LOOKUP (Time, ([(2000,0)-(2050,0.1)],(2000,0.0902888),(2001,0.0872296),(2002,0.0869673),(2003,0.0906045),(2004,0.0905316),(2005,0.0904747),(2006,0.0831439),(2007,0.0825853),(2008,0.0858944),(2009,0.0752809),(2010,0.0772072),(2011,0.0744771),(2012,0.0729202),(2013,0.0719167),(2014,0.0683257),(2015,0.0656432),(2016,0.0634215),(2017,0.0617315),(2018,0.0643581),(2019,0.0608251),(2020,0.0597394),(2021,0.0634811),(2022,0.0627704),(2023,0.0632981),(2024,0.0638932),(2050,0.0614035))) Units: Dmnl

"non-metallic mineral demand per vehicle"= WITH LOOKUP (Time, ([(2000,2)-(2050,4)],(2000,2.21909),(2001,2.18247),(2002,2.49578),(2003,2.4191),(2004,2.27445),(2005,2.31704),(2006,2.31804),(2007,2.50321),(2008,2.37902),(2009,2.34159),(2010,2.45259),(2011,2.60506),(2012,2.59967),(2013,2.62352),(2014,2.57709),(2015,2.66628),(2016,2.70042),(2017,2.58358),(2018,2.60443),(2019,2.52955),(2020,2.92852),(2021,2.64457),(2022,2.89742),(2023,3.02875),(2024,3.09806),(2050,3.6))) Units: Ton/vehicle

"Non-metallic minerals for demand for buildings"= (("non-metallic mineral demand per building"*Sale of buildings)/Material efficiency for buildings)-building materials to be reused[non metallic mineral material] Units: Ton/Year

"Non-metallic minerals for demand for clothing"= (("non-metallic mineral demand per clothing"*Sale of clothing)/Material efficiency for clothing)-clothing materials to be reused[non metallic mineral material] Units: Ton/Year

"Non-metallic minerals for demand for plastic"= MAX(0,(("non-metallic mineral demand per plastic"*Sale of plastic)/Material efficiency for plastic)-plastic materials to be reused[non metallic mineral material]) Units: Ton/Year

"Non-metallic minerals for demand for vehicles"= (("non-metallic mineral demand per vehicle"*Sale of vehicle)/Material efficiency for vehicles)-Vehicle materials to be reused[non metallic mineral material] Units: Ton/Year

"non-recyclers convinced by campaign"= ("non-recyclers"*probability to get informed via campaign)/time to become recyclers *probability to become recyclers due to pollution Units: Person/Year

"non-recyclers"= total population-recyclers Units: Person

"non-seperators contacted by recyclers per time period"= total contacts of recyclers per time period*("SHARE OF non-recyclers")*probability to inform a person about waste recycling Units: Person/Year

nonhydro BKWH to QDBTU conversion= WITH LOOKUP (Time, ([(1980,0)-(2050,0.05)],(1980,0.0202343),(1981,0.0348601),(1982,0.0433299

),(1983,0.0443541),(1984,0.0431824),(1985,0.04054),(1986,0.0419223),(1987,0.042250
3),(1988,0.0444516),(1989,0.0247298),(1990,0.0224287),(1991,0.021461),(1992,
0.0209),(1993,0.0206105),(1994,0.0209595),(1995,0.0217695),(1996,0.0225078)
,(1997,0.0214352),(1998,0.0210483),(1999,0.0204245),(2000,0.0192507),(2001,
0.0191726),(2002,0.0189264),(2003,0.0183927),(2004,0.0178678),(2005,0.0173433
),(2006,0.0148251))) Units: qdbtu/BKWH

nonhydro electricity production= TOTAL electricity demand accounting for distribution losses-hydro electricity generation Units: BKWH/Year

nonhydro renewable electricty production share= min(1,nonhydro renewable energy for electricity generaetion in gwh/nonhydro electricity production) Units: Dmnl

nonhydro renewable energy for electricity generaetion in bkwh= nonhydro renewable energy for electricity generaetion in qdbtu*QDBTU to BKWH Units: BKWH/Year

nonhydro renewable energy for electricity generaetion in gwh= nonhydro renewable energy for electricity generaetion in bkwh/gwh to bkwh Units: GWh/Year

nonhydro renewable energy for electricity generaetion in qdbtu= total electricity generation from renewables in qdbtu-hydro electricity generation in Qdbtu Units: qdbtu/Year

nonhydro renewable energy production in qdbtu= (biomass energy production in QDBTU+geothermal energy production in bkwh+municipal waste energy production in QDBTU +solar energy production in QDBTU+wind energy production in QDBTU+"Tide, wave and ocean energy production IN QDBTU" +OTHER RENEWABLES energy production IN QDBTU) Units: qdbtu/Year

nonpredation: (FISHYR0-fishyr2)

normalized agriculture coal demand= normalized agriculture coal share of energy demand*total agriculture indicated energy demand Units: qdbtu/Year

normalized agriculture coal share of energy demand= agriculture coal demand/total agriculture energy demand Units: Dmnl

normalized agriculture electricity net demand= normalized agriculture electricity net share of energy demand*total agriculture indicated energy demand Units: qdbtu/Year

normalized agriculture electricity net share of energy demand= agriculture electricity demand/total agriculture energy demand Units: Dmnl

Normalized agriculture GDP= Agriculture share of GDP*real gross domestic product Units: usd15/Year

normalized agriculture investment fraction= fraction of investment agriculture/sum of investment shares Units: Dmnl

normalized agriculture natural gas demand= normalized agriculture natural gas share of energy demand*total agriculture indicated energy demand Units: qdbtu/Year

normalized agriculture natural gas share of energy demand= agriculture natural gas demand/total agriculture energy demand Units: Dmnl

normalized agriculture petroleum demand= normalized agriculture petroleum share of energy demand*total agriculture indicated energy demand Units: qdbtu/Year

normalized agriculture petroleum share of energy demand= agriculture petroleum demand/total agriculture energy demand Units: Dmnl

normalized agriculture renewable resources demand= normalized agriculture renewable resources share of energy demand*total agriculture indicated energy demand Units: qdbtu/Year

normalized agriculture renewable resources share of energy demand= agriculture renewable resources demand/total agriculture energy demand Units: Dmnl

normalized area lost= area lost due to limited income classes/SUM(income distribution[IncClass!]) Units: Dmnl

normalized coal demand[INDUSTRY]= (normalized industrial coal demand+normalized agriculture coal demand+normalized Fishing coal demand)/TJ of coal to QDBTU normalized coal demand[transport]= normalized transportation coal demand/TJ of coal to QDBTU normalized coal demand[NONENERGY USE]= (normalized commercial coal demand+"normalized non-energy use coal demand")/TJ of coal to QDBTU normalized coal demand[other energy uses]= normalized Others coal demand/TJ of coal to QDBTU normalized coal demand[HOUSEHOLDS]= normalized residential coal demand/TJ of coal to QDBTU Units: Tj/Year

normalized commercial coal demand= normalized commercial coal share of energy demand*total commercial indicated energy demand Units: qdbtu/Year

normalized commercial coal share of energy demand= commercial coal demand/total commercial energy demand Units: Dmnl

normalized commercial electricity net demand= normalized commercial electricity net share of energy demand*total commercial indicated energy demand Units: qdbtu/Year

normalized commercial electricity net share of energy demand= commercial electricity demand/total commercial energy demand Units: Dmnl

normalized commercial natural gas demand= normalized commercial natural gas share of energy demand*total commercial indicated energy demand Units: qdbtu/Year

normalized commercial natural gas share of energy demand= commercial natural gas demand/total commercial energy demand Units: Dmnl

normalized commercial petroleum demand= normalized commercial petroleum share of energy demand*total commercial indicated energy demand Units: qdbtu/Year

normalized commercial petroleum share of energy demand= commercial petroleum demand/total commercial energy demand Units: Dmnl

normalized commercial renewable resources demand= normalized commercial renewable resources share of energy demand*total commercial indicated energy demand Units: qdbtu/Year

normalized commercial renewable resources share of energy demand= commercial renewable resources demand/total commercial energy demand Units: Dmnl

normalized Fishing coal demand= normalized Fishing coal share of energy demand*total Fishing indicated energy demand Units: qdbtu/Year

normalized Fishing coal share of energy demand= Fishing coal demand/total Fishing energy demand Units: Dmnl

normalized Fishing electricity net demand= normalized Fishing electricity net share of energy demand*total Fishing indicated energy demand Units: qdbtu/Year

normalized Fishing electricity net share of energy demand= Fishing electricity demand/total Fishing energy demand Units: Dmnl

normalized Fishing natural gas demand= normalized Fishing natural gas share of energy demand*total Fishing indicated energy demand Units: qdbtu/Year

normalized Fishing natural gas share of energy demand= Fishing natural gas demand/total Fishing energy demand Units: Dmnl

normalized Fishing petroleum demand= normalized Fishing petroleum share of energy demand*total Fishing indicated energy demand Units: qdbtu/Year

normalized Fishing petroleum share of energy demand= Fishing petroleum demand/total Fishing energy demand Units: Dmnl

normalized Fishing renewable resources demand= normalized Fishing renewable resources share of energy demand*total Fishing indicated energy demand Units: qdbtu/Year

normalized Fishing renewable resources share of energy demand= Fishing renewable resources demand/total Fishing energy demand Units: Dmnl

normalized income distribution area[IncClass]= income distribution area[IncClass]/(SUM(income distribution area[IncClass!])+area lost due to limited income classes) Units: Dmnl

normalized industrial coal demand= normalized industrial coal share of energy demand*Total Industrial Indicated Energy Demand *(1-energy efficiency ratio from green investment industry) Units: qdbtu/Year

normalized industrial coal share of energy demand= industrial coal demand/Total Industrial Energy Demand Units: Dmnl

normalized industrial electricity net demand= normalized industrial electricity net share of energy demand*Total Industrial Indicated Energy Demand *(1-energy efficiency ratio from green investment industry) Units: qdbtu/Year

normalized industrial electricity net share of energy demand= industrial electricity demand/Total Industrial Energy Demand Units: Dmnl

normalized industrial natural gas demand= normalized industrial natural gas share of energy demand*Total Industrial Indicated Energy Demand *(1-energy efficiency ratio from green investment industry) Units: qdbtu/Year

normalized industrial natural gas share of energy demand= industrial natural gas demand/Total Industrial Energy Demand Units: Dmnl

normalized industrial petroleum demand= normalized industrial petroleum share of energy demand*Total Industrial Indicated Energy Demand *(1-energy efficiency ratio from green investment industry) Units: qdbtu/Year

normalized industrial petroleum share of energy demand= industrial petroleum demand/Total Industrial Energy Demand Units: Dmnl

Normalized Industrial renewable resources demand= normalized Industrial renewable resources share of energy demand*Total Industrial Indicated Energy Demand Units: qdbtu/Year

normalized Industrial renewable resources share of energy demand= Industrial renewable resources demand/Total Industrial Energy Demand Units: Dmnl

Normalized industry GDP= Industry share of GDP*real gross domestic product Units: usd15/Year

normalized industry investment fraction= fraction of investment industry/sum of investment shares Units: Dmnl

normalized natural gas demand[INDUSTRY]= (normalized industrial coal demand+normalized Fishing natural gas demand+normalized agriculture natural gas demand)/TJ of coal to QDBTU normalized natural gas demand[transport]= normalized transportation natural gas demand/TJ of coal to QDBTU normalized natural gas demand[NONENERGY USE]= (normalized commercial natural gas demand+"normalized non-energy use natural gas demand")/TJ of coal to QDBTU normalized natural gas demand[other energy uses]= normalized Others natural gas demand/TJ of coal to QDBTU normalized natural gas demand[HOUSEHOLDS]= normalized residential natural gas demand/TJ of coal to QDBTU Units: Tj/Year

"normalized non-energy use coal demand"= "normalized non-energy use coal share of energy demand"*"total non-energy use indicated energy demand" Units: qdbtu/Year

"normalized non-energy use coal share of energy demand"= "non-energy use coal demand"/"total non-energy use energy demand" Units: Dmnl

"normalized non-energy use electricity net demand"= "normalized non-energy use electricity net share of energy demand"*"total non-energy use indicated energy demand" Units: qdbtu/Year

"normalized non-energy use electricity net share of energy demand"= "non-energy use electricity demand"/"total non-energy use energy demand" Units: Dmnl

"normalized non-energy use natural gas demand"= "normalized non-energy use natural gas share of energy demand"*"total non-energy use indicated energy demand" Units: qdbtu/Year

"normalized non-energy use natural gas share of energy demand"= "non-energy use natural gas demand"/"total non-energy use energy demand" Units: Dmnl

"normalized non-energy use petroleum demand"= "normalized non-energy use petroleum share of energy demand"*"total non-energy use indicated energy demand" Units: qdbtu/Year

"normalized non-energy use petroleum share of energy demand"= "non-energy use petroleum demand"/"total non-energy use energy demand" Units: Dmnl

"normalized non-energy use renewable resources demand"= "normalized non-energy use renewable resources share of energy demand"*"total non-energy use indicated energy demand" Units: qdbtu/Year

"normalized non-energy use renewable resources share of energy demand"= "non-energy use renewable resources demand"/"total non-energy use energy demand" Units: Dmnl

normalized Others coal demand= normalized Others coal share of energy demand*total Others indicated energy demand Units: qdbtu/Year

normalized Others coal share of energy demand= Others coal demand/total Others energy demand Units: Dmnl

normalized Others electricity net demand= normalized Others electricity net share of energy demand*total Others indicated energy demand Units: qdbtu/Year

normalized Others electricity net share of energy demand= Others electricity demand/total Others energy demand Units: Dmnl

normalized Others natural gas demand= normalized Others natural gas share of energy demand*total Others indicated energy demand Units: qdbtu/Year

normalized Others natural gas share of energy demand= Others natural gas demand/total Others energy demand Units: Dmnl

normalized Others petroleum demand= normalized Others petroleum share of energy demand*total Others indicated energy demand Units: qdbtu/Year

normalized Others petroleum share of energy demand= Others petroleum demand/total Others energy demand Units: Dmnl

normalized Others renewable resources demand= normalized Others renewable resources share of energy demand*total Others indicated energy demand Units: qdbtu/Year

normalized Others renewable resources share of energy demand= Others renewable resources demand/total Others energy demand Units: Dmnl

normalized petroleum demand[INDUSTRY]= ((normalized agriculture petroleum demand+normalized Fishing petroleum demand +normalized industrial petroleum demand))/TJ of coal to QDBTU normalized petroleum demand[transport]= normalized transportation petroleum demand/TJ of coal to QDBTU normalized petroleum demand[NONENERGY USE]= ("normalized non-energy use petroleum demand"+normalized commercial petroleum demand)/TJ of coal to QDBTU normalized petroleum demand[other energy uses]= (normalized Others petroleum demand)/TJ of coal to QDBTU normalized petroleum demand[HOUSEHOLDS]= ((normalized residential petroleum demand))/TJ of coal to QDBTU Units: Tj/Year

normalized residential coal demand= normalized residential coal share of energy demand*total residential indicated energy demand Units: qdbtu/Year

normalized residential coal share of energy demand= residential coal demand/total residential energy demand Units: Dmnl

normalized residential electricity net demand= normalized residential electricity net share of energy demand*total residential indicated energy demand Units: qdbtu/Year

normalized residential electricity net share of energy demand= residential electricity demand/total residential energy demand Units: Dmnl

normalized residential natural gas demand= normalized residential natural gas share of energy demand*total residential indicated energy demand Units: qdbtu/Year

normalized residential natural gas share of energy demand= residential natural gas demand/total residential energy demand Units: Dmnl

normalized residential petroleum demand= normalized residential petroleum share of energy demand*total residential indicated energy demand Units: qdbtu/Year

normalized residential petroleum share of energy demand= residential petroleum demand/total residential energy demand Units: Dmnl

normalized residential renewable resources demand= normalized residential renewable resources share of energy demand*total residential indicated energy demand Units: qdbtu/Year

normalized residential renewable resources share of energy demand= residential renewable resources demand/total residential energy demand Units: Dmnl

Normalized services GDP= Services share of GDP*real gross domestic product Units: usd15/Year

normalized services investment fraction= fraction of investment services/sum of investment shares Units: Dmnl

normalized transportation coal demand= normalized transportation coal share of energy demand*total transportation indicated energy demand Units: qdbtu/Year

normalized transportation coal share of energy demand= transportation coal demand/total transportation energy demand Units: Dmnl

normalized transportation electricity net demand= normalized transportation electricity net share of energy demand*total transportation indicated energy demand Units: qdbtu/Year

normalized transportation electricity net share of energy demand= transportation electricity demand/total transportation energy demand Units: Dmnl

normalized transportation natural gas demand= normalized transportation natural gas share of energy demand*total transportation indicated energy demand Units: qdbtu/Year

normalized transportation natural gas share of energy demand= transportation natural gas demand/total transportation energy demand Units: Dmnl

normalized transportation petroleum demand= normalized transportation petroleum share of energy demand*total transportation indicated energy demand Units: qdbtu/Year

normalized transportation petroleum share of energy demand= transportation petroleum demand/total transportation energy demand Units: Dmnl

normalized transportation renewable resources demand= normalized transportation renewable resources share of energy demand*total transportation indicated energy demand Units: qdbtu/Year

normalized transportation renewable resources share of energy demand= transportation renewable resources demand/total transportation energy demand Units: Dmnl

NOx emissions from biomass= biomass and waste in TJ*NOx emissions per tj of biomass by sector/KG PER TON Units: Ton/Year

NOx emissions from coal[sector]= normalized coal demand[sector]*NOx emissions per tj of coal by sector[sector]/KG PER TON Units: Ton/Year

NOx emissions from natural gas[sector]= normalized natural gas demand[sector]*NOx emissions per tj of natural gas by sector [sector]/KG PER TON Units: Ton/Year

NOx emissions from petroleum[sector]= normalized petroleum demand[sector]*NOx emissions per tj of gasoline by sector [sector]*effect of fuel grade on transport NOx emissions [sector]/KG PER TON Units: Ton/Year

NOx emissions from power generation[power generation technology]= fuel use for power generation in TJ[power generation technology]*NOx emissions per TJ of fuel combusted [power generation technology]/KG PER TON*policy reduction in air pollution from thermal power generation Units: Ton/Year

NOx emissions per tj of biomass by sector= 134.6 Units: Kg/Tj

NOx emissions per tj of coal by sector[sector]= 173, 0, 34, 0, 173 Units: Kg/Tj

NOx emissions per TJ of fuel combusted[power generation technology]= 142, 142, 89, 247, 0, 0, 0, 0, 0, 0, 0, 0, 81, 0 Units: Kg/Tj

NOx emissions per tj of gasoline by sector[sector]= 513, 644.2, 942, 0, 306 Units: Kg/Tj

NOx emissions per tj of natural gas by sector[sector]= 74, 543.48, 74, 0, 51 Units: Kg/Tj

nuclear capacity from green investment= nuclear green investment/nuclear energy cost per mw(Time)/nuclear energy construction time Units: MW

nuclear capital life time= 30 Units: Year

Nuclear demand for buildings= (Nuclear intensity per building(Time)*Sale of buildings)/Energy efficiency in building construction Units: Tj/Year

Nuclear demand for clothing= (Nuclear intensity per clothing(Time)*Sale of clothing)/Energy efficiency in clothing manufacturing Units: Tj/Year

Nuclear demand for plastic= (Nuclear intensity per plastic(Time)*Sale of plastic)/Energy efficiency in plastic manufacturing Units: Tj/Year

Nuclear demand for vehicles= (Nuclear intensity per vehicle(Time)*Sale of vehicle)/Energy efficiency in vehicle manufacturing Units: Tj/Year

nuclear electricity demand in BKWH([(1980,0)-(2050,4000)],(1980,237.304),(1981,257.676),(1982,267.221),(1983,277.525),(1984,309.614),(1985,362.588),(1986,391.266),(1987,430.231),(1988,497.99),(1989,500.24),(1990,545.134),(1991,578.874),(1992,584.744),(1993,576.725),(1994,605.216),(1995,636.365),(1996,637.618),(1997,594.069),(1998,636.648),(1999,688.2),(2000,712.429),(2001,726.541),(2002,737.161),(2003,721.727),(2004,745.185),(2007,794),(2049.14,1800)) Units: BKWH/Year

nuclear energy capacity= INTEG (nuclear energy construction-nuclear energy discard, intial nucelar energy capacity) Units: MW

nuclear energy construction= (if then else(Time<2010, nuclear energy investment(Time)/nuclear energy cost per mw (Time)/nuclear energy construction time , (future nuclear energy investment /nuclear energy cost per mw(Time)/nuclear energy construction time)+nuclear capacity from green investment))*if then else(IEA NET ZERO SWITCH=1,"Increase in nuclear capacity IEA.NZ" ,1) Units: MW/Year

nuclear energy construction employment= nuclear energy construction*(nuclear energy construction employment factor (Time)+nuclear energy manufacturing employment factor(Time)) Units: Person/Year

nuclear energy construction employment factor([(2010,0)-(2030,30)],(2010,24.96),(2011,24.648),(2012,24.336),(2013,24.024),(2014,23.712),(2015,23.4),(2016,23.088),(2017,22.776),(2018,22.464),(2019,22.152),(2020,21.84),(2021,21.528),(2022,21.216),(2023,20.904),(2024,20.592),(2025,20.28),(2026,19.968),(2027,19.656),(2028,19.344),(2029,19.032),(2030 ,18.72)) Units: Person/MW

nuclear energy construction time= 1 Units: Year

nuclear energy cost per mw([(2015,0)-(2030,8e+006)],(2015,2.86e+006),(2030,2.86e+006)) Units: usd15/MW

nuclear energy discard= nuclear energy capacity/nuclear capital life time Units: MW/Year

nuclear energy electricity generation= min((TOTAL electricity demand accounting for distribution losses-hydro electricity generation -wind electricity generation-solar electricity generation-geothermal electricity generation -tidal energy electricity generation-wave energy electricity generation-landfill gas electricity generation), nuclear energy power capacity use/mwh to gwh) Units: GWh/Year

nuclear energy investment([(1970,0)-(2010,8e+010)],(1970,1.86e+010),(1981,4.74e+010),(1983,7.16e+010),(1990,5.26e+010),(2001,4.81e+010),(2009,4.54e+010)) Units: usd15

nuclear energy maintenance cost= nuclear energy capacity*nuclear energy maintenance cost per mw Units: usd15/Year

nuclear energy maintenance cost per mw= 102563 Units: usd15/MW/Year

nuclear energy manufacturing employment factor([(2010,0)-(2030,10)],(2010,0),(2011,0),(2012,0),(2013,0),(2014,0),(2015,0),(2016,0),(2017,0),(2018,0),(2019,0),(2020,0),(2021,0),(2022,0),(2023,0),(2024,0),(2025,0),(2026,0),(2027,0),(2028,0),(2029,0),(2030,0)) Units: Person/MW

nuclear energy operation and maintenance employment= nuclear energy capacity*nuclear energy operation and maintenance employment factor (Time) Units: Person/Year

nuclear energy operation and maintenance employment factor([(2010,0)-(2030,10)],(2010,0.824),(2011,0.8137),(2012,0.8034),(2013,0.7931),(2014,0.7828),(2015,0.7725),(2016,0.7622),(2017,0.7519),(2018,0.7416),(2019,0.7313),(2020,0.721),(2021,0.7107),(2022,0.7004),(2023,0.6901),(2024,0.6798),(2025,0.6695),(2026,0.6592),(2027,0.6489),(2028,0.6386),(2029,0.6283),(2030 ,0.618)) Units: Person/MW

nuclear energy power capacity use= nuclearenergy load factor(Time)*potential electricity generation nuclear energy Units: MWh/Year

Nuclear GENERATION EFFICIENCY table([(1980,0)-(2025,1)],(1980,0.32),(1990,0.325),(2000,0.332),(2025,0.348)) Units: Dmnl

nuclear green investment= nuclear green investment fraction(Time)*power generation investment Units: usd15/Year

nuclear green investment fraction([(2011,0)-(2050,0.6)],(2011,0.1),(2050,0.1)) Units: Dmnl

Nuclear intensity per building([(2000,0.004)-(2024,0.009)],(2000,0.00201616),(2001,0.00198759),(2002,0.0019738),(2003,0.00181632),(2004,0.00160424),(2005,0.00147933),(2006,0.00137352),(2007,0.00115418),(2008,0.00102382),(2009,0.00108969),(2010,0.000981989),(2011,0.000846313),(2012,0.000802096),(2013,0.000740203),(2014,0.000766567),(2015,0.000865647),(2016,0.000962115),(2017,0.00105492),(2018,0.00103937),(2019,0.00102015),(2020,0.00105421),(2021,0.000870219),(2022,0.000867214),(2023,0.000850407),(2024,0.000816989)) Units: Tj/building

Nuclear intensity per clothing([(2000,0)-(2022,0.007)],(2000,0.00587296),(2001,0.006085),(2002,0.00597359),(2003,0.00608703),(2004,0.00551781),(2005,0.00491161),(2006,0.00405153),(2007,0.00320121),(2008,0.00301137),(2009,0.00301712),(2010,0.00270597),(2011,0.00219273),(2012,0.00185364),(2013,0.00184319),(2014,0.00185106),(2015,0.00203141),(2016,0.00198111),(2017,0.00199066),(2018,0.00192389),(2019,0.00198476),(2020,0.00203925),(2021,0.00173054),(2022,0.00154878)) Units: Tj/Ton

Nuclear intensity per plastic([(2000,0)-(2024,0.0003)],(2000,0.000280984),(2001,0.000266114),(2002,0.000260929),(2003,0.000221383),(2004,0.000206443),(2005,0.000198604),(2006,0.000184868),(2007,0.000166545),(2008,0.000163317),(2009,0.00015588),(2010,0.000141556),(2011,0.000117285),(2012,0.000101854),(2013,9.71841e-005),(2014,9.50322e-005),(2015,9.53966e-005),(2016,9.23157e-005),(2017,9.16133e-005),(2018,9.7448e-005),(2019,9.48822e-005),(2020,9.40015e-005),(2021,9.7403e-005),(2022,9.35018e-005),(2023,9.1782e-005),(2024,8.9709e-005)) Units: Tj/Ton

Nuclear intensity per vehicle([(2000,0.004)-(2024,0.009)],(2000,0.00788991),(2001,0.00791239),(2002,0.00873303),(2003,0.00845914),(2004,0.0084736),(2005,0.00826997),(2006,0.00802387),(2007,0.00767118),(2008,0.00719176),(2009,0.00705595),(2010,0.00704375),(2011,0.00569432),(2012,0.00492324),(2013,0.00498971),(2014,0.00494654),(2015,0.00496745),(2016,0.00509185),(2017,0.005214),(2018,0.00528674),(2019,0.00514986),(2020,0.005879),(2021,0.00516444),(2022,0.00548093),(2023,0.00550895),(2024,0.00539735)) Units: Tj/vehicle

nuclear share of power generation= nuclear energy electricity generation/total electricity generation Units: Dmnl

nuclearenergy load factor([(2010,0)-(2050,1)],(2010,0.781727),(2022,0.735646),(2023,0.759348),(2030,0.7795),(2035,0.800583),(2040,0.791035),(2050,0.786976)) Units: Dmnl

"Number of batteries required (60 kWh)"= INTEG (annual number of batteries required-annual number of batteries discarded, 0) Units: Battery

number of buses[bus type]= number of buses time series[bus type](Time) Units: vehicle/Year

number of buses time series[bus]([(1970,0)-(2050,1e+007)],(1970,5.65789e+006),(2000,6.29908e+006),(2005,6.40181e+006),(2010,6.50636e+006),(2015,6.61277e+006),(2020,6.72107e+006),(2025,6.8313e+006),(2030,6.94349e+006),(2035,7.05768e+006),(2040,7.17391e+006),(2045,7.29221e+006),(2050,7.41262e+006)) number of buses time series[minibus]([(1900,6e+006)-(2100,1e+008)],(1970.24,6.412e+006),(2000,7.2e+006),(2005,7.5e+006),(2010,7.7e+006),(2015,7.9e+006),(2020,8.1e+006),(2025,8.3e+006),(2030,8.6e+006),(2035,8.8e+006),(2040,9.1e+006),(2045,9.3e+006),(2050,9.6e+006)) Units: vehicle/Year

ocean carbon intake share= 0.2 Units: Dmnl

Oil and natural gas demand for buildings= (Oil and natural gas intensity per building(Time)*Sale of buildings)/Energy efficiency in building construction Units: Tj/Year

Oil and natural gas demand for clothing= (Oil and natural gas intensity per clothing(Time)*Sale of clothing)/Energy efficiency in clothing manufacturing Units: Tj/Year

Oil and natural gas demand for plastic= (Oil and natural gas intensity per plastic(Time)*Sale of plastic)/Energy efficiency in plastic manufacturing Units: Tj/Year

Oil and natural gas demand for vehicles= (Oil and natural gas intensity per vehicle(Time)*Sale of vehicle)/Energy efficiency in vehicle manufacturing Units: Tj/Year

Oil and natural gas intensity per building([(2000,0.1)-(2024,0.2)],(2000,0.0282631),(2001,0.0285482),(2002,0.0268455),(2003,0.0259915),(2004,0.0237123),(2005,0.0219608),(2006,0.0200871),(2007,0.0175727),(2008,0.0165058),(2009,0.0177475),(2010,0.0166825),(2011,0.0143786),(2012,0.0148636),(2013,0.0147135),(2014,0.0148382),(2015,0.0165009),(2016,0.0155709),(2017,0.0142538),(2018,0.0135286),(2019,0.0136948),(2020,0.0152094),(2021,0.0127236),(2022,0.0126219),(2023,0.0122874),(2024,0.0117671)) Units: Tj/building

Oil and natural gas intensity per clothing([(2000,0.03)-(2022,0.06)],(2000,0.0513767),(2001,0.0560445),(2002,0.0555271),(2003,0.0557777),(2004,0.052112),(2005,0.0491763),(2006,0.0488469),(2007,0.0440889),(2008,0.0414664),(2009,0.0435866),(2010,0.0407989),(2011,0.0368994),(2012,0.0357866),(2013,0.037002),(2014,0.0376331),(2015,0.0416063),(2016,0.0435778),(2017,0.0428394),(2018,0.0429558),(2019,0.0450349),(2020,0.0510079),(2021,0.0456241),(2022,0.0409782)) Units: Tj/Ton

Oil and natural gas intensity per plastic([(2000,0.002)-(2024,0.004)],(2000,0.00380915),(2001,0.00365345),(2002,0.00341472),(2003,0.00328416),(2004,0.00321929),(2005,0.00317757),(2006,0.00307146),(2007,0.00280996),(2008,0.00289836),(2009,0.00259573),(2010,0.00254332),(2011,0.00257065),(2012,0.00249995),(2013,0.00236205),(2014,0.00227659),(2015,0.00223623),(2016,0.00226925),(2017,0.00232803),(2018,0.0024877),(2019,0.00239391),(2020,0.0024751),(2021,0.00263377),(2022,0.00256988),(2023,0.00255491),(2024,0.00252548)) Units: Tj/Ton

Oil and natural gas intensity per vehicle([(2000,0.1)-(2024,0.2)],(2000,0.149999),(2001,0.154212),(2002,0.167348),(2003,0.177662),(2004,0.172664),(2005,0.171079),(2006,0.167835),(2007,0.175822),(2008,0.169798),(2009,0.166746),(2010,0.170241),(2011,0.166678),(2012,0.165491),(2013,0.164862),(2014,0.165641),(2015,0.168304),(2016,0.167235),(2017,0.165037),(2018,0.162288),(2019,0.159066),(2020,0.185898),(2021,0.170233),(2022,0.183166),(2023,0.186845),(2024,0.185021)) Units: Tj/vehicle

oil co2 emission= oil energy consumption ag*CO2 EMISSION FACTORS[gasoline power]*ktoe to mtoe Units: mtoe/Year

oil consumption from building= Oil and natural gas demand for buildings Units: Tj/Year

oil consumption from clothing= Oil and natural gas demand for clothing Units: Tj/Year

oil consumption from plastic= Oil and natural gas demand for plastic Units: Tj/Year

oil consumption from vehicles= Oil and natural gas demand for vehicles Units: Tj/Year

oil demand for power generation in barrels= oil demand per qwh of power generation(Time)*diseal and fuel oil energy electricity generation *(1-efficiency factor power generation)*(1-(EXOGENOUS CCS CAPACITY*IEA NET ZERO SWITCH)) Units: Ton/Year

oil demand for power generation in mb= oil demand for power generation in barrels/1e+006 Units: MB/Year

oil demand per qwh of power generation([(1990,0)-(2050,2000)],(1990,1980),(2007,1780),(2015,1790),(2020,1800),(2025,1790),(2030,1760)) Units: Ton/GWh

oil employment factor([(1970,0)-(2050,200)],(1970,104.89),(1971,103.126),(1972,100.995),(1973,98.0664),(1974,95.4172),(1975,95.2432),(1976,97.0649),(1977,98.2015),(1978,98.3737),(1979,98.517),(1980,99.2762),(1981,102.09),(1982,106.865),(1983,111.902),(1984,116.126),(1985,118.827),(1986,120.21),(1987,120.339),(1988,119.648),(1989,118.38),(1990,117.481),(1991,117.649),(1992,118.012),(1993,118.068),(1994

,118.239),(1995,118.042),(1996,117.125),(1997,115.767),(1998,114.228),(1999
,112.874),(2000,111.734),(2001,111.048),(2002,110.487),(2003,109.827),(2004
,108.996),(2005,107.565),(2006,106.46),(2007,106.254),(2008,108.841),(2009,
111.429),(2010,111.81),(2050,85)) Units: Person/MB

oil energy consumption ag= (agriculture petroleum demand*QDBTU to MB(Time))/ktoe to MB Units: ktoe/Year

Oil Energy Market Share= World Oil Production in qdbtu/total energy production Units: Dmnl

oil extraction employment= World Oil Production rate*oil employment factor(Time) Units: Person

Oil Fraction Developable([(1980,0)-
(2050,10)],(1980,0.243485),(1981,0.245026),(1982,0.252847),(1983
,0.265688),(1984,0.280053),(1985,0.293577),(1986,0.305319),(1987,0.315181),
(1988,0.323409),(1989,0.330343),(1990,0.336304),(1991,0.341559),(1992,0.346316
),(1993,0.350718),(1994,0.354861),(1995,0.3588),(1996,0.362567),(1997,0.366183
),(1998,0.369661),(1999,0.373012),(2000,0.376246),(2001,0.379372),(2002,0.382398
),(2003,0.385332),(2004,0.388172),(2005,0.390914),(2006,0.393557),(2007,0.396098
),(2008,0.39854),(2009,0.400894),(2010,0.403173),(2011,0.405391),(2012,0.407549
),(2013,0.409624),(2014,0.411577),(2015,0.413391),(2016,0.415093),(2017,0.416735
),(2018,0.418365),(2019,0.420004),(2020,0.421657),(2021,0.423318),(2022,0.424976
),(2023,0.426617),(2024,0.428227),(2025,0.429799),(2026,0.431327),(2027,0.432809
),(2028,0.434243),(2029,0.435629),(2030,0.436968),(2031,0.438261),(2032,0.43951
),(2033,0.440716),(2034,0.441882),(2035,0.443009),(2036,0.444101),(2037,0.445157
),(2038,0.446181)) Units: Dmnl

Oil Fraction Discoverable([(1980,0)-
(2050,10)],(1980,0.703813),(1981,0.704257),(1982,0.706673),(1983
,0.711145),(1984,0.716965),(1985,0.72343),(1986,0.730062),(1987,0.736609),(
1988,0.742964),(1989,0.749107),(1990,0.755064),(1991,0.760877),(1992,0.766586
),(1993,0.772213),(1994,0.77776),(1995,0.783216),(1996,0.788561),(1997,0.793778
),(1998,0.798857),(1999,0.803793),(2000,0.808586),(2001,0.81324),(2002,0.817764
),(2003,0.822161),(2004,0.826428),(2005,0.830557),(2006,0.834542),(2007,0.83838
),(2008,0.842076),(2009,0.845642),(2010,0.849099),(2011,0.852467),(2012,0.855748
),(2013,0.858908),(2014,0.861885),(2015,0.864652),(2016,0.86725),(2017,0.869761
),(2018,0.872254),(2019,0.874764),(2020,0.877297),(2021,0.879845),(2022,0.88239
),(2023,0.884911),(2024,0.887388),(2025,0.889807),(2026,0.892161),(2027,0.894446
),(2028,0.896659),(2029,0.898799),(2030,0.900868),(2031,0.902868),(2032,0.9048
),(2033,0.906668),(2034,0.908475),(2035,0.910223),(2036,0.911916),(2037,0.913557
),(2038,0.915147)) Units: Dmnl

Oil Fraction Recoverable([(1970,0)-(2050,10)],(1970,0.457134),(1985,0.486125),(2001,0.534211),(2009,0.576316),(2019,0.615),(2050,0.65)) Units: Dmnl

oil inventory and losses([(1990,0)-(2030,2000)],(1990,1614.48),(2007,1929.16),(2015,1929.16),(2020,1915.48),(2025,1737.61),(2030,1785.5)) Units: MB/Year

Oil per vehicle= indicated transportation oil demand/Vehicles currently in use Units: mtoe/(Year*vehicle)

oil price= real oil price*gdp deflator Units: usd15/Barrel

Oil price 1970= 10 Units: usd15/Barrel

Oil price 1980 BTU= 1.8 Units: usd15/Mbtu

Oil Price per MBtu= real oil price per Mbtu*gdp deflator Units: usd15/Mbtu

Oil Price Substitutability= DELAY N((Relative Oil Price per Mbtu/Relative Weighted Average Energy Price), 1,1, 1) Units: Dmnl

opportunity cost of forest land= (natural crops yield per hectare*value added)+estimated forest tree value Units: usd15/Ha

organic carbon emissions from biomass= biomass and waste in TJ*Organic carbon emissions per tj of biomass by sector /KG PER TON Units: Ton/Year

organic carbon emissions from coal[sector]= normalized coal demand[sector]*Organic carbon emissions per tj of coal by sector [sector]/KG PER TON Units: Ton/Year

organic carbon emissions from natural gas[sector]= normalized natural gas demand[sector]*Organic carbon emissions per tj of natural gas by sector [sector]/KG PER TON Units: Ton/Year

organic carbon emissions from petroleum[sector]= normalized petroleum demand[sector]*Organic carbon emissions per tj of gasoline by sector [sector]/KG PER TON Units: Ton/Year

organic carbon emissions from power generation[power generation technology] = fuel use for power generation in TJ[power generation technology]*Organic carbon emissions per TJ of fuel combusted [power generation technology]/KG PER TON Units: Ton/Year

Organic carbon emissions per tj of biomass by sector= 178.4 Units: Kg/Tj

Organic carbon emissions per tj of coal by sector[sector]= 5.2, 0, 5.2, 0, 196.4 Units: Kg/Tj

Organic carbon emissions per TJ of fuel combusted[power generation technology]= 0.359, 0.359, 0.223, 0.167, 0, 0, 0, 0, 0, 0, 0, 0, 0.222, 0 Units: Kg/Tj

Organic carbon emissions per tj of gasoline by sector[sector]= 3.6, 116.38, 28, 0, 2.89 Units: Kg/Tj

Organic carbon emissions per tj of natural gas by sector[sector]= 0.26, 0.326, 0.26, 0, 0.54 Units: Kg/Tj

organic fertilizer cost per tonne= 8000 Units: usd15/Ton

organic fertilizer increase= SMOOTH N(organic fertilizer investment/cost difference, 3, organic fertilizer investment /cost difference, 3) Units: Ton/Year

organic fertilizer investment= agriculture green investment*organic fertilizer investment fraction(Time) Units: usd15/Year

organic fertilizer investment fraction([(2011,0)-(2050,1)],(2011,0.25),(2050,0.25)) Units: Dmnl

organic fertilizer use= fertilizer use by type[organic] Units: Ton/Year

organic waste to electricity= bimass for cofiring existing plants+organic waste used in electricity generation from organic waste new plant +electricity from biomass production Units: Ton/Year

organic waste used in electricity generation from organic waste new plant= electricity from biomass cofiring new plant capacity factor *electricity from biomass cofiring new plant capacity Units: Ton/Year

other disposal waste= INTEG (disposed waste, 7.4e+007) Units: Ton

other elasticity of customers to GDP= 0.85 Units: Dmnl

other electricity customers= initial other electricity customers*relative gdp^other elasticity of customers to GDP Units: customers

Other Land= INTEG (pasture to others-other to pasture-others to settlement, initial others) Units: Ha

other land available for conversion= Other Land-non convertible other land Units: Ha

Other liquid biofuels= Other liquid biofuels time series(Time) Units: ktoe/Year

Other liquid biofuels time series([(1971,0)-(2100,100000)],(1971,135.364),(1972,113.307),(1973,130.687),(1974,141.031),(1975,89.891),(1976,109.529),(1977,114.031),(1978,164.165),(1979,222.405),(1980,760.751),(1981,1324.78),(1982,1011.79),(1983,2513.54),(1984,

3374.34),(1985,4090.34),(1986,3821.48),(1987,4997.27),(1988,4821.31),(1989,
5088.68),(1990,5072.66),(1991,5411.25),(1992,4720.06),(1993,4277.28),(1994,
4626.33),(1995,4475.65),(1996,4571.92),(1997,4742.92),(1998,3961.78),(1999,
3171.12),(2000,2097.16),(2001,2095.77),(2002,2540.92),(2003,2787.49),(2004,
3477.58),(2005,4565.83),(2006,5500.94),(2007,7523.39),(2050,12280)) Units: ktoe/Year

other power demand= (other electricity customers*average other power units per customer)/KWH to gwh *(1-efficiency factor power generation) Units: GWh/Year

other renewables= (total renewable energy production power-hydro electricity generation-waste energy electricity generation)*GWH TO QDBTU Units: qdbtu/Year

OTHER RENEWABLES energy production IN QDBTU= OTHER RENEWABLES GENERATION IN QDBTU TABLE(Time) Units: qdbtu/Year

OTHER RENEWABLES GENERATION IN QDBTU TABLE([(1971,0)-
(2010,0.5)],(1971,0),(1972,0),(1973,0),(1974,0),(1975,0),(1976,0
),(1977,0),(1978,0),(1979,0),(1980,0),(1981,0),(1982,0),(1983,0),(1984,0),(
1985,0),(1986,0),(1987,0),(1988,0),(1989,1.23508e-005),(1990,0.00384989),(1991
,0.00355547),(1992,0.0156074),(1993,0.0143462),(1994,0.0137658),(1995,0.0147615
),(1996,0.0156298),(1997,0.0138056),(1998,0.0180855),(1999,0.0211242),(2000
,0.0224572),(2001,0.0226501),(2002,0.0253948),(2003,0.0236422),(2004,0.0277163
),(2005,0.355233),(2006,0.365226),(2007,0.346422)) Units: qdbtu/Year

other to pasture= min(required change in pasture land,other land available for conversion*other to pasture fraction) Units: Ha/Year

other to pasture fraction= 0.015 Units: Dmnl/Year

other uses energy efficiency([(1990,0.8)-
(2025,1.2)],(1990,1),(2005,1),(2008,1),(2010,1),(2015,1),(2020 ,1),(2025,1),(2040,1)) Units: Dmnl

Others coal demand= DELAY N((indicated Others coal demand 0*Coal Price Substitutability^Others elasticity of coal demand to coal price), time to adapt demand to price changes,(indicated Others coal demand 0*Coal Price Substitutability ^Others elasticity of coal demand to coal price), 3) Units: qdbtu/Year

Others coal gdp intensity= normalized Others coal demand/real gross domestic product Units: qdbtu/usd15

Others elasticity of coal demand to coal price= -0.1 Units: Dmnl

Others elasticity of coal demand to price= 1 Units: Dmnl

Others elasticity of electricity demand to electricity price= -0.05 Units: Dmnl

Others elasticity of electricity to gdp= 0.4 Units: Dmnl

Others elasticity of natural gas demand to natural gas price= -0.05 Units: Dmnl

Others Elasticity of natural gas demand to price= 0.1 Units: Dmnl

Others elasticity of oil demand to price= 0.6 Units: Dmnl

Others elasticity of petroleum demand to oil price= -0.125 Units: Dmnl

Others elasticity of renewable resources demand to price= 1 Units: Dmnl

Others elasticity of renewable resources demand to renewable resources price = -0.05 Units: Dmnl

others elasticity of units to gdp= 0.75 Units: Dmnl

others elasticity of units to price= 0.2 Units: Dmnl

Others electricity demand= DELAY N((indicated Others electricity net demand 0*Electricity Price Substitutability ^Others elasticity of electricity demand to electricity price), time to adapt demand to price changes,(indicated Others electricity net demand 0 *Electricity Price Substitutability ^Others elasticity of electricity demand to electricity price), 3) Units: qdbtu/Year

Others electricity GDP Intensity= normalized Others electricity net demand/real gross domestic product Units: qdbtu/usd15

Others natural gas demand= DELAY N((indicated Others natural gas demand 0*Natural Gas Price Substitutability ^Others elasticity of natural gas demand to natural gas price), time to adapt demand to price changes,(indicated Others natural gas demand 0 *Natural Gas Price Substitutability^Others elasticity of natural gas demand to natural gas price), 3) Units: qdbtu/Year

Others natural gas GDP Intensity= normalized Others natural gas demand/real gross domestic product Units: qdbtu/usd15

Others petroleum demand= DELAY N((indicated Others petroleum demand 0*Oil Price Substitutability ^Others elasticity of petroleum demand to oil price), time to adapt demand to price changes ,(indicated Others petroleum demand 0*Oil Price Substitutability^Others elasticity of petroleum demand to oil price), 3) Units: qdbtu/Year

Others petroleum gdp intensity= normalized Others petroleum demand/real gross domestic product Units: qdbtu/usd15

Others renewable resources demand= DELAY N((indicated Others renewable resources demand 0*Renewable Resources Price Substitutability ^Others elasticity of renewable

resources demand to renewable resources price), time to adapt demand to price changes, (indicated Others renewable resources demand 0 *Renewable Resources Price Substitutability ^ Others elasticity of renewable resources demand to renewable resources price), 3) Units: qdbtu/Year

Others renewable resources GDP intensity= normalized Others renewable resources demand/real gross domestic product Units: qdbtu/usd15

others to settlement= required settlement land adjustment Units: Ha/Year

p= 3.14159 Units: Dmnl

Paper and pulp allowance share of EITE= Paper and pulp average two years emissions*total allowances share of eite/ average two years emissions Units: Dmnl

Paper and pulp average two years emissions= (Paper and pulp emission one+Paper and pulp emission two)/2 Units: Ton/Year

Paper and pulp average two years production= (Paper and pulp production one+Paper and pulp production two)/2 Units: Ton/Year

Paper and pulp carbon intensity= Paper and pulp average two years emissions/Paper and pulp average two years production Units: Dmnl

Paper and pulp coal consumption= total Paper and pulp production*Paper and pulp energy Intensity[coal energy]*(1-energy efficiency ratio from green investment industry) Units: ktoe/Year

Paper and pulp coal consumption IN MBTU= Paper and pulp coal consumption*KTOE TO MBTU Units: Mbtu/Year

Paper and pulp coal emissions= Paper and pulp coal consumption IN MBTU*coal emission factor*MBTU TO TJ Units: Kg/Year

Paper and pulp coal intensity([(1971,0)-(2010,10)],(1971,1.01603e-006),(1972,9.73079e-007),(1973,8.65822e-007),(1974,8.62957e-007),(1975,7.6168e-007),(1976,7.87098e-007),(1977,7.87701e-007),(1978,6.91529e-007),(1979,6.68777e-007),(1980,9.82277e-007),(1981,9.63786e-007),(1982,9.66624e-007),(1983,1.01351e-006),(1984,1.07796e-006),(1985,1.15853e-006),(1986,1.18503e-006),(1987,1.21406e-006),(1988,1.22631e-006),(1989,1.20197e-006),(1990,1.10092e-006),(1991,1.05887e-006),(1992,8.34817e-007),(1993,8.70539e-007),(1994,8.31797e-007),(1995,8.9275e-007),(1996,7.35307e-007),(1997,7.04524e-007),(1998,4.69885e-007),(1999,4.09768e-007),(2000,3.06847e-007),(2001,2.93437e-007),(2002,5.61516e-007),(2003,5.2241e-007),(2004,4.68216e-007),(2005,3.58207e-007),(2006,3.46651e-007),(2007,3.4366e-007)) Units: Mbtu/Ton

Paper and pulp coal price= REFERENCE Paper and pulp COAL PRICE(Time) Units: USD/Mbtu

Paper and pulp demand over supply= total Paper and pulp demand/total Paper and pulp production Units: Dmnl

Paper and pulp demand per unit of GDP([(1995,0)-(2006,0.0006)],(1995,0.00028429),(1996,0.000313696),(1997,0.000306877),(1998,0.000452891),(1999,0.000437401),(2000,0.00056503),(2001,0.000583603),(2002,0.000315348),(2003,0.000355282),(2004,0.00043993),(2005,0.000563238),(2006,0.000575559)) Units: Ton/usd15

Paper and pulp ELECTRICITY consumption= total Paper and pulp production*Paper and pulp energy Intensity[electricity]*(1-energy efficiency ratio from green investment industry) Units: ktoe/Year

Paper and pulp ELECTRICITY consumption IN MBTU= Paper and pulp ELECTRICITY consumption*KTOE TO MBTU Units: Mbtu/Year

Paper and pulp electricity emissions= Paper and pulp ELECTRICITY consumption IN MBTU*electricity emission factor Units: Kg/Year

Paper and pulp ELECTRICITY intensity([(1971,0)-(2010,10)],(1971,1.47286e-006),(1972,1.55203e-006),(1973,1.61559e-006),(1974,1.63838e-006),(1975,1.50829e-006),(1976,1.61201e-006),(1977,1.58526e-006),(1978,1.61825e-006),(1979,1.60499e-006),(1980,1.59121e-006),(1981,1.53689e-006),(1982,1.52024e-006),(1983,1.55018e-006),(1984,1.75863e-006),(1985,1.76788e-006),(1986,1.76373e-006),(1987,1.80628e-006),(1988,1.81502e-006),(1989,1.80256e-006),(1990,1.68617e-006),(1991,1.67479e-006),(1992,1.64985e-006),(1993,1.65292e-006),(1994,1.6624e-006),(1995,1.7113e-006),(1996,1.50412e-006),(1997,1.53675e-006),(1998,1.02835e-006),(1999,1.06257e-006),(2000,8.219e-007),(2001,7.74088e-007),(2002,1.38074e-006),(2003,1.23037e-006),(2004,1.0069e-006),(2005,7.93372e-007),(2006,7.65276e-007),(2007,7.45087e-007)) Units: Mbtu/Ton

Paper and pulp electricity price= Coal Price per MBTU Units: USD/kWh

Paper and pulp electricity price in mbtu= Paper and pulp electricity price*kwh to mbtu Units: USD/Mbtu

Paper and pulp emission one= DELAY FIXED (Paper and pulp emissions, 1 , Paper and pulp emissions) Units: Ton/Year

Paper and pulp emission two= DELAY FIXED (Paper and pulp emissions, 2 ,Paper and pulp emissions) Units: Ton/Year

Paper and pulp emissions= Paper and pulp total emissions in tons Units: Ton/Year

Paper and pulp employment per unit of output([(1995,0)-(2010,0.01)],(1995,0.0005231),(1996,0.0003858),(1997,0.0005984),(1998,0.0003317),(1999,0.0003444),(2000,0.0002247),(2001,0.0001844),(2002,0.0003516),(2003,0.0002874),(2004,0.0002228),(2005,0.000156),(2006,0.0002576)) Units: Person/Ton

Paper and pulp energy cost= Paper and pulp coal consumption IN MBTU*Paper and pulp coal price+Paper and pulp ELECTRICITY consumption IN MBTU *Paper and pulp electricity price in mbtu +Paper and pulp natural gas consumption IN MBTU*Paper and pulp natural gas price +Paper and pulp oil consumption IN MBTU *Paper and pulp oil price +Paper and pulp residual fuel consumption IN MBTU*Paper and pulp reNEWABLES price Units: USD/Year

Paper and pulp energy cost over total cost= Paper and pulp energy cost/Paper and pulp total production cost Units: Dmnl

Paper and pulp energy intensity change[electricity]= Paper and pulp indicated energy intensity[electricity]-Paper and pulp energy Intensity [electricity] Paper and pulp energy intensity change[diesel]= Paper and pulp indicated energy intensity[diesel]-Paper and pulp energy Intensity [diesel] Paper and pulp energy intensity change[natural gas]= Paper and pulp indicated energy intensity[natural gas]-Paper and pulp energy Intensity [natural gas] Paper and pulp energy intensity change[ethanol]= Paper and pulp indicated energy intensity[ethanol]-Paper and pulp energy Intensity [ethanol] Paper and pulp energy intensity change[coal energy]= Paper and pulp indicated energy intensity[coal energy]-Paper and pulp energy Intensity [coal energy] Units: Mbtu/Ton

Paper and pulp energy Intensity[electricity]= INTEG (Paper and pulp energy intensity change[electricity], Paper and pulp ELECTRICITY intensity(Time)) Paper and pulp energy Intensity[diesel]= INTEG (Paper and pulp energy intensity change[diesel], Paper and pulp oil intensity(Time)) Paper and pulp energy Intensity[natural gas]= INTEG (Paper and pulp energy intensity change[natural gas], Paper and pulp natural gas intensity(Time)) Paper and pulp energy Intensity[ethanol]= INTEG (Paper and pulp energy intensity change[ethanol], Paper and pulp renewables intensity(Time)) Paper and pulp energy Intensity[coal energy]= INTEG (Paper and pulp energy intensity change[coal energy], Paper and pulp coal intensity(Time)) Units: Mbtu/Ton

Paper and pulp indicated energy intensity[electricity]= if then else(Time<2008, Paper and pulp ELECTRICITY intensity(Time), Paper and pulp energy Intensity [electricity]/percentage increase in efficiency) Paper and pulp indicated energy intensity[diesel]= if then else(Time<2008, Paper and pulp oil intensity(Time), Paper and pulp energy Intensity [diesel]/percentage increase in efficiency) Paper and pulp indicated energy intensity[natural gas]= if then else(Time<2008, Paper and pulp natural gas intensity(Time), Paper and pulp energy Intensity [natural gas]/percentage increase in efficiency) Paper and pulp indicated energy intensity[ethanol]= if then else(Time<2008,

Paper and pulp renewables intensity(Time), Paper and pulp energy Intensity [ethanol]/percentage increase in efficiency) Paper and pulp indicated energy intensity[coal energy]= if then else(Time<2008, Paper and pulp coal intensity(Time), Paper and pulp energy Intensity [coal energy]/percentage increase in efficiency) Units: Mbtu/Ton

Paper and pulp labor cost= total Paper and pulp employment*Paper and pulp labor cost table(Time) Units: USD/Year

Paper and pulp labor cost table([(1995,0)-(2010,100000)],(1995,21700),(1996,21500),(1997,22300),(1998,18600),(1999,20000),(2000,17400),(2001,17800),(2002,17600),(2003,18000),(2004,22700),(2005,23300),(2006,8340)) Units: USD/Person

Paper and pulp market price= Paper and pulp market price table(Time) Units: USD/Ton

Paper and pulp market price table([(1995,0)-(2010,1000)],(1995,101.68),(1996,62.78),(1997,102.39),(1998,47.9),(1999,55.97),(2000,37.02),(2001,31.87),(2002,61.52),(2003,51.51),(2004,50.61),(2005,38.25),(2006,36.24)) Units: USD/Ton

Paper and pulp material and capital production cost= total Paper and pulp production*Paper and pulp unit cost(Time) Units: USD/Year

Paper and pulp material cost= INTEG (Paper and pulp material cost change, Paper and pulp unit cost(Time)) Units: USD/Ton

Paper and pulp material cost change= indicated Paper and pulp material cost-Paper and pulp material cost Units: USD/Ton

Paper and pulp natural gas consumption= total Paper and pulp production*Paper and pulp energy Intensity[natural gas]*(1-energy efficiency ratio from green investment industry) Units: ktoe/Year

Paper and pulp natural gas consumption IN MBTU= Paper and pulp natural gas consumption*KTOE TO MBTU Units: Mbtu/Year

Paper and pulp natural gas emissions= Paper and pulp natural gas consumption IN MBTU*natural gas emission factor *MBTU TO TJ Units: Kg/Year

Paper and pulp natural gas intensity([(1971,0)-(2010,10)],(1971,1.49849e-007),(1972,2.06277e-007),(1973,2.45125e-007),(1974,2.93352e-007),(1975,2.81544e-007),(1976,2.91921e-007),(1977,3.04007e-007),(1978,4.42937e-007),(1979,4.35227e-007),(1980,4.28006e-007),(1981,4.20444e-007),(1982,3.9469e-007),(1983,3.69768e-007),(1984,3.86472e-007),(1985,3.95579e-007),(1986,3.9351e-007),(1987,4.24467e-007),(1988,4.26218e-007),(1989,4.59544e-007),(1990,5.07904e-007),(1991,5.38833e-

007),(1992,5.6186e-007),(1993,5.6535e-007),(1994,5.76783e-007),(1995,1.30867e-006),(1996,1.18582e-006),(1997,1.1879e-006),(1998,7.6401e-007),(1999,7.65243e-007),(2000,6.39392e-007),(2001,5.47001e-007),(2002,1.0222e-006),(2003,8.57345e-007),(2004,6.48875e-007),(2005,4.61668e-007),(2006,4.43949e-007),(2007,4.55075e-007)) Units: Mbtu/Ton

Paper and pulp natural gas price= Natural Gas Price per MBTU Units: USD/Mbtu

Paper and pulp net allocations variable shares= min(Paper and pulp production based allocation,Paper and pulp upper limit allocation variable shares) Units: USD/Year

Paper and pulp oil consumption= total Paper and pulp production*Paper and pulp energy Intensity[diesel]*(1- energy efficiency ratio from green investment industry) Units: ktoe/Year

Paper and pulp oil consumption IN MBTU= Paper and pulp oil consumption*KTOE TO MBTU Units: Mbtu/Year

Paper and pulp oil emissions= Paper and pulp oil consumption IN MBTU*distillate fuel oil emission factor *MBTU TO TJ Units: Kg/Year

Paper and pulp oil intensity([(1971,0)-(2010,10)],(1971,2.41144e-006),(1972,2.55961e-006),(1973,2.85141e-006),(1974,2.76829e-006),(1975,2.38693e-006),(1976,2.6777e-006),(1977,2.26059e-006),(1978,2.06394e-006),(1979,1.99887e-006),(1980,1.89683e-006),(1981,1.56224e-006),(1982,1.49088e-006),(1983,8.82712e-007),(1984,7.99451e-007),(1985,7.49343e-007),(1986,7.29938e-007),(1987,6.84682e-007),(1988,7.03451e-007),(1989,6.91759e-007),(1990,6.71696e-007),(1991,6.38973e-007),(1992,5.97977e-007),(1993,5.73689e-007),(1994,5.98084e-007),(1995,7.68897e-007),(1996,6.91597e-007),(1997,6.24681e-007),(1998,3.74603e-007),(1999,3.55231e-007),(2000,3.10805e-007),(2001,2.89821e-007),(2002,4.81615e-007),(2003,4.34724e-007),(2004,3.62907e-007),(2005,2.94995e-007),(2006,2.43151e-007),(2007,2.06327e-007)) Units: Mbtu/Ton

Paper and pulp oil price= Oil Price per MBtu Units: USD/Mbtu

Paper and pulp operating margin= Paper and pulp operating surplus/Paper and pulp revenues Units: Dmnl

Paper and pulp operating surplus= Paper and pulp revenues-Paper and pulp total production cost Units: USD/Year

Paper and pulp price= INTEG (Paper and pulp price change, Paper and pulp market price table(Time)) Units: USD/Ton

Paper and pulp price change= indicated Paper and pulp price-Paper and pulp price Units: USD/Ton

Paper and pulp production based allocation= Paper and pulp average two years production*Paper and pulp carbon intensity *allowance price per ton Units: USD/Year

Paper and pulp production one= DELAY FIXED (total Paper and pulp production, 1 , total Paper and pulp production) Units: Ton/Year

Paper and pulp production two= DELAY FIXED (total Paper and pulp production, 2 , total Paper and pulp production) Units: Ton/Year

Paper and pulp profit share([(1992,-0.8)-(2030,1)],(2000,0),(2001,-0.51),(2002,-0.1814),(2003,-0.2286) ,(2004,0.3487),(2005,0.3981),(2006,0.5337),(2007,0.6042)) Units: Dmnl

Paper and pulp profits over revenues= real Paper and pulp profit/real Paper and pulp revenues Units: Dmnl

Paper and pulp reNEWABLES emissions= Paper and pulp residual fuel consumption IN MBTU*residual fuel oil emission factor *MBTU TO TJ Units: Kg/Year

Paper and pulp renewables intensity([(1971,0)-(2010,10)],(1971,9.25974e-007),(1972,9.3433e-007),(1973,1.19623e-006),(1974,1.18725e-006),(1975,1.04043e-006),(1976,1.03595e-006),(1977,1.02651e-006),(1978,1.08554e-006),(1979,1.09375e-006),(1980,1.09319e-006),(1981,1.05802e-006),(1982,1.17186e-006),(1983,1.24178e-006),(1984,1.32145e-006),(1985,1.3612e-006),(1986,1.36656e-006),(1987,1.36384e-006),(1988,1.35576e-006),(1989,1.28118e-006),(1990,1.05383e-006),(1991,1.05928e-006),(1992,1.10297e-006),(1993,1.23239e-006),(1994,1.25891e-006),(1995,1.38186e-006),(1996,1.11099e-006),(1997,1.16861e-006),(1998,8.06588e-007),(1999,1.40138e-006),(2000,1.12634e-006),(2001,9.36753e-007),(2002,1.69209e-006),(2003,1.51036e-006),(2004,1.28064e-006),(2005,1.08764e-006),(2006,1.14201e-006),(2007,1.12287e-006)) Units: Mbtu/Ton

Paper and pulp reNEWABLES price= Renewable Resource price per MBTU(Time) Units: USD/Mbtu

Paper and pulp residual fuel consumption= total Paper and pulp production*Paper and pulp energy Intensity[ethanol]*(1 -energy efficiency ratio from green investment industry) Units: ktoe/Year

Paper and pulp residual fuel consumption IN MBTU= Paper and pulp residual fuel consumption*KTOE TO MBTU Units: Mbtu/Year

Paper and pulp revenues= Paper and pulp market price*total Paper and pulp production Units: USD/Year

Paper and pulp total demand growth rate= ((total Paper and pulp demand-previous Paper and pulp total demand)/previous Paper and pulp total demand)/GROWTH RATE base period Units: Dmnl/Year

Paper and pulp total emissions in tons= (Paper and pulp coal emissions+Paper and pulp oil emissions+Paper and pulp electricity emissions + +Paper and pulp natural gas emissions+Paper and pulp reNEWABLES emissions) /1000 Units: Ton/Year

Paper and pulp total production cost= Paper and pulp labor cost+Paper and pulp material and capital production cost +Paper and pulp energy cost-Paper and pulp net allocations variable shares Units: USD/Year

Paper and pulp total production cost growth rate= ((Paper and pulp total production cost-previous Paper and pulp total production cost)/previous Paper and pulp total production cost)/GROWTH RATE base period Units: Dmnl/Year

Paper and pulp total real unit cost= Paper and pulp total unit cost/gdp deflator Units: usd15/Ton

Paper and pulp total real unit cost growth rate= ((Paper and pulp total real unit cost-previous Paper and pulp total real unit cost)/previous Paper and pulp total real unit cost)/GROWTH RATE base period Units: Dmnl/Year

Paper and pulp total unit cost= Paper and pulp total production cost/total Paper and pulp production Units: USD/Ton

Paper and pulp unit cost([(1995,0)-(2010,100)],(1995,56.4),(1996,34.2),(1997,55.8),(1998,26.6),(1999 ,29.6),(2000,19.7),(2001,16.9),(2002,34.3),(2003,28.8),(2004,29),(2005,21.9),(2006,21.8)) Units: USD/Ton

Paper and pulp upper limit allocation variable shares= total allowance value*Paper and pulp allowance share of EITE Units: USD/Year

passenger rail average fuel efficiency([(1970,0)-(2050,0.1)],(1970,0.00789474),(1989,0.00701754),(1998,0.00614035),(2010,0.00701754),(2018,0.00657895),(2033,0.00657895),(2050,0.00745614)) Units: litre/Km

passenger rail CO2 emissions= ((passenger rail energy consumption*share of passenger rail fuel consumption time series [diesel](Time)*CO2 EMISSION FACTORS [diesel])) Units: mtoe/Year

passenger rail employment factor= WITH LOOKUP (Time, ([(1996,0)-(2050,7e-006)],(2004,5.24e-006),(2005,5.43e-006),(2006,5.03e-006),(2007,5.41e-006),(2008,5.3e-006),(2009,5.19e-006),(2010,5.09e-006),(2011, 4.99e-006),(2012,4.89e-006),(2013,4.79e-

006),(2014,4.7e-006),(2015,4.6e-006),(2016,4.51e-006),(2017,4.42e-006),(2018,4.33e-006),(2019,4.24e-006),(2020 ,4.16e-006),(2021,4.08e-006),(2022,3.99e-006),(2023,3.91e-006),(2024,3.84e-006),(2025,3.76e-006),(2026,3.68e-006),(2027,3.61e-006),(2028,3.54e-006),(2029 ,3.47e-006),(2030,3.4e-006),(2031,3.33e-006),(2032,3.26e-006),(2033,3.2e-006),(2034,3.13e-006),(2035,3.07e-006),(2036,3.01e-006),(2037,2.95e-006),(2038 ,2.89e-006),(2039,2.83e-006),(2040,2.78e-006),(2041,2.72e-006),(2042,2.67e-006),(2043,2.61e-006),(2044,2.56e-006),(2045,2.51e-006),(2046,2.46e-006),(2047 ,2.41e-006),(2048,2.36e-006),(2049,2.32e-006),(2050,2.27e-006))) Units: Person/Km

passenger rail energy consumption= passenger rail average fuel efficiency(Time)*passenger rail travel volume* convert LITRE to mtoe*(1-efficiency ratio transport from green investment) Units: mtoe/Year

passenger rail travel employment= passenger rail employment factor*passenger rail travel volume Units: Person

passenger rail travel volume= indicated rail travel volume[passenger]+indicated air travel reduction+((1 -share of car travel reduction to buses)*indicated car travel reduction) Units: Km/Year

passenger train emission abatement ton= passenger train emission change mtoe(Time)*ton to mtoe Units: Ton/Year

passenger train emission change mtoe([(1900,0)-(2050,100)],(1970,0),(2010,0),(2011,8.65133),(2012,9.38251),(2013 ,10.1372),(2014,10.915),(2015,11.7152),(2016,12.9285),(2017,14.212),(2018,15.5666),(2019,16.9914),(2020,18.4854),(2021,19.5048),(2022,20.5337),(2023,21.5738),(2024,22.6253),(2025,23.6847),(2026,24.7657),(2027,25.8539),(2028,26.9487),(2029,28.0491),(2030,29.1545),(2031,30.2796),(2032,31.409),(2033,32.5417) ,(2034,33.6766),(2035,34.8124),(2036,35.9588),(2037,37.1045),(2038,38.2486) ,(2039,39.3897),(2040,40.527),(2041,41.6641),(2042,42.7956),(2043,43.9205), (2044,45.0381),(2045,46.1472),(2046,45.7453),(2047,45.2852),(2048,44.7682), (2049,44.1952),(2050,43.5675)) Units: mtoe/Year

passenger travel employment= passenger rail employment factor*passenger rail travel volume Units: Person/Year

Pasture Land= INTEG (arable to pasture+forest to pasture+other to pasture-change in forest from pasture -pasture to others-pasture to settlement, initial Pasture Land) Units: Ha

pasture land adjustment time= 10 Units: Year

pasture land conversion fraction= 0.0001 Units: Dmnl/Year

pasture land per capita= WITH LOOKUP (Time, ([(1970,0)-(2050,0.9)],(1970,0.851922),(1971,0.839567),(1972,0.825532),(1973,0.811869),(1974,0.799156),(1975,0.786282),(1976,0.771259),(1977,0.757849),(1978,0.746148),(1979,0.733503),(1980,0.72274),(1981,0.710147),(1982,0.698433),(1983,0.686334),(1984,0.676408),(1985,0.667418),(1986,0.654657),(1987,0.645193),(1988,0.637105),(1989,0.62798),(1990,0.618327),(1991,0.608111),(1992,0.606067),(1993,0.593713),(1994,0.589039),(1995,0.580212),(1996,0.573245),(1997,0.567723),(1998,0.562112),(1999,0.554272),(2000,0.547868),(2001,0.54045),(2002,0.532304),(2003,0.521754),(2004,0.507913),(2005,0.501735),(2006,0.495365),(2007,0.487588),(2008,0.479556),(2009,0.47208),(2010,0.466095),(2011,0.46199),(2012,0.455086),(2013,0.44752),(2014,0.441713),(2015,0.432893),(2016,0.427055),(2017,0.425672),(2018,0.419009),(2019,0.415044),(2020,0.410122),(2021,0.407278),(2022,0.403473),(2023,0.399112),(2048.78,0.346316))) Units: Ha/Person

pasture to others= Pasture Land*pasture land conversion fraction Units: Ha/Year

pasture to settlement= 0 Units: Ha/Year

PC DISPOSABLE INCOME= disposable income/total population Units: usd15/Person/Year

pc gdp= real gross domestic product/total population Units: usd15/(Year*Person)

pc health expenditure= health expenditure(Time)/total population Units: usd15/Year/Person

per capita GDP([(1985,0)-(2000,10000)],(1985,8432.42),(2000,9975.58)) Units: Dmnl/Year

per capita land area([(1985,0)-(2000,0.1)],(1985,0.010501),(2000,0.012165)) Units: Ha/Person

per ton cost of fishing= 1125 Units: usd15/Ton

per unit variable cost of fishing= 900 Units: usd15/Ton

perceived under five mortality rate= SMOOTH N(under five mortality rate, time to perceive change in under five mortality rate , 250, 3) Units: Dmnl

percentage increase in efficiency= 1.01 Units: Dmnl

percentage increase in material cost F= 1 Units: Dmnl

Persons employed per car= 0.025 Units: Person/vehicle

pest control investment= agriculture green investment*pest control investment fraction(Time) Units: usd15/Year

pest control investment fraction([(2011,0)-(2050,1)],(2011,0.25),(2050,0.25)) Units: Dmnl

petroleum electricity production share= min(1,(diseal and fuel oil energy electricity generation)/nonhydro electricity production) Units: Dmnl

petroleum generation efficiency table([(1980,0)-(2050,1)],(1980,0.3),(1990,0.32),(2000,0.338),(2025,0.398),(2050 ,0.45)) Units: Dmnl

petroleum GHG emission coefficient= 74.2 Units: Ton/Tj

Phasing out coal capacity CA= WITH LOOKUP (Time, ([(0,0)-(2027,10)],(2000,1),(2026,1),(2027,0.5))) Units: Dmnl

Phasing out coal capacity HA= WITH LOOKUP (Time, ([(0,0)-(2027,10)],(2000,1),(2026,1),(2027,2.9),(2040,2.9),(2040,2))) Units: Dmnl

Phasing out coal capacity LA= WITH LOOKUP (Time, ([(0,0)-(2027,10)],(2000,1),(2026,1),(2027,0.75))) Units: Dmnl

Phasing out diesel and fuel oil capacity CA= WITH LOOKUP (Time, ([(0,0)-(2027,10)],(2000,1),(2026,1),(2027,0.5))) Units: Dmnl

Phasing out diesel and fuel oil capacity HA= WITH LOOKUP (Time, ([(0,0)-(2027,10)],(2000,1),(2026,1),(2027,3.2))) Units: Dmnl

Phasing out diesel and fuel oil capacity LA= WITH LOOKUP (Time, ([(0,0)-(2027,10)],(2000,1),(2026,1),(2027,0.75))) Units: Dmnl

Phasing out gas turbine capacity CA= WITH LOOKUP (Time, ([(0,0)-(2027,10)],(2000,1),(2026,1),(2027,0.5))) Units: Dmnl

Phasing out gas turbine capacity HA= WITH LOOKUP (Time, ([(0,0)-(2027,10)],(2000,1),(2026,1),(2027,1.4))) Units: Dmnl

Phasing out gas turbine capacity LA= WITH LOOKUP (Time, ([(0,0)-(2027,10)],(2000,1),(2026,1),(2027,0.75))) Units: Dmnl

pi= 3.14159 Units: Dmnl

planted forest area= INTEG (afforestation-harvested forest, initial planted forest) Units: Ha

plastic currently in use= INTEG (reusing of used plastic+Sale of plastic-Discard of plastic, initial plastic in use) Units: Ton

plastic demand per population= WITH LOOKUP (Time, ([(2000,0)-(2050,2)],(2000,0.477021),(2001,0.48171),(2002,0.487098),(2003 ,0.493457),(2004,0.500696),(2005,0.50874),(2006,0.517539),(2007,0.527543),(

2008,0.537252),(2009,0.545865),(2010,0.555423),(2011,0.566312),(2012,0.57771
),(2013,0.589667),(2014,0.601911),(2015,0.614139),(2016,0.626408),(2017,0.638661
),(2018,0.651228),(2019,0.664163),(2020,0.676585),(2021,0.688285),(2022,0.700362
),(2023,0.712933),(2024,0.72592),(2025,0.738751),(2026,0.751342),(2027,0.764426
),(2028,0.77805),(2029,0.792252),(2030,0.80706),(2031,0.822517),(2032,0.838571
),(2033,0.85527),(2034,0.872618),(2035,0.890624),(2036,0.909311),(2037,0.928603
),(2038,0.948551),(2039,0.969157),(2040,0.990438),(2041,1.0124),(2042,1.035
),(2043,1.05827),(2044,1.08222),(2045,1.10687),(2046,1.13222),(2047,1.15824
),(2048,1.18496),(2049,1.21242),(2050,1.24062))) Units: Ton/Person/Year

plastic material waste to landfills[Materials]= MAX(0,Material waste collected from plastic[Materials]*share of material waste from plastic to be landfilled [Materials]) Units: Ton/Year

plastic materials to be reused[Materials]= DELAY FIXED (plastic waste from manufacturing[Materials]+plastic waste to be reused in plastic manufacturing [Materials],1,0) Units: Ton/Year

plastic recycling BAU[Materials]= share of material waste from plastic to be recycled BAU[Materials](Time) Units: Dmnl/Year

plastic recycling CA[Materials]= share of material waste from plastic to be recycled CA[Materials](Time) Units: Dmnl/Year

plastic recycling HA[Materials]= share of material waste from plastic to be recycled HA[Materials](Time) Units: Dmnl/Year

plastic recycling LA[Materials]= share of material waste from plastic to be recycled LA[Materials](Time) Units: Dmnl/Year

plastic resuing BAU[Materials]= share of material from plastic waste to be reused BAU[Materials](Time) Units: Dmnl/Year

plastic reusing CA[Materials]= share of material from plastic waste to be reused CA[Materials](Time) Units: Dmnl/Year

plastic reusing HA[Materials]= share of material from plastic waste to be reused HA[Materials](Time) Units: Dmnl/Year

plastic reusing LA[Materials]= share of material from plastic waste to be reused LA[Materials](Time) Units: Dmnl/Year

plastic waste collected[Materials]= if then else(CE policy switch=1,Material waste generated from plastic[Materials]*CE share of material waste from plastic collected[Materials](Time),Material waste generated from plastic [Materials]*share of material waste from plastic collected[Materials](Time)) Units: Ton/Year

plastic waste from manufacturing[Materials]= Material Consumption for plastic production[Materials]*material waste generated per material for plastic [Materials] Units: Ton/Year

plastic waste in landfills to be incinerated[Materials]= Material waste from plastic landfilled[Materials]/Average time for waste from plastic to be incinerated Units: Ton/Year

plastic waste shares check[Materials]= share of material from plastic waste to be reused[Materials] +share of material waste from plastic to be landfilled[Materials] +share of material waste from plastic to be recycled[Materials] Units: Dmnl/Year

plastic waste to be reused[Materials]= Material waste collected from plastic[Materials]*share of material from plastic waste to be reused [Materials] Units: Ton/Year

plastic waste to be reused in plastic manufacturing[Materials]= plastic waste to be reused[Materials]+(reusing of plastic in landfills[Materials]*share of plastics from landfills to be reused CE) Units: Ton/Year

pm10 emissions from biomass= biomass and waste in TJ*pm10 emissions per tj of biomass by sector/KG PER TON Units: Ton/Year

pm10 emissions from coal[sector]= normalized coal demand[sector]*pm10 emissions per tj of coal by sector[sector]/KG PER TON Units: Ton/Year

pm10 emissions from natural gas[sector]= normalized natural gas demand[sector]*pm10 emissions per tj of natural gas by sector [sector]/KG PER TON Units: Ton/Year

pm10 emissions from petroleum[sector]= normalized petroleum demand[sector]*pm10 emissions per tj of gasoline by sector [sector]/KG PER TON Units: Ton/Year

pm10 emissions from power generation[power generation technology]= fuel use for power generation in TJ[power generation technology]*pm10 emissions per TJ of fuel combusted [power generation technology]/KG PER TON*policy reduction in air pollution from thermal power generation Units: Ton/Year

pm10 emissions per tj of biomass by sector= 512.35 Units: Kg/Tj

pm10 emissions per tj of coal by sector[sector]= 117, 0, 117, 0, 490.1 Units: Kg/Tj

pm10 emissions per TJ of fuel combusted[power generation technology]= 25.2, 25.2, 0.89, 7.9, 0, 0, 0, 0, 0, 0, 0, 0, 155, 0 Units: Kg/Tj

pm10 emissions per tj of gasoline by sector[sector]= 20, 161.64, 96, 0, 21 Units: Kg/Tj

pm10 emissions per tj of natural gas by sector[sector]= 0.78, 0.725, 0.78, 0, 1.2 Units: Kg/Tj

"pm2.5 emissions from biomass 0"= biomass and waste in TJ*"pm2.5 emissions per tj of biomass by sector"/KG PER TON Units: Ton/Year

"pm2.5 emissions from coal new"[sector]= normalized coal demand[sector]*"pm2.5 emissions per tj of coal by sector"[sector]/KG PER TON Units: Ton/Year

"pm2.5 emissions from natural gas"[sector]= normalized natural gas demand[sector]*"pm2.5 emissions per tj of natural gas by sector" [sector]/KG PER TON Units: Ton/Year

"pm2.5 emissions from petroleum new"[sector]= normalized petroleum demand[sector]*"pm2.5 emissions per tj of gasoline by sector" [sector]/KG PER TON Units: Ton/Year

"pm2.5 emissions from power generation"[power generation technology]= fuel use for power generation in TJ[power generation technology]*"pm2.5 emissions per TJ of fuel combusted" [power generation technology]/KG PER TON*policy reduction in air pollution from thermal power generation Units: Ton/Year

"pm2.5 emissions Index"= ZIDZ("total pm2.5 emissions from energy and power","initial pm2.5 emissions for 2016") Units: 1

"pm2.5 emissions per tj of biomass by sector"= 409.88 Units: Kg/Tj

"pm2.5 emissions per tj of coal by sector"[sector]= 108, 0, 108, 0, 440.4 Units: Kg/Tj

"pm2.5 emissions per TJ of fuel combusted"[power generation technology]= 19.3, 19.3, 0.89, 3.2, 0, 0, 0, 0, 0, 0, 0, 0, 133, 0 Units: Kg/Tj

"pm2.5 emissions per tj of gasoline by sector"[sector]= 20, 161.64, 96, 0, 18 Units: Kg/Tj

"pm2.5 emissions per tj of natural gas by sector"[sector]= 0.78, 0.725, 0.78, 0, 1.2 Units: Kg/Tj

policy reduction in air pollution from thermal power generation= if then else (LOW IMPACT DEVELOPMENT POLICY SWITCH = 1, LCD policy reduction in air pollution from thermal power generation, if then else (LOW IMPACT DEVELOPMENT POLICY SWITCH = 2, net zero policy reduction in air pollution from thermal power generation, 1)) Units: 1

Pollutant coefficient per building[NH3]([(2000,0)-(2024,3e-007)],(2000,2.23316e-007),(2001,2.26022e-007),(2002,2.42088e-007),(2003,2.36088e-007),(2004,2.27389e-007),(2005,1.91729e-007),(2006,1.58028e-007),(2007,1.29671e-007),(2008,1.23063e-007),(2009,1.55288e-007),(2010,1.33261e-007),(2011,1.28756e-007),(2012,1.11578e-007),(2013,1.19169e-007),(2014,1.06205e-007),(2015,1.17445e-007),(2016,1.09868e-

007),(2017,1.54101e-007),(2018,1.27609e-007),(2019,1.38571e-007),(2020,1.58113e-007),(2021,1.32202e-007),(2022,1.29955e-007),(2023,1.25801e-007),(2024,1.19444e-007)) Pollutant coefficient per building[NOx]([(2000,5e-007)-(2024,1e-006)],(2000,9.71967e-007),(2001,9.7617e-007),(2002 ,9.54776e-007),(2003,9.45152e-007),(2004,9.43638e-007),(2005,8.84223e-007) ,(2006,8.56876e-007),(2007,7.81272e-007),(2008,7.16978e-007),(2009,8.23576e-007),(2010,7.73769e-007),(2011,7.28858e-007),(2012,7.24794e-007),(2013,6.93885e-007),(2014,6.82137e-007),(2015,6.9022e-007),(2016,6.53393e-007),(2017,6.93356e-007),(2018,6.39611e-007),(2019,6.24508e-007),(2020,6.54816e-007),(2021,5.35957e-007),(2022,5.33295e-007),(2023,5.21926e-007),(2024,5.02325e-007)) Pollutant coefficient per building["PM2.5"]([(2000,2e-006)-(2024,3e-006)],(2000,2.9311e-006),(2001,2.94369e-006),(2002 ,2.83624e-006),(2003,2.90293e-006),(2004,2.91051e-006),(2005,2.78293e-006) ,(2006,2.71825e-006),(2007,2.58108e-006),(2008,2.46738e-006),(2009,2.95787e-006),(2010,2.90025e-006),(2011,2.9988e-006),(2012,2.88975e-006),(2013,2.79826e-006),(2014,2.73001e-006),(2015,2.68758e-006),(2016,2.73719e-006),(2017,2.73188e-006),(2018,2.54537e-006),(2019,2.46613e-006),(2020,2.54477e-006),(2021,2.13764e-006),(2022,2.14663e-006),(2023,2.11862e-006),(2024,2.04891e-006)) Pollutant coefficient per building[SO2]([(2000,0)-(2024,3e-006)],(2000,2.10743e-006),(2001,2.15198e-006),(2002,2.06691e-006),(2003,1.95458e-006),(2004,1.88771e-006),(2005,1.79824e-006),(2006,1.75231e-006),(2007,1.58052e-006),(2008,1.47827e-006),(2009,1.69459e-006),(2010,1.60558e-006),(2011,1.56516e-006),(2012,1.56667e-006),(2013,1.49914e-006),(2014,1.50512e-006),(2015,1.499e-006),(2016,1.43709e-006),(2017,1.4037e-006),(2018,1.32297e-006),(2019,1.29886e-006),(2020,1.37414e-006),(2021,1.13765e-006),(2022,1.13074e-006),(2023,1.10641e-006),(2024,1.06569e-006)) Units: KILODALY/building

Pollutant coefficient per clothing[NH3]([(2000,8e-006)-(2022,2e-005)],(2000,1.38814e-005),(2001,1.50549e-005),(2002 ,1.54216e-005),(2003,1.65428e-005),(2004,1.73059e-005),(2005,1.65757e-005), (2006,1.65065e-005),(2007,1.49305e-005),(2008,1.50467e-005),(2009,1.72609e-005),(2010,1.49339e-005),(2011,1.38905e-005),(2012,1.25284e-005),(2013,1.31931e-005),(2014,1.29513e-005),(2015,1.43956e-005),(2016,1.28062e-005),(2017,1.22917e-005),(2018,1.16002e-005),(2019,1.19751e-005),(2020,1.23757e-005),(2021,1.09873e-005),(2022,9.78719e-006)) Pollutant coefficient per clothing[NOx]([(2000,1e-005)-(2022,2e-005)],(2000,1.34577e-005),(2001,1.45085e-005),(2002 ,1.45594e-005),(2003,1.5011e-005),(2004,1.55064e-005),(2005,1.53054e-005), (2006,1.58817e-005),(2007,1.5061e-005),(2008,1.38839e-005),(2009,1.52233e-005),(2010,1.42838e-005),(2011,1.35028e-005),(2012,1.29084e-005),(2013,1.29566e-005),(2014,1.31498e-005),(2015,1.38573e-005),(2016,1.37678e-005),(2017,1.32702e-005),(2018,1.29595e-005),(2019,1.33675e-005),(2020,1.40971e-005),(2021,1.20924e-005),(2022,1.08974e-005)) Pollutant coefficient per clothing["PM2.5"]([(2000,4e-005)-(2022,6e-005)],(2000,4.84291e-005),(2001,5.24419e-005),(2002 ,5.0057e-005),(2003,5.25807e-005),(2004,5.18002e-005),(2005,5.30223e-005), (2006,5.30026e-005),(2007,5.08561e-005),(2008,4.88142e-005),(2009,5.43292e-005),(2010,5.22885e-005),(2011,5.02892e-005),(2012,4.85891e-005),(2013,4.88707e-005),(2014,5.03669e-

005),(2015,5.28733e-005),(2016,5.07294e-005),(2017,4.97741e-005),(2018,4.87848e-005),(2019,5.08021e-005),(2020,5.41274e-005),(2021,4.75672e-005),(2022,4.29693e-005)) Pollutant coefficient per clothing[SO2]([(2000,2e-005)-(2022,4e-005)],(2000,2.77821e-005),(2001,2.98622e-005),(2002 ,2.9875e-005),(2003,2.93293e-005),(2004,2.99166e-005),(2005,3.04219e-005), (2006,3.15293e-005),(2007,2.95534e-005),(2008,2.7707e-005),(2009,3.12333e-005),(2010,3.00183e-005),(2011,2.88424e-005),(2012,2.83247e-005),(2013,2.89668e-005),(2014,3.02949e-005),(2015,3.14935e-005),(2016,3.0476e-005),(2017,2.98564e-005),(2018,2.97444e-005),(2019,3.08195e-005),(2020,3.31788e-005),(2021,2.84916e-005),(2022,2.56952e-005)) Units: KILODALY/Ton

Pollutant coefficient per plastic[NH3]([(2000,0)-(2024,3e-008)],(2000,2.34924e-008),(2001,2.13926e-008),(2002,2.0746e-008),(2003,2.87341e-008),(2004,2.90661e-008),(2005,2.74258e-008),(2006,2.2733e-008),(2007,1.71019e-008),(2008,2.68918e-008),(2009,2.72279e-008),(2010,2.59778e-008),(2011,1.67513e-008),(2012,1.62127e-008),(2013,2.35392e-008),(2014,2.09534e-008),(2015,2.03534e-008),(2016,1.26657e-008),(2017,1.20059e-008),(2018,1.24336e-008),(2019,1.15387e-008),(2020,1.10544e-008),(2021,1.16966e-008),(2022,1.12612e-008),(2023,1.10298e-008),(2024,1.07978e-008)) Pollutant coefficient per plastic[NOx]([(2000,5e-008)-(2024,1e-007)],(2000,9.59049e-008),(2001,9.1592e-008),(2002 ,8.6437e-008),(2003,8.76954e-008),(2004,9.3914e-008),(2005,8.90395e-008),(2006,8.13331e-008),(2007,8.2127e-008),(2008,8.7602e-008),(2009,7.9453e-008),(2010,8.14253e-008),(2011,7.69112e-008),(2012,7.64577e-008),(2013,7.15762e-008),(2014,7.05146e-008),(2015,6.3212e-008),(2016,5.45225e-008),(2017,5.61219e-008),(2018,6.10021e-008),(2019,5.52406e-008),(2020,5.25754e-008),(2021,6.03498e-008),(2022,5.87561e-008),(2023,5.7838e-008),(2024,5.71518e-008)) Pollutant coefficient per plastic["PM2.5"]([(2000,1e-007)-(2024,3e-007)],(2000,2.20366e-007),(2001,2.11562e-007),(2002 ,1.94929e-007),(2003,2.03373e-007),(2004,2.23416e-007),(2005,2.22634e-007) ,(2006,2.07304e-007),(2007,2.15528e-007),(2008,2.43353e-007),(2009,2.35042e-007),(2010,2.55864e-007),(2011,2.48756e-007),(2012,2.47408e-007),(2013,2.29718e-007),(2014,2.32926e-007),(2015,2.05344e-007),(2016,1.71037e-007),(2017,1.742e-007),(2018,1.91055e-007),(2019,1.70188e-007),(2020,1.58413e-007),(2021,1.85584e-007),(2022,1.82723e-007),(2023,1.81107e-007),(2024,1.79745e-007)) Pollutant coefficient per plastic[SO2]([(2000,1e-007)-(2024,3e-007)],(2000,2.23572e-007),(2001,2.12895e-007),(2002 ,1.97649e-007),(2003,1.88527e-007),(2004,2.00735e-007),(2005,1.96117e-007) ,(2006,1.8316e-007),(2007,1.85685e-007),(2008,1.98808e-007),(2009,1.89362e-007),(2010,2.00564e-007),(2011,1.94589e-007),(2012,1.97482e-007),(2013,1.8107e-007),(2014,1.87448e-007),(2015,1.64292e-007),(2016,1.41401e-007),(2017,1.43101e-007),(2018,1.54383e-007),(2019,1.39143e-007),(2020,1.31204e-007),(2021,1.4967e-007),(2022,1.45946e-007),(2023,1.44055e-007),(2024,1.42736e-007)) Units: KILODALY/Ton

Pollutant coefficient per vehicle[NH3]([(2000,5e-007)-(2024,9e-007)],(2000,5.38219e-007),(2001,5.37371e-007),(2002 ,5.69309e-007),(2003,6.21756e-007),(2004,6.75532e-

007),(2005,7.18296e-007), (2006,6.75801e-007),(2007,6.64002e-007),(2008,7.32128e-007),(2009,8.48111e-007),(2010,7.7525e-007),(2011,6.38699e-007),(2012,6.34212e-007),(2013,7.62258e-007),(2014,7.05965e-007),(2015,7.60892e-007),(2016,6.31861e-007),(2017,5.65502e-007),(2018,5.33848e-007),(2019,5.4278e-007),(2020,6.41175e-007),(2021,5.27466e-007),(2022,5.59588e-007),(2023,5.65548e-007),(2024,5.56921e-007)) Pollutant coefficient per vehicle[NOx]([(2000,3e-006)-(2024,7e-006)],(2000,3.52587e-006),(2001,3.51041e-006),(2002 ,3.62729e-006),(2003,3.86844e-006),(2004,4.29102e-006),(2005,4.6437e-006), (2006,4.95063e-006),(2007,5.36878e-006),(2008,5.32153e-006),(2009,5.58455e-006),(2010,5.69819e-006),(2011,5.85014e-006),(2012,6.02037e-006),(2013,5.98262e-006),(2014,6.13793e-006),(2015,6.07295e-006),(2016,5.93609e-006),(2017,5.78731e-006),(2018,5.79528e-006),(2019,5.77348e-006),(2020,6.7673e-006),(2021,5.95354e-006),(2022,6.38111e-006),(2023,6.49246e-006),(2024,6.47087e-006)) Pollutant coefficient per vehicle["PM2.5"]([(2000,0)-(2024,3e-005)],(2000,9.82275e-006),(2001,9.80922e-006),(2002,1.00349e-005),(2003,1.0682e-005),(2004,1.19423e-005),(2005,1.34883e-005),(2006,1.43329e-005),(2007,1.57701e-005),(2008,1.63354e-005),(2009,1.75347e-005),(2010,1.84985e-005),(2011,1.95019e-005),(2012,2.02893e-005),(2013,2.04616e-005),(2014,2.14376e-005),(2015,2.09454e-005),(2016,1.98533e-005),(2017,1.93532e-005),(2018,1.95708e-005),(2019,1.95049e-005),(2020,2.28091e-005),(2021,2.01308e-005),(2022,2.17285e-005),(2023,2.2237e-005),(2024,2.21992e-005)) Pollutant coefficient per vehicle[SO2]([(2000,0)-(2024,2e-005)],(2000,8.35078e-006),(2001,8.31167e-006),(2002,8.45104e-006),(2003,8.57689e-006),(2004,9.39192e-006),(2005,1.0276e-005),(2006,1.10258e-005),(2007,1.18826e-005),(2008,1.21004e-005),(2009,1.29573e-005),(2010,1.34797e-005),(2011,1.41772e-005),(2012,1.50523e-005),(2013,1.52572e-005),(2014,1.63361e-005),(2015,1.58057e-005),(2016,1.52491e-005),(2017,1.50572e-005),(2018,1.53505e-005),(2019,1.53233e-005),(2020,1.80188e-005),(2021,1.58257e-005),(2022,1.69979e-005),(2023,1.73451e-005),(2024,1.73195e-005)) Units: KILODALY/vehicle

Pollutants: NH3, NOx, "PM2.5", SO2

Population[sex, new born]= INTEG (births[sex], INITIAL POPULATION[sex, new born]) Population[sex,Age Over 0]= INTEG (-deaths[sex,Age Over 0], INITIAL POPULATION[sex,Age Over 0]) Units: Person

population cohort shift[sex]= SHIFT IF TRUE(Population[sex,new born] , MODULO(Time,1) < TIME STEP/2,AGE 80 AND OVER ,1,0) Units: Person

Population Group[sex,AG UNDER 1]= Population[sex,AGE 0] Population Group[sex,AG 1 TO 4]=SUM(Population[sex,AGE 1 to 4!]) Population Group[sex,AG 5 to 9]=SUM(Population[sex,AGE 5 to 9!]) Population Group[sex,AG 10 to 14]=SUM(Population[sex,AGE 10 to 14!]) Population Group[sex,AG 15 TO 19]=SUM(Population[sex,AGE 15 to 19!]) Population Group[sex,AG 20 to 24]=SUM(Population[sex,AGE 20 to 24!]) Population Group[sex,AG 25 to 29]=SUM(Population[sex,AGE 25 to 29!]) Population Group[sex,AG 30 to

34]=SUM(Population[sex,AGE 30 to 34!]) Population Group[sex,AG 35 to 39]=SUM(Population[sex,AGE 35 to 39!]) Population Group[sex,AG 40 to 44]=SUM(Population[sex,AGE 40 to 44!]) Population Group[sex,AG 45 to 49]=SUM(Population[sex,AGE 45 to 49!]) Population Group[sex,AG 50 to 54]=SUM(Population[sex,AGE 50 to 54!]) Population Group[sex,AG 55 to 59]=SUM(Population[sex,AGE 55 to 59!]) Population Group[sex,AG 60 to 64]=SUM(Population[sex,AGE 60 to 64!]) Population Group[sex,AG 65 TO 69]=SUM(Population[sex,AGE 65 to 69!]) Population Group[sex,AG 70 TO 74]=SUM(Population[sex,AGE 70 to 74!]) Population Group[sex,AG 75 TO 79]=SUM(Population[sex,AGE 75 to 79!]) Population Group[sex,AG 80 AND OVER]=Population[sex,AGE 80 AND OVER] Units: Person

population growth= TREND(total population, 1, 0.02)*100 Units: Dmnl

population growth index= (1-(population growth+1.5)/6.5)*10 Units: Dmnl

population of school going age[sex]= SUM(Population[sex,school age!]) Units: Person

population under five[sex]= Population Group[sex,AG UNDER 1]+ Population Group[sex,AG 1 TO 4] Units: Person

population under water stress= initial share of population under water stress*relative water stress^elasticity to water Units: Dmnl

"potential electricity generation co-generation energy"= "Co-generation energy capacity"*hours per day*days per year Units: MWh/Year

potential electricity generation coal energy= (coal energy capacity*hours per day*days per year)-(coal energy capacity*ratio of coal ccs capacity to coal energyy capacity *coal efficiency loss from ccs*hours per day*days per year) Units: MWh/Year

potential electricity generation diseal and fuel oil energy= diseal and fuel oil energy capacity*hours per day*days per year Units: MWh/Year

potential electricity generation gas turbine energy= (gas turbine energy capacity*hours per day*days per year)-(gas turbine energy capacity *ratio of gas ccs capacity to gas energy capacity*gas efficiency loss from ccs *hours per day*days per year) Units: MWh/Year

potential electricity generation geothermal= geothermal capacity*hours per day*days per year Units: MWh/Year

potential electricity generation hydro= hydro capacity*hours per day*days per year Units: MWh/Year

potential electricity generation landfill gas= landfill gas capacity*hours per day*days per year Units: MWh/Year

potential electricity generation nuclear energy= nuclear energy capacity*hours per day*days per year Units: MWh/Year

potential electricity generation tidal energy= tidal energy capacity*hours per day*days per year Units: MWh/Year

potential electricity generation waste energy= waste energy capacity*hours per day*days per year Units: MWh/Year

potential electricity generation wave energy= wave energy capacity*hours per day*days per year Units: MWh/Year

potential electricity generation wind= wind capacity*hours per day*days per year Units: MWh/Year

potential electricity solar= solar capacity*hours per day*days per year Units: MWh/Year

potential production trend= (World Oil Potential Production*(1+ROW Potential Production Trend*Minimum Extraction Time)^5) Units: MB/Year

poverty line= poverty line in usd/reference income Units: Dmnl

poverty line in usd= 730 Units: $/(Year*Person)

power generation co2 emission abatement from green investment= DELAY N(cumulative investment for power efficiency/cost of abatement of co2 power generation (Time), 3, cumulative investment for power efficiency /cost of abatement of co2 power generation(Time), 3) Units: Ton/Year

power generation investment= energy green investment*power generation investment fraction(Time) Units: usd15/Year

power generation investment fraction([(2011,0)-(2050,1)],(2011,1),(2030,1),(2031,1),(2050,1)) Units: Dmnl

power generation shares test= coal share of power generation+"co-generation share of power generation"+diesel and fuel oil share of power generation + gas turbine share of power generation +hydro share of power generation+waste share of power generation+wind share of power generation +solar share of power generation+wave share of power generation +nuclear share of power generation+tidal share of power generation +landfill gas share of power generation+geothermal share of power generation Units: Dmnl

power generation technology: DIESEL AND FUEL OIL, COGENERATION, GAS TURBINE, coal power, nuclear, BIOMASS , HYDROPOWER LARGE SCALE, HYDROPOWER SMALL SCALE, SOLAR LARGE SCALE, SOLAR SMALL SCALE , WIND ONSHORE, WIND OFFSHORE, WASTE GENERATION, GEOTHERMAL

precipitation= average precipitation*total land area*HA TO KM3 Units: Km3/Year

predation: (fishyr3-fishyr15)

present year= 2004 Units: Year

previous Aluminum total demand= DELAY N(total Aluminum demand, GROWTH RATE base period, 9.688e+007 ,(1/TIME STEP)*GROWTH RATE base period) Units: USD/Year

previous Aluminum total production cost= DELAY N(Aluminum total production cost, GROWTH RATE base period, 2.602e+010 ,(1/TIME STEP)*GROWTH RATE base period) Units: USD/Year

previous Aluminum total real unit cost= DELAY N(Aluminum total real unit cost, GROWTH RATE base period, 323.88 ,(1 /TIME STEP)*GROWTH RATE base period) Units: usd15/Ton

previous Chemical and plastics total demand= DELAY N(total Chemical and plastics demand, GROWTH RATE base period, 9.688e+007 ,(1/TIME STEP)*GROWTH RATE base period) Units: usd15/Year

previous Chemical and plastics total production cost= DELAY N(Chemical and plastics total production cost, GROWTH RATE base period , 2.602e+010 ,(1/TIME STEP)*GROWTH RATE base period) Units: usd15/Year

previous Chemical and plastics total real unit cost= DELAY N(Chemical and plastics total real unit cost, GROWTH RATE base period , 323.88 ,(1/TIME STEP)*GROWTH RATE base period) Units: usd15/Ton

previous Leather total demand= DELAY N(total Leather demand, GROWTH RATE base period, 9.688e+007 ,(1/TIME STEP)*GROWTH RATE base period) Units: USD/Year

previous Leather total production cost= DELAY N(Leather total production cost, GROWTH RATE base period, 2.602e+010 ,(1/TIME STEP)*GROWTH RATE base period) Units: USD/Year

previous Leather total real unit cost= DELAY N(Leather total real unit cost, GROWTH RATE base period, 323.88 ,(1/ TIME STEP)*GROWTH RATE base period) Units: usd15/Ton

previous Paper and pulp total demand= DELAY N(total Paper and pulp demand, GROWTH RATE base period, 9.688e+007 , (1/TIME STEP)*GROWTH RATE base period) Units: USD/Year

previous Paper and pulp total production cost= DELAY N(Paper and pulp total production cost, GROWTH RATE base period, 2.602e+010 ,(1/TIME STEP)*GROWTH RATE base period) Units: USD/Year

previous Paper and pulp total real unit cost= DELAY N(Paper and pulp total real unit cost, GROWTH RATE base period, 323.88 ,(1/TIME STEP)*GROWTH RATE base period) Units: usd15/Ton

previous real Aluminum profits= DELAY N(real Aluminum operating surplus, GROWTH RATE base period, 2.015e+010 ,(1/TIME STEP)*GROWTH RATE base period) Units: usd15/Year

previous real Chemical and plastics profits= DELAY N(real Chemical and plastics operating surplus, GROWTH RATE base period , 2.015e+010 ,(1/TIME STEP)*GROWTH RATE base period) Units: usd15/Year

previous real Leather profits= DELAY N(real Leather operating surplus, GROWTH RATE base period, 2.015e+010 ,(1/TIME STEP)*GROWTH RATE base period) Units: usd15/Year

previous real Paper and pulp profits= DELAY N(real Paper and pulp operating surplus, GROWTH RATE base period, 2.015e+010 ,(1/TIME STEP)*GROWTH RATE base period) Units: usd15/Year

previous real steel profits= DELAY N(real steel operating surplus, GROWTH RATE base period, 2.015e+010 ,(1/TIME STEP)*GROWTH RATE base period) Units: usd15/Year

previous real Textile profits= DELAY N(real Textile operating surplus, GROWTH RATE base period, 2.015e+010 ,(1/TIME STEP)*GROWTH RATE base period) Units: usd15/Year

previous steel total demand= DELAY N(total Steel demand, GROWTH RATE base period, 9.688e+007 ,(1/TIME STEP)*GROWTH RATE base period) Units: USD/Year

previous steel total production cost= DELAY N(steel total production cost, GROWTH RATE base period, 2.602e+010 , (1/TIME STEP)*GROWTH RATE base period) Units: USD/Year

previous steel total real unit cost= DELAY N(steel total real unit cost, GROWTH RATE base period, 323.88 ,(1/TIME STEP)*GROWTH RATE base period) Units: usd15/Ton

previous Textile total demand= DELAY N(total Textile demand, GROWTH RATE base period, 9.688e+007 ,(1/TIME STEP)*GROWTH RATE base period) Units: USD/Year

previous Textile total production cost= DELAY N(Textile total production cost, GROWTH RATE base period, 2.602e+010 ,(1/TIME STEP)*GROWTH RATE base period) Units: USD/Year

previous Textile total real unit cost= DELAY N(Textile total real unit cost, GROWTH RATE base period, 323.88 ,(1/ TIME STEP)*GROWTH RATE base period) Units: usd15/Ton

price adjustment= 1 Units: Year

price of feedstock= 21 Units: usd15/Ton

primary school age: (AGE 7 - AGE 12)

Primary solid biomass= initial Primary solid biomass*effect of primary sold biomass on relative total population *effect of primary sold biomass on relative oil price*effect of primary solid biomass on relative population below poverty line Units: ktoe/Year

primary student crude death rate [sex]= SUM(deaths[sex, primary school age!])/SUM(Population[sex, primary school age !]) Units: Dmnl/Year

private car users population= indicated transport model share[pvtcars]*URBAN population Units: Person/Year

private car users population reduction= private car users population*actual fraction of private cars population reduction Units: Person/Year

private cars co2 emission urban= private cars energy consumption by energy[gasoline power]*CO2 EMISSION FACTORS [gasoline power]+private cars energy consumption by energy[diesel]*CO2 EMISSION FACTORS [diesel]+private cars energy consumption by energy[CNG]*CO2 EMISSION FACTORS [CNG] Units: mtoe/Year

private cars energy consumption by energy[gasoline power]= private cars energy consumption by type urban[reg gasoline]+private cars energy consumption by type urban [hybrid gasoline] private cars energy consumption by energy[diesel]= private cars energy consumption by type urban[reg diesel]+private cars energy consumption by type urban [hybrid diesel] private cars energy consumption by energy[CNG]= private cars energy consumption by type urban[V CNG]+private cars energy consumption by type urban [V fuel cell] Units: mtoe/Year

private cars energy consumption by type urban[vehicle tech type]= private cars energy consumption urban[vehicle tech type]*(share of car energy type time series [vehicle tech type](Time)/100) Units: mtoe/Year

private cars energy consumption urban[vehicle tech type]= indicated urban car travel volume[vehicle tech type]*(cars average fuel efficiency time series [vehicle tech type](Time)/100)*convert LITRE to mtoe Units: mtoe/Year

private consumption= private consumption fraction(Time)*real gross domestic product Units: usd15/Year

private consumption fraction([(1971,0)-(2006,1)],(1971,0.381879),(1972,0.389735),(1973,0.396178),(1974,0.386907),(1975,0.383694),(1976,0.388308),(1977,0.393016),(1978,0.394316),(1979,0.397537),(1980,0.394136),(1981,0.395552),(1982,0.402926),(1983,0.406897),(1984,0.403998),(1985,0.405122),(1986,0.405196),(1987,0.403651),(1988,0.401369),(1989,0.397001),(1990,0.400067),(1991,0.402883),(1992,0.404747),(1993,0.407619),(1994,0.407405),(1995,0.404578),(1996,0.405779),(1997,0.404911),(1998,0.406708),(1999,0.406778),(2000,0.404237),(2001,0.406667),(2002,0.404487),(2003,0.399355),(2004,0.392832),(2005,0.388128),(2006,0.381735)) Units: Dmnl

"private defensive spending on health and education (PDS)"= (health expenditure(Time))/2+(education expenditure)*0.1 Units: USD15/year

private investment= private investment fraction(Time)*real gross domestic product Units: usd15/Year

private investment fraction([(1971,0.07)-(2006,0.2)],(1971,0.105),(1972,0.112639),(1973,0.126992),(1974,0.125601),(1975,0.110167),(1976,0.115565),(1977,0.116414),(1978,0.117136),(1979,0.117906),(1980,0.114473),(1981,0.108717),(1982,0.0953801),(1983,0.0907538),(1984,0.0948629),(1985,0.0931183),(1986,0.0923103),(1987,0.0951012),(1988,0.102046),(1989,0.109301),(1990,0.10275),(1991,0.0984811),(1992,0.0950055),(1993,0.0874979),(1994,0.0917398),(1995,0.0986399),(1996,0.0978462),(1997,0.0982671),(1998,0.091441),(1999,0.0872859),(2000,0.0883377),(2001,0.0798978),(2002,0.0888576),(2003,0.0932939),(2004,0.0981091),(2005,0.0942592),(2006,0.0948266)) Units: Dmnl

"probability of becoming non-recyclers"= 0.05 Units: Dmnl/Year

probability to become recyclers due to pollution= initial probability to become recyclers due to pollution*effect of relative GHG emissions on probability to become recyclers Units: Dmnl

probability to get informed via campaign= initial probability to get informed via campaign*"effect of share of separators on probability to reach non-recyclers" *effect of relative campaign expenditure on probability to get informed via campaign Units: Dmnl

probability to inform a person about waste recycling= "effect of share of separators on probability to reach non-recyclers"*initial probability to inform a person about waste recycling Units: Dmnl

product recovery ratio= 0.5 Units: Dmnl

proportion below poverty line from class across poverty line[IncClass]= if then else(income class level[IncClass]>poverty line :AND: income class level [IncClass]<(poverty line+income class size), normalized income distribution area [IncClass]*(poverty line-(income class level [IncClass]-income class size))/income class size ,0) Units: Dmnl

proportion of babies per sex[FEMALE]= 0.495 proportion of babies per sex[MALE] = 1-proportion of babies per sex[FEMALE] Units: Dmnl

proportion of population below poverty line= SUM(if then else(income class level[IncClass!]<poverty line :OR: income class level [IncClass!] = poverty line, 1,0)*normalized income distribution area[IncClass !])+SUM(proportion below poverty line from class across poverty line[IncClass !]) Units: Dmnl

PROPORTION OF WOMEN HAVING OUT OF WEDLOCK SEX= 0.4 Units: Dmnl

PROPORTION OF WOMEN MARRIED= 0.6 Units: Dmnl

proteins per person per day= DELAY N(total proteins consumed/total population/days in one year,2,total proteins consumed /total population/days in one year,1) Units: gr/Person/day

proteins per ton of food vegetable= 56476.1 Units: gr/Ton

proteins per ton of meat= 263871 Units: gr/Ton

public cleansing cost per ton([(1970,0)-(2010,200)],(1970,45),(1990,100),(2010,190)) Units: USD/Ton

public cleansing employment factor per ton= 0.00028 Units: Person/Ton

public consumption= public consumption fraction(Time)*real gross domestic product Units: usd15/Year

public consumption fraction([(1971,0.09)-(2006,0.2)],(1971,0.0981905),(1972,0.101485),(1973,0.102666),(1974,0.102655),(1975,0.110596),(1976,0.109445),(1977,0.10878),(1978,0.11161),(1979,0.112579),(1980,0.112804),(1981,0.114332),(1982,0.115704),(1983,0.115231),(1984,0.110691),(1985,0.112369),(1986,0.113996),(1987,0.11386),(1988,0.11),(1989,0.110388),(1990,0.112394),(1991,0.115375),(1992,0.118171),(1993,0.11698),(1994,0.114316),(1995,0.114332),(1996,0.113999),(1997,0.112613),(1998,0.111527

),(1999,0.109898),(2000,0.107915),(2001,0.109464),(2002,0.113674),(2003,0.114584
),(2004,0.113798),(2005,0.112683),(2006,0.112475)) Units: Dmnl

public investment= public investment fraction(Time)*real gross domestic product Units: usd15/Year

public investment fraction([(1971,0.04)-
(2006,0.07)],(1971,0.0464485),(1972,0.0440335),(1973,0.0435523
),(1974,0.0440668),(1975,0.0409043),(1976,0.0435744),(1977,0.0449637),(1978
,0.0484872),(1979,0.0506163),(1980,0.0489884),(1981,0.0515454),(1982,0.0557995
),(1983,0.0563327),(1984,0.0591349),(1985,0.0580311),(1986,0.0581135),(1987
,0.0559735),(1988,0.0557997),(1989,0.0527041),(1990,0.0555487),(1991,0.0565465
),(1992,0.0560777),(1993,0.0612527),(1994,0.0597956),(1995,0.0543444),(1996
,0.0529332),(1997,0.0531198),(1998,0.055606),(1999,0.0585398),(2000,0.0593206
),(2001,0.0603468),(2002,0.0465242),(2003,0.0434713),(2004,0.0435823),(2005
,0.0498779),(2006,0.0530293)) Units: Dmnl

"public non-defensive consumption expenditure (PNCE)"= education expenditure+health expenditure(Time)/2 Units: Dmnl

Public spending on education as a fraction of GDP Units: Dmnl

public transport users population= indicated transport model share[ptransport]*URBAN population+private car users population reduction Units: Person/Year

QDBTU to BCF= 973.7 Units: BCF/qdbtu

QDBTU to BKWH= 293 Units: BKWH/qdbtu

QDBTU to BTU= 1e+015 Units: BTU/qdbtu

QDBTU to MB([(1980,0)-
(2005,250)],(1980,182.515),(1981,183.554),(1982,184.672),(1983,184.98
),(1984,185.357),(1985,185.632),(1986,184.57),(1987,185.082),(1988,184.843)
,(1989,184.843),(1990,184.809),(1991,185.735),(1992,185.943),(1993,185.908)
,(1994,186.532),(1995,187.231),(1996,187.406),(1997,187.407),(1998,186.951)
,(1999,187.688),(2000,187.758),(2001,187.091),(2002,187.828),(2003,187.266)
,(2004,187.126)) Units: MB/qdbtu

qdbtu to mbtu= 1/1e+009 Units: qdbtu/Mbtu

QDBTU to MST= 47.45 Units: MST/qdbtu

qdbtu to Mtoe= 23.51 Units: mtoe/qdbtu

quality of nutrition= 0.625*calories per person per day/WHO STANDARD CALORIES+0.375*proteins per person per day /WHO STANDARD PROTEINS +0*micronutrients per person per day/WHO STANDARD MICRONUTRIENTS Units: Dmnl

rail travel= travel volume by travel modes[rail] Units: Km/Year

rail type: passenger, freight

ratio of coal ccs capacity to coal energyy capacity= (COAL CCS CAPACITY/coal energy capacity)*0+EXOGENOUS CCS CAPACITY*IEA NET ZERO SWITCH Units: Dmnl

ratio of crops to ag= crop production/agriculture production Units: 1

ratio of fish to ag= fish production/agriculture production Units: 1

ratio of forestry to ag= forestry production/agriculture production Units: 1

ratio of gas ccs capacity to gas energy capacity= (GAS CCS CAPACITY/gas turbine energy capacity)*0+EXOGENOUS CCS CAPACITY*IEA NET ZERO SWITCH Units: Dmnl

ratio of livestock to ag= livestock production/agriculture production Units: 1

ratio of organic to chemical fertilizer use= organic fertilizer use/total fertilizer use Units: Dmnl

ratio of power generated from ccs= total electricity generation from ccs plant/total power generated Units: 1

real Aluminum energy cost= Aluminum energy cost/gdp deflator Units: usd15/Year

real Aluminum labor cost= Aluminum labor cost/gdp deflator Units: usd15/Year

real Aluminum market price= Aluminum market price/gdp deflator Units: usd15/Year

real Aluminum material cost= Aluminum material and capital production cost/gdp deflator Units: usd15/Year

real Aluminum operating surplus= Aluminum operating surplus/gdp deflator Units: usd15/Year

real Aluminum profit= real Aluminum operating surplus*Aluminum profit share(Time) Units: usd15/Year

real Aluminum profits growth rate= ((real Aluminum operating surplus-previous real Aluminum profits)/previous real Aluminum profits)/GROWTH RATE base period Units: Dmnl/Year

real Aluminum revenues= Aluminum revenues/gdp deflator Units: usd15/Year

real Aluminum unit energy cost= real Aluminum energy cost/total Aluminum production Units: usd15/Ton

real Aluminum unit labor cost= real Aluminum labor cost/total Aluminum production Units: usd15/Ton

real Aluminum unit material cost= real Aluminum material cost/total Aluminum production Units: usd15/Ton

real Aluminum unit operating surplus= real Aluminum operating surplus/total Aluminum production Units: usd15/Ton

real base case allowance price per ton= nominal base case allowance price per ton(Time)/gdp deflator Units: usd15/Ton

real Chemical and plastics energy cost= Textile energy cost/gdp deflator Units: usd15/Year

real Chemical and plastics labor cost= Chemical and plastics labor cost/gdp deflator Units: usd15/Year

real Chemical and plastics market price= Chemical and plastics market price/gdp deflator Units: usd15/Year

real Chemical and plastics material cost= Chemical and plastics material and capital production cost/gdp deflator Units: usd15/Year

real Chemical and plastics operating surplus= Chemical and plastics operating surplus/gdp deflator Units: usd15/Year

real Chemical and plastics profit= real Chemical and plastics operating surplus*Chemical and plastics profit share (Time) Units: usd15/Year

real Chemical and plastics profits growth rate= ((real Chemical and plastics operating surplus-previous real Chemical and plastics profits)/previous real Chemical and plastics profits)/GROWTH RATE base period Units: Dmnl/Year

real Chemical and plastics revenues= Chemical and plastics revenues/gdp deflator Units: usd15/Year

real Chemical and plastics unit energy cost= real Chemical and plastics energy cost/total Chemical and plastics production Units: usd15/Ton

real Chemical and plastics unit labor cost= real Chemical and plastics labor cost/total Chemical and plastics production Units: usd15/Ton

real Chemical and plastics unit material cost= real Chemical and plastics material cost/total Chemical and plastics production Units: usd15/Ton

real Chemical and plastics unit operating surplus= real Chemical and plastics operating surplus/total Chemical and plastics production Units: usd15/Ton

real Coal price over cost= (Coal Price per MBTU/real coal production cost per MBTU)-1 Units: Dmnl

real coal price per MBTU= ((initial coal ROW price*Coal World Effect of Demand Supply Balance on Price ^Elasticity of World Coal Price on Demand Supply Ratio)*Coal World desired available ratio effect on price^Coal World Elasticity of price to availability of resource)/relative Coal recoverable reserves demand ratio ^Elasticity of World Coal Price on recoverable reserve demand ratio/20 Units: usd15/Mbtu

real coal production cost per MBTU= (((Coal production cost from data/relative Coal recoverable reserves demand ratio ^Elasticity of Coal Cost on recoverable reserve demand ratio)*Coal US Effect of Demand Supply Balance on Cost ^Elasticity of Coal Cost on Demand Supply Ratio)/effect of coal fraction total resources remaining ^Elasticity of Coal Price to Total Resources Remaining) Units: usd15/Mbtu

real Electricity Price per mbtu= relative effect of energy price on electricity price*Initial real electricity price Units: usd15/Mbtu

real emissions cost= nominal emissions cost/gdp deflator Units: usd15/Year

real GDP growth rate= TREND(real gross domestic product,0.75,inital GDP growth rate) Units: Dmnl

real GDP test= real gross domestic product/gdp deflator Units: usd15*usd15/(Year*USD)

real gross domestic product= test real gross domestic product Units: usd15/Year

real industrial emissions cost= nominal industrial emissions cost/gdp deflator Units: USD/Ton/Year

real Leather energy cost= Textile energy cost/gdp deflator Units: usd15/Year

real Leather labor cost= Leather labor cost/gdp deflator Units: usd15/Year

real Leather market price= Leather market price/gdp deflator Units: usd15/Year

real Leather material cost= Leather material and capital production cost/gdp deflator Units: usd15/Year

real Leather operating surplus= Leather operating surplus/gdp deflator Units: usd15/Year

real Leather profit= real Leather operating surplus*Leather profit share(Time) Units: usd15/Year

real Leather profits growth rate= ((real Leather operating surplus-previous real Leather profits)/previous real Leather profits)/GROWTH RATE base period Units: Dmnl/Year

real Leather revenues= Leather revenues/gdp deflator Units: usd15/Year

real Leather unit energy cost= real Leather energy cost/total Leather production Units: usd15/Ton

real Leather unit labor cost= real Leather labor cost/total Leather production Units: usd15/Ton

real Leather unit material cost= real Leather material cost/total Leather production Units: usd15/Ton

real Leather unit operating surplus= real Leather operating surplus/total Leather production Units: usd15/Ton

real natural gas price over cost= (Natural Gas Price per MBTU/real natural gas production cost per MBTU)-1 Units: Dmnl

real natural gas price per MBTU= (Initial natural gas ROW price*relative row gas demand and supply balance^ Elasticity of World Natural Gas Price on Demand Supply Ratio)*Gas World desired available ratio effect on price^(if then else(Gas World desired available ratio effect on price >0,Gas World Elasticity of price to availability of resource,0)) Units: usd15/Mbtu

real natural gas production cost per MBTU= (((gas production cost from data/relative natural gas recoverable reserves demand ratio ^Elasticity of Natural Gas Cost on recoverable reserve demand ratio *Gas US Effect of Demand Supply Balance on Cost^Elasticity of Natural Gas Cost on Demand Supply Ratio)/effect of Natural Gas fraction total resources remaining^Elasticity of Natural Gas Price to Total Resources Remaining)) Units: usd15/Mbtu

real oil price= Oil price 1970*effect of resources on world price*effect of world oil demand supply on price Units: usd15/Barrel

real oil price per Mbtu= Oil price 1980 BTU*effect of resources on world price*effect of world oil demand supply on price Units: usd15/Mbtu

real Paper and pulp energy cost= Textile energy cost/gdp deflator Units: usd15/Year

real Paper and pulp labor cost= Paper and pulp labor cost/gdp deflator Units: usd15/Year

real Paper and pulp market price= Paper and pulp market price/gdp deflator Units: usd15/Year

real Paper and pulp material cost= Paper and pulp material and capital production cost/gdp deflator Units: usd15/Year

real Paper and pulp operating surplus= Paper and pulp operating surplus/gdp deflator Units: usd15/Year

real Paper and pulp profit= real Paper and pulp operating surplus*Paper and pulp profit share(Time) Units: usd15/Year

real Paper and pulp profits growth rate= ((real Paper and pulp operating surplus-previous real Paper and pulp profits)/previous real Paper and pulp profits)/GROWTH RATE base period Units: Dmnl/Year

real Paper and pulp revenues= Paper and pulp revenues/gdp deflator Units: usd15/Year

real Paper and pulp unit energy cost= real Paper and pulp energy cost/total Paper and pulp production Units: usd15/Ton

real Paper and pulp unit labor cost= real Paper and pulp labor cost/total Paper and pulp production Units: usd15/Ton

real Paper and pulp unit material cost= real Paper and pulp material cost/total Paper and pulp production Units: usd15/Ton

real Paper and pulp unit operating surplus= real Paper and pulp operating surplus/total Paper and pulp production Units: usd15/Ton

real pc gdp= real gross domestic product/total population Units: usd15/Person/Year

real steel energy cost= steel energy cost/gdp deflator Units: usd15/Year

real steel labor cost= steel labor cost/gdp deflator Units: usd15/Year

real steel market price= steel market price/gdp deflator Units: usd15/Year

real steel material cost= steel material and capital production cost/gdp deflator Units: usd15/Year

real steel operating surplus= steel operating surplus/gdp deflator Units: usd15/Year

real steel profit= real steel operating surplus*steel profit share(Time) Units: usd15/Year

real steel profits growth rate= ((real steel operating surplus-previous real steel profits)/previous real steel profits)/GROWTH RATE base period Units: Dmnl/Year

real steel revenues= steel revenues/gdp deflator Units: usd15/Year

real steel unit energy cost= real steel energy cost/total steel production Units: usd15/Ton

real steel unit labor cost= real steel labor cost/total steel production Units: usd15/Ton

real steel unit material cost= real steel material cost/total steel production Units: usd15/Ton

real steel unit operating surplus= real steel operating surplus/total steel production Units: usd15/Ton

real Textile energy cost= Textile energy cost/gdp deflator Units: usd15/Year

real Textile labor cost= Textile labor cost/gdp deflator Units: usd15/Year

real Textile market price= Textile market price/gdp deflator Units: usd15/Year

real Textile material cost= Textile material and capital production cost/gdp deflator Units: usd15/Year

real Textile operating surplus= Textile operating surplus/gdp deflator Units: usd15/Year

real Textile profit= real Textile operating surplus*Textile profit share(Time) Units: usd15/Year

real Textile profits growth rate= ((real Textile operating surplus-previous real Textile profits)/previous real Textile profits)/GROWTH RATE base period Units: Dmnl/Year

real Textile revenues= Textile revenues/gdp deflator Units: usd15/Year

real Textile unit energy cost= real Textile energy cost/total Textile production Units: usd15/Ton

real Textile unit labor cost= real Textile labor cost/total Textile production Units: usd15/Ton

real Textile unit material cost= real Textile material cost/total Textile production Units: usd15/Ton

real Textile unit operating surplus= real Textile operating surplus/total Textile production Units: usd15/Ton

real value added from buildings= (nominal economic output from building*value generated per unit of economic output for buildings)/gdp deflator Units: usd15/Year

real value added from clothing manufacturing= (nominal economic output from clothing production*value generated per unit of economic output of clothing)/gdp deflator Units: usd15/Year

real value added from plastic manufacturing= (nominal economic output from plastic production*value generated per unit of economic output for plastic)/gdp deflator Units: usd15/Year

real value added from vehicle manufacturing= (nominal economic output from vehicile production*value generated per unit of economic output)/gdp deflator Units: usd15/Year

recovered waste= "by-product recovery capacity" Units: Ton/Year

recruitment= fish eggs*fraction of hatched eggs Units: Ton/Year

recycled waste= INTEG (waste to recycle-material reuse, 1.5e+008) Units: Ton

recyclers= total population*share of recyclers Units: Person

recycling and reuse rate switch= 0 Units: Dmnl

recycling investment= recycling investment time series(Time) Units: usd15/Year/Year

recycling investment time series([(0,0)-(2000,10)],(1970,0),(2000,0)) Units: usd15/Year

Reduction in coal capacity CA= WITH LOOKUP (Time, ([(0,0)-(2027,10)],(2000,1),(2026,1),(2027,0.5))) Units: Dmnl

Reduction in coal capacity HA= WITH LOOKUP (Time, ([(0,0)-(2027,10)],(2000,1),(2026,1),(2027,0))) Units: Dmnl

Reduction in coal capacity LA= WITH LOOKUP (Time, ([(0,0)-(2027,10)],(2000,1),(2026,1),(2027,0.75))) Units: Dmnl

Reduction in Diesel anf fuel oil energy capacity CA= WITH LOOKUP (Time, ([(0,0)-(2027,10)],(2000,1),(2026,1),(2027,0.5))) Units: Dmnl

Reduction in Diesel anf fuel oil energy capacity HA= WITH LOOKUP (Time, ([(0,0)-(2027,10)],(2000,1),(2026,1),(2027,0))) Units: Dmnl

Reduction in Diesel anf fuel oil energy capacity LA= WITH LOOKUP (Time, ([(0,0)-(2027,10)],(2000,1),(2026,1),(2027,0.75))) Units: Dmnl

Reduction in gas turbine capacity CA= WITH LOOKUP (Time, ([(0,0)-(2027,10)],(2000,1),(2026,1),(2027,0.5))) Units: Dmnl

Reduction in gas turbine capacity HA= WITH LOOKUP (Time, ([(0,0)-(2027,10)],(2000,1),(2026,1),(2027,0))) Units: Dmnl

Reduction in gas turbine capcaity LA= WITH LOOKUP (Time, ([(0,0)-(2027,10)],(2000,1),(2026,1),(2027,0.75))) Units: Dmnl

reduction in share= (recyclers*"probability of becoming non-recyclers")/total population Units: Dmnl/Year

reduction in total travel volume due to efficiency= if then else(indicated green economy investment fraction=0, 0, indicated fraction of reduction in total travel volume due to efficiency) Units: Dmnl

reference coal fraction total resource remaining= 0.775 Units: Dmnl

reference Coal recoverable reserves demand ratio= INITIAL(coal recoverable reserves demand ratio) Units dmnl

reference crops yield per hectare= 8.2 Units: Ton/Ha

reference electricity price= WITH LOOKUP (Time, ([(1999,0)-(2010,1)],(1999,0.055),(2000,0.051),(2001,0.05),(2002,0.054),(2003,0.065),(2004,0.072),(2005,0.088),(2006,0.096),(2007,0.1))) Units: usd15/kWh

reference income= 1 Units: $/Person/Year

REFERENCE Leather COAL PRICE([(1999,0)-(2010,10)],(1999,1.889),(2000,1.915),(2001,2.046),(2002,2.272),(2003,2.674),(2004,2.99),(2005,2.995),(2006,3.715),(2007,5.67)) Units: USD/Mbtu

reference Natural Gas fraction total resource remaining= 0.7755 Units: Dmnl

reference natural gas recoverable reserves demand ratio= INITIAL(natural gas recoverable reserves demand ratio) Units: Year

REFERENCE Paper and pulp COAL PRICE([(1999,0)-(2010,10)],(1999,1.889),(2000,1.915),(2001,2.046),(2002,2.272),(2003,2.674),(2004,2.99),(2005,2.995),(2006,3.715),(2007,5.67)) Units: USD/Mbtu

reference relative international coal price= 1.02 Units: Dmnl

reference relative international natural gas price= 1.26 Units: Dmnl

Reference Reserve Production Ratio= 20 Units: Year

Reference ROW Oil Actual Reserves Production Ratio= INITIAL(ROW Oil Actual Reserves Production Ratio) Units: Dmnl

reference saturation income= 22500 Units: usd15/(Year*Person)

reference saturation pc health expenditure= INITIAL(600) Units: usd15/(Person*Year)

REFERENCE SHARE OF BUS TRAVEL([(2000,0)-(2050,0.1)],(2000,0.04),(2005,0.04),(2010,0.04),(2015,0.04),(2020,0.03),(2025,0.03),(2030,0.03),(2035,0.02),(2040,0.02),(2045,0.02),(2050,0.02)) Units: Dmnl

REFERENCE SHARE OF CAR TRAVEL([(2000,0)-(2050,1)],(2000,0.73),(2005,0.71),(2010,0.7),(2015,0.71),(2020,0.73),(2025,0.75),(2030,0.77),(2035,0.78),(2040,0.79),(2045,0.8),(2050,0.8)) Units: Dmnl

REFERENCE Share of travel volume BY BUS[bus]([(2000,0)-(2050,10)],(2000,0.557018),(2005,0.508772),(2010,0.464912),(2015,0.447368),(2020,0.460526),(2025,0.434211),(2030,0.416667),(2035,0.403509),(2040,0.412281),(2045,0.434211),(2050,0.45614)) REFERENCE Share of travel volume BY BUS[minibus]([(2000,0)-(2050,10)],(2000,0.535088),(2005,0.5),(2010,0.469298),(2015,0.442982),(2020,0.451754),(2025,0.451754),(2030,0.429825),(2035,0.416667),(2040,0.429825),(2045,0.473684),(2050,0.5)) Units: Dmnl

REFERENCE Share of travel volume BY CAR[reg gasoline]([(2000,0)-(2050,10)],(2000,0.877),(2005,0.864),(2010,0.847),(2015,0.83),(2020,0.827),(2025,0.826),(2030,0.826),(2035,0.826),(2040,0.826),(2045,0.825),(2050 ,0.807)) REFERENCE Share of travel volume BY CAR[hybrid gasoline]([(2000,0)-(2050,0.1)],(2000,0.001),(2005,0.001),(2010,0.002),(2015,0.003),(2020,0.004),(2025,0.006),(2030,0.007),(2035,0.009),(2040,0.01),(2045,0.011),(2050,0.013)) REFERENCE Share of travel volume BY CAR[reg diesel]([(2000,0)-(2050,1)],(2000,0.104),(2005,0.119),(2010,0.137),(2015,0.154),(2020,0.156),(2025,0.156),(2030,0.155),(2035,0.154),(2040,0.154),(2045,0.155),(2050,0.17)) REFERENCE Share of travel volume BY CAR[hybrid diesel]([(2000,0)-(2050,1)],(2000,0),(2005,0),(2010,0),(2015,0),(2020,0),(2025,0),(2030,0),(2035,0),(2040,0),(2045,0),(2050,0)) REFERENCE Share of travel volume BY CAR[V CNG]([(2000,0)-(2050,0.1)],(2000,0.018),(2005,0.016),(2010,0.015),(2015,0.013),(2020,0.012),(2025,0.012),(2030,0.011),(2035,0.011),(2040,0.01),(2045,0.01),(2050,0.01)) REFERENCE Share of travel volume BY CAR[V fuel cell]([(2000,0)-(2050,1)],(2000,0),(2005,0),(2010,0),(2015,0),(2020,0),(2025,0),(2030,0),(2035,0),(2040,0),(2045,0),(2050,0)) Units: Dmnl

REFERENCE Share of travel volume BY rail[passenger]([(2000,0)-(2050,1)],(2000,0.234),(2005,0.235),(2010,0.236),(2015,0.237),(2020

,0.238),(2025,0.239),(2030,0.24),(2035,0.24),(2040,0.24),(2045,0.24),(2050, 0.24)) REFERENCE Share of travel volume BY rail[freight]([(2000,0)-(2050,1)],(2000,0.766),(2005,0.765),(2010,0.764),(2015,0.763),(2020,0.762),(2025,0.761),(2030,0.76),(2035,0.76),(2040,0.76),(2045,0.76),(2050,0.76)) Units: Dmnl

REFERENCE share of travel volume BY TRAVEL MODES[road]([(2000,0)-(2050,1)],(2000,0.482456),(2005,0.486842),(2010,0.47807),(2015,0.473684),(2020,0.495),(2025,0.486),(2030,0.530702),(2035,0.526316),(2040,0.535088),(2045,0.539474),(2050,0.552632)) REFERENCE share of travel volume BY TRAVEL MODES[rail]([(2000,0)-(2050,1)],(2000,0.369831),(2005,0.361111),(2010,0.359223),(2015,0.35579),(2020,0.335),(2025,0.334651),(2030,0.299954),(2035,0.297513),(2040,0.287511),(2045,0.279574),(2050,0.266003)) REFERENCE share of travel volume BY TRAVEL MODES[air]([(2000,0)-(2050,1)],(2000,0.147713),(2005,0.152047),(2010,0.162707),(2015,0.170526),(2020,0.17),(2025,0.179349),(2030,0.169344),(2035,0.176171),(2040,0.177401),(2045,0.180952),(2050,0.181365)) REFERENCE share of travel volume BY TRAVEL MODES[water]([(0,0)-(10,10)],(0,0),(0,0)) Units: Dmnl

REFERENCE Share of travel volume BY TRUCK[medium truck]([(2000,0)-(2050,1)],(2000,0.42),(2005,0.421),(2010,0.422),(2015,0.424),(2020,0.426),(2025,0.428),(2030,0.429),(2035,0.43),(2040,0.431),(2045,0.432),(2050 ,0.433)) REFERENCE Share of travel volume BY TRUCK[heavy truck]([(2000,0)-(2050,1)],(2000,0.58),(2005,0.579),(2010,0.578),(2015,0.576),(2020,0.574),(2025,0.572),(2030,0.571),(2035,0.57),(2040,0.569),(2045,0.568),(2050 ,0.567)) Units: Dmnl

REFERENCE share of travel volume BY VEHICLE[two wheel]([(2000,0)-(2050,10)],(2000,0.864035),(2005,0.872807),(2010,0.881579),(2015,0.903509),(2020,0.912281),(2025,0.916667),(2030,0.921053),(2035,0.921053),(2040,0.921053),(2045,0.925439),(2050,0.929825)) REFERENCE share of travel volume BY VEHICLE[three wheel]([(2000,0)-(2050,1)],(2000,0.135965),(2005,0.126),(2010,0.122),(2015,0.102),(2020,0.0877193),(2025,0.0833333),(2030,0.08),(2035,0.07648),(2040,0.0789474),(2045,0.076),(2050,0.0701754)) Units: Dmnl

REFERENCE SHARE OF TRUCK TRAVEL([(2000,0)-(2050,1)],(2000,0.08),(2005,0.08),(2010,0.09),(2015,0.09),(2020,0.08),(2025,0.08),(2030,0.07),(2035,0.07),(2040,0.07),(2045,0.07),(2050,0.07)) Units: Dmnl

REFERENCE SHARE OF VEHICLE TRAVEL([(2000,0)-(2050,1)],(2000,0.14),(2005,0.17),(2010,0.17),(2015,0.17),(2020,

0.16),(2025,0.14),(2030,0.13),(2035,0.12),(2040,0.12),(2045,0.12),(2050,0.11)) Units: Dmnl

Refurbishing houses= if then else(CE policy switch=3:OR:S4 CE building refurbishing policy=3 ,MAX(0,Stock of discarded buildings*S4 CE refurbishing of buildings HA (Time)), if then else(CE policy switch=2:OR:S4 CE building refurbishing policy=2 ,MAX(0,Stock of discarded buildings*S4 CE refurbishing of buildings CA (Time)), if then else(CE policy switch=1:OR:S4 CE building refurbishing policy=1 ,MAX(0,Stock of discarded buildings*S4 CE refurbishing of buildings LA (Time)),MAX(0,Stock of discarded buildings*Refurbishing rate)))) Units: building/Year

Refurbishing rate= 0 Units: Dmnl/Year

regeneration time= 500 Units: Year

relative agric land= Agricultural Land/initial agric land Units: 1

relative AGRICLTURAL LAND= Agricultural Land/initial AGRICLTURAL LAND Units: Dmnl

relative agriculture employment= agriculture employment/initial agriculture employment Units: Dmnl

relative agriculture production= agriculture production/initial agriculture production Units: 1

relative Aluminum demand= total Aluminum demand/initial Aluminum demand Units: Dmnl

relative Aluminum total unit cost= Aluminum total real unit cost/initial Aluminum total unit cost Units: Dmnl

relative average electricity production cost= average electricity production cost/initial average electricity production cost Units: Dmnl

relative average life expectancy= average life expectancy/initial average life expectancy Units: Dmnl

relative average oil price= average oil price/initial average oil price Units: Dmnl

relative average SO2 emissions per TJ of petroleum= average SO2 emissions per TJ of petroleum[transport]/initial average SO2 emissions per TJ of petroleum Units: 1

relative average years of schooling= average years of schooling/initial average years of schooling Units: Dmnl

relative biomass price= relative oil price Units: Dmnl

relative campaign expenditure= total government investment for promoting waste management/initial campaign expenditure Units: Dmnl

relative capital agriculture= capital agriculture/initial capital agriculture Units: Dmnl

relative capital industry= (capital industry/initial capital industry)*COVID shock on capital industry and services Units: Dmnl

relative capital services= (capital services/initial capital services)*COVID shock on capital industry and services Units: Dmnl

relative carbon uptake land= carbon uptake land/initial carbon uptake land Units: Dmnl

relative check for building employee= total gendered employment in the building sector/total skilled employment in the building sector Units: 1

relative check for clothing employee= total gendered employment in the clothing sector/total skilled employment in the clothing sector Units: 1

relative check for plastic employee= total gendered employment in the plastic sector/total skilled employment in the plastic sector Units: 1

relative check for vehicle employee= total gendered employment in the vehicle sector/total skilled employment in the vehicle sector Units: 1

relative Chemical and plastics demand= total Chemical and plastics demand/initial Chemical and plastics demand Units: Dmnl

relative Chemical and plastics total unit cost= Chemical and plastics total real unit cost/initial Chemical and plastics total unit cost Units: Dmnl

relative chemical fertilizer use= chemical fertilizer use/initial chemical fertilizer use Units: Dmnl

relative co2 emissions per hectare= ZIDZ(co2 emissions per hectare,initial co2 emissions per hectare) Units: Dmnl

relative coal price= real coal price per MBTU/initial coal ROW price Units: Dmnl

relative Coal recoverable reserves demand ratio= coal recoverable reserves demand ratio /reference Coal recoverable reserves demand ratio Units: Dmnl

relative diesel oil price= relative fuel oil price Units: Dmnl

relative education expenditure per pupil= education expenditure per pupil/initial education expenditure per pupil Units: Dmnl

relative effect of energy price on electricity price= DELAY N(effect of energy price on electricity price/initial effect of energy price on electricity price , 1, 1, 1) Units: Dmnl

relative electricity price= exogenous electricity price/initial electricity price Units: Dmnl

relative employment industry= industry employment/initial employment industry Units: Dmnl

relative employment ratio= employment ratio/initial employment ratio Units: Dmnl

relative employment services= services employment/initial employment services Units: Dmnl

relative energy bill as share of GDP= energy bill as share of total real gdp/initial energy bill as share of GDP Units: 1

relative energy efficiency= relative energy efficiency table(Time) Units: Dmnl

relative energy efficiency table([(1980,0)-(2010,10)],(1980,1),(1981,1.00689),(1982,1.02128),(1983,1.03296),(1984,1.04345),(1985,1.05628),(1986,1.06036),(1987,1.05605),(1988,1.05431),(1989,1.05589),(1990,1.0673),(1991,1.08498),(1992,1.1001),(1993,1.11228),(1994,1.12437),(1995,1.13773),(1996,1.15398),(1997,1.17747),(1998,1.20635),(1999,1.2257),(2000,1.24013),(2001,1.27706),(2002,1.32536),(2003,1.36418),(2004,1.39777),(2005,1.42848),(2006,1.45813),(2007,1.48614),(2008,1.51354),(2009,1.54122),(2010,1.569),(2011,1.5963),(2012,1.61976),(2013,1.63978),(2014,1.65891),(2015,1.67781),(2016,1.69627),(2017,1.71331),(2018,1.72957),(2019,1.74556),(2020,1.76124),(2021,1.77637),(2022,1.79141),(2023,1.8066),(2024,1.82181),(2025,1.83683),(2026,1.85158),(2027,1.86617),(2028,1.88058),(2029,1.89478),(2030,1.90871),(2031,1.9223),(2032,1.93552),(2033,1.94839),(2034,1.96094),(2035,1.9732),(2036,1.98515),(2037,1.99682),(2038,2.0082)) Units: Dmnl

relative energy emissions= DELAY1I(total emissions from energy/initial energy emissions,1,1) Units: 1

relative forest land= Forest Land/initial forest land Units: 1

relative forest production= forest production/initial forest production Units: Dmnl

relative fossil fuel CO2 emission= fossil fuel CO2 emission/initial fossil fuel CO2 emission Units: Dmnl

relative fossil fuel emissions= FF GHG emissions in ton/initial fossil fuel emissions Units: 1

relative fuel oil price= relative oil price Units: Dmnl

relative gdp= real gross domestic product/initial gross domestic product Units: Dmnl

relative GDP in 2024= INTEG (change in relative GDP, 1) Units: Dmnl

relative GHG emissions per capita= ghg emissions per capita/initial ghg emissions per capita Units: Dmnl

relative harvested area= Harvested area/initial harvested area Units: Dmnl

relative industry production= industry production/initial industry production Units: 1

relative international coal price= real coal price per MBTU/Initial International Coal Price Units: Dmnl

relative international natural gas price= real natural gas price per MBTU/Initial International Natural Gas Price Units: Dmnl

relative kerosene price= relative fuel oil price Units: Dmnl

relative labor effect= labor/initial labor Units: Dmnl

relative Leather demand= total Leather demand/initial Leather demand Units: Dmnl

relative Leather total unit cost= Leather total real unit cost/initial Leather total unit cost Units: Dmnl

Relative Natural Gas Price= real natural gas price per MBTU/Initial Natural Gas Price per MBTU Units: Dmnl

relative natural gas recoverable reserves demand ratio= natural gas recoverable reserves demand ratio /reference natural gas recoverable reserves demand ratio Units: Dmnl

relative oil price= oil price/intial oil price Units: 1

Relative Oil Price per Mbtu= real oil price per Mbtu/Initial Oil Price per MBTU Units: Dmnl

relative organic fertilizer use= organic fertilizer use/initial organic fertilizer use Units: Dmnl

relative Paper and pulp demand= total Paper and pulp demand/initial Paper and pulp demand Units: Dmnl

relative Paper and pulp total unit cost= Paper and pulp total real unit cost/initial Paper and pulp total unit cost Units: Dmnl

relative pasture land= Pasture Land/initial Pasture Land Units: Dmnl

relative pc disposable income= PC DISPOSABLE INCOME/INITIAL PC DISPOSABLE INCOME Units: Dmnl

relative pc gdp= pc gdp/INITIAL PC GDP Units: Dmnl

relative population below poverty line= 0.6/initial population below poverty line Units: dmml

relative quality of nutrition= quality of nutrition/initial quality of nutrition Units: Dmnl

Relative real Coal Price= real coal price per MBTU/Initial Coal Price per MBTU Units: Dmnl

relative real gdp at market prices= real gross domestic product/initial real gross domestic product Units: Dmnl

relative real pc gdp= real pc gdp/initial real pc gdp Units: Dmnl

RELATIVE RECYLCE RATE= waste to recycle/INITIAL WASTE TO RECYCLE Units: Dmnl

Relative Renewable Resources Price= Renewable Resources price/Initial Renewable Resources Price per MBTU Units: Dmnl

relative Research and development= Research and development/initial Research and development Units: Dmnl

relative row gas demand and supply balance= row Gas demand supply balance/0.7 Units: Dmnl

relative row natural gas price= real natural gas price per MBTU/Initial natural gas ROW price Units: Dmnl

relative ROW oil price= real oil price/ROW initial Oil Price Units: Dmnl

relative services production= services production/initial services production Units: Dmnl

relativeSettlementland= Settlement Land/initial Settlement Land Units: Dmnl

relative share of forest land= share of forest land/initial share of forest land Units: Dmnl

relative share of recyclers= share of recyclers/initial share of recyclers Units: Dmnl

relative soil quality= soil quality/initial soil quality Units: Dmnl

relative steel demand= total Steel demand/initial steel demand Units: Dmnl

relative steel total unit cost= steel total real unit cost/initial steel total unit cost Units: Dmnl

relative Textile demand= total Textile demand/initial Textile demand Units: Dmnl

relative Textile total unit cost= Textile total real unit cost/initial Textile total unit cost Units: Dmnl

relative total fish stock= initial fish catch/stock ratio Units: Dmnl

relative total GHG emissions= total annual co2e emissions/initial total GHG emissions Units: 1

relative total population= total population/initial total population Units: Dmnl

relative water stress= water stress/initial water stress Units: 1

Relative Weighted Average Energy Price= Weighted Average Energy Price/Initial Weighted Average Energy Price Units: Dmnl

relative world oil demand supply balance= world oil demand supply balance/initial world oil demand supply balance Units: 1

remaining waste in Landfill= Landfill-usable waste for LFG Units: Ton/Year

renewable electricity price([(1980,0)-(2050,25)],(1980.64,17.5439),(2009.76,6.5),(2020,6),(2050,5)) Units: usd15/Mbtu

renewable fuel employment= (waste energy electricity generation+"co-generation energy electricity generation")*biomass conversion jobs Units: Person/Year

Renewable Resource Demand Non Electric in Qdbtu= world renewable resources final consumption inqdbtu-total electricity generation from renewables in qdbtu Units: qdbtu/Year

Renewable Resource price per MBTU([(1990,0)-(2005,3)],(1990,1.7),(1991,1.75),(1992,1.66),(1993,1.58),(1994,1.5),(1995,1.42),(1996,1.53),(1997,1.42),(1998,1.5),(1999,1.6),(2000,1.9)) Units: usd15/Mbtu

Renewable Resources Demand in Qdbtu= world renewable resources final consumption in mb/QDBTU to MB(Time) Units: qdbtu/Year

renewable resources demand supply balance= Renewable Resources Demand in Qdbtu/Renewable Resources Production in QDBTU Units: Dmnl

Renewable Resources Energy Market Share= world biofuel production in qdbtu/total energy production Units: Dmnl

renewable resources GHG emission coefficient= 30 Units: Ton/Tj

Renewable Resources price= Renewable Resource price per MBTU(Time)/gdp deflator Units: usd15/Mbtu

Renewable Resources Price Substitutability= DELAY N((Relative Renewable Resources Price/Relative Weighted Average Energy Price), 1,1, 1) Units: Dmnl

Renewable Resources Production in QDBTU= total renewable energy production in qdbtu Units: qdbtu/Year

Renewable Resources Production non electric in QDBTU= nonhydro renewable energy production in qdbtu-nonhydro renewable energy for electricity generaetion in qdbtu Units: qdbtu/Year

renewable water supply= total water internally produced-surface evaporation Units: Km3/Year

renewables and waste co2 emission= renewables and waste energy consumption ag*CO2 EMISSION FACTORS[natural gas]*ktoe to mtoe Units: mtoe/Year

renewables and waste energy consumption ag= (agriculture renewable resources demand*QDBTU to MB(Time))/ktoe to MB Units: ktoe/Year

required arable land= total population*arable land per capita-additional agricultural land able to be reforested Units: Ha

required change in arable land= ((required arable land-Arable Land)/arable land adjustment time) Units: Ha/Year

required change in pasture land= (required pasture land-Pasture Land)/pasture land adjustment time Units: Ha/Year

required pasture land= (total population*pasture land per capita) Units: Ha

required settlement land= total population*required settlement land per capita Units: Ha

required settlement land adjustment= (required settlement land-Settlement Land)/settlement land adjustment time Units: Ha/Year

required settlement land per capita= WITH LOOKUP (Time, ([(2001,0.01)-(2023,0.02)],(2001,0.013),(2002,0.013),(2003,0.013),(2004,0.013),(2005,0.013),(2006,0.012),(2007,0.012),(2008,0.012),(2009,0.012),(2010,0.012),(2011,0.012),(2012,0.012),(2013,0.012),(2014,0.012),(2015,0.011),(2016,0.011),(2017,0.011),(2018,0.011),(2019,0.011),(2020,0.011),(2021,0.011),(2022,0.011),(2023,0.011))) Units: Ha/Person

Research and development= SMOOTH N(Research and development time series(Time)+research and development investment , 5, Research and development time series (Time), 1) Units: usd15/Year

research and development investment= agriculture green investment*research and development investment fraction(Time) Units: usd15/Year

research and development investment fraction([(2011,0)-(2050,1)],(2011,0.25),(2050,0.25)) Units: Dmnl

Research and development time series([(1970,0)-(2020,2e+010)],(1970,5e+009),(1971,5e+009),(1972,5e+009),(1973,5e+009),(1974,5e+009),(1975,6e+009),(1976,6e+009),(1977,6e+009),(1978,7e+009),(1979,7e+009),(1980,7e+009),(1981,7e+009),(1982,7e+009),(1983,7e+009),(1984,8e+009),(1985,8e+009),(1986,8e+009),(1987,7e+009),(1988,8e+009),(1989,8e+009),(1990,8e+009),(1991,8e+009),(1992,8e+009),(1993,8e+009),(1994,8e+009),(1995,9e+009),(1996,8e+009),(1997,9e+009),(1998,9e+009),(2019.39,1.23684e+010)) Units: usd15/Year

reserve addition= 0 Units: MB/Year

RESERVE ADDITION YEAR= 2020 Units: Year

reservoir capacity= DELAY N(desired reservois capacity, time to adjust reservoirs capacity , desired reservois capacity , 3) Units: Km3

reservoirs area= (water in reservoirs/average depth of reservoirs)/squared KILOmeters per hectare Units: Ha

reservoirs evaporation= reservoirs area*temperature*evaporation per hectare per degree per year Units: Km3/Year

reservoirs potential supply= water in reservoirs/time to empty reservoir Units: Km3/Year

reservoirs recharge= if then else(surface water>0,dESIRED reservoirs RECHARGE/time to fill reservoirs ,0) Units: Km3/Year

reservoirs use= min(non surface water use,reservoirs potential supply) Units: Km3/Year

residential coal demand= DELAY N((indicated residential coal demand 0*Coal Price Substitutability^ residential elasticity of coal demand to coal price), time to adapt demand to price changes 0, (indicated residential coal demand 0 *Coal Price Substitutability^residential elasticity of coal demand to coal price), 3) Units: qdbtu/Year

residential coal gdp intensity= normalized residential coal demand/real gross domestic product Units: qdbtu/usd15

residential elasticity of coal demand to coal price= -0.025 Units: Dmnl

residential elasticity of coal demand to price= 1 Units: Dmnl

residential elasticity of customers to gdp= 0.42 Units: Dmnl

residential elasticity of electricity demand to electricity price= -0.05 Units: Dmnl

residential elasticity of electricity to gdp= 0.5 Units: Dmnl

residential elasticity of natural gas demand to natural gas price= -0.05 Units: Dmnl

Residential Elasticity of natural gas demand to price= 0.43 Units: Dmnl

Residential Elasticity of oil demand to price= 0.5 Units: Dmnl

residential elasticity of petroleum demand to petroleum price= -0.01 Units: Dmnl

residential elasticity of renewable resources demand to renewable resources price = -0.025 Units: Dmnl

residential Elasticity of renewale resources demand to price= 0.2 Units: Dmnl

residential elasticity of units to price= 0 Units: Dmnl

residential electricity customers= initial residential electricity customers*relative total population*relative gdp ^residential elasticity of customers to gdp Units: customers

residential electricity demand= DELAY N((indicated residential electricity net demand 0*Electricity Price Substitutability ^residential elasticity of electricity demand to electricity price), time to adapt demand to price changes 0,(indicated residential electricity net demand 0 *Electricity Price Substitutability ^residential elasticity of electricity demand to electricity price), 3) Units: qdbtu/Year

residential electricity GDP Intensity= normalized residential electricity net demand/real gross domestic product Units: qdbtu/usd15

residential energy conservation([(2000,0)-(2050,2)],(2000,1),(2007,1),(2010,1),(2020,1),(2030,1),(2050,1)) Units: Dmnl

residential energy efficiency= relative energy efficiency*residential energy conservation(Time) Units: Dmnl

residential natural gas demand= DELAY N((indicated residential natural gas demand 0*Natural Gas Price Substitutability ^residential elasticity of natural gas demand to natural gas price), time to adapt demand to price changes 0,(indicated residential natural gas demand 0 *Natural Gas Price Substitutability ^ residential elasticity of natural gas demand to natural gas price), 3) Units: qdbtu/Year

residential natural gas GDP Intensity= normalized residential natural gas demand/real gross domestic product Units: qdbtu/usd15

residential petroleum demand= DELAY N((indicated residential petroleum demand 0*Oil Price Substitutability ^residential elasticity of petroleum demand to petroleum price), time to adapt demand to price changes 0,(indicated residential petroleum demand 0 *Oil Price Substitutability^residential elasticity of petroleum demand to petroleum price), 3) Units: qdbtu/Year

residential petroleum gdp intensity= normalized residential petroleum demand/real gross domestic product Units: qdbtu/usd15

"residential pm2.5 emissions Index"= ZIDZ("household pm2.5 emissions","initial residential pm2.5 emissions for 2016") Units: 1

residential power demand= ((residential electricity customers*average residential power units per customer)/KWH to gwh)*(1-efficiency factor power generation) Units: GWh/Year

residential renewable resources demand= DELAY N((indicated residential renewable resources demand 0*Renewable Resources Price Substitutability ^residential elasticity of renewable resources demand to renewable resources price), time to adapt demand to price changes 0, (indicated residential renewable resources demand 0 *Renewable Resources Price Substitutability ^ residential elasticity of renewable resources demand to renewable resources price), 3) Units: qdbtu/Year

residential renewable resources GDP intensity= normalized residential renewable resources demand/real gross domestic product Units: qdbtu/usd15

residual forest investment to energy= if then else(indicated green economy investment fraction=0, 0, forestry green investment -TOTAL FOREST INVESTMENT) Units: usd15/Year

residual fuel oil emission factor= 77400 Units: Kg/Tj

residual industry production= initial industry production*relative capital industry^industry capital elasticity *relative employment industry^(1-industry capital elasticity)*total factor productivity industry Units: usd15/Year

residual investment from waste= waste green investment-cost of recyclying green investment Units: USD/Year

residual LFG= LFG*(1-share of LFG for electricity) Units: Cubic Feet/Year

resource addition= 0 Units: MB/Year

RESOURCE ADDITION YEAR= 2010 Units: Year

Reuse of clothing rate= 0.23 Units: Dmnl/Year

Reuse of EVs rate= 0 Units: Dmnl/Year

Reuse of plastic products rate= 0.09 Units: Dmnl/Year

Reuse of vehicle rate= 0.033 Units: Dmnl/Year

reusing of EVs= Reuse of EVs rate*Stock of discarded EVs Units: vehicle/Year

reusing of plastic in landfills[Materials]= if then else(CE policy switch=3:OR:S10 reusing plastic from landfills=3,MAX (0,S10 CE share of material from landfills to be reused HA [Materials](Time)*Material waste from plastic landfilled[Materials]), if then else(CE policy switch=2:OR:S10 reusing plastic from landfills=2,MAX (0,S10 CE share of material from landfills to be reused CA [Materials](Time)*Material waste from plastic landfilled[Materials]),if then else (CE policy switch=1:OR:S10 reusing plastic from landfills=1,MAX(0,S10 CE share of material from landfills to be reused LA [Materials](Time)*Material waste from plastic landfilled[Materials]),0))) Units: Ton/Year

reusing of used clothing= if then else(CE policy switch=3:OR:S4 CE clothing reuse policy=3,MAX(0,Stock of discarded clothing *S4 CE reuse of clothing rate HA (Time)),if then else(CE policy switch=2:OR:S4 CE clothing reuse policy=2,MAX (0,Stock of discarded clothing*S4 CE reuse of clothing rate CA (Time)),if then else(CE policy switch=1:OR:S4 CE clothing reuse policy=1,MAX (0,Stock of discarded clothing*S4 CE reuse of clothing rate LA (Time)),MAX(0,Stock of discarded clothing*Reuse of clothing rate)))) Units: Ton/Year

reusing of used plastic= if then else(CE policy switch=3:OR:S4 CE plastic reuse policy=3,MAX(0,Stock of discarded plastic *S4 CE reuse of plastic rate HA (Time)),if then else(CE policy switch=2:OR:S4 CE plastic reuse policy=2,MAX (0,Stock of discarded plastic*S4 CE reuse of plastic rate CA (Time)),if then else(CE policy switch=1:OR:S4 CE plastic reuse policy=1,MAX (0,Stock of discarded plastic*S4 CE reuse of plastic rate LA (Time)),MAX(0,Stock of discarded plastic*Reuse of plastic products rate)))) Units: Ton/Year

reusing of used vehicles= if then else(CE policy switch=3:OR:S4 CE reusing of vehicles switch=3,MAX(0,Stock of discarded vehicles *S4 CE reuse of vehicle rate HA(Time)),if then else(CE policy switch=2:OR: S4 CE reusing of vehicles switch=2,MAX(0,Stock of discarded vehicles *S4 CE reuse of vehicle rate CA(Time)),if then else(CE policy switch=1:OR: S4 CE reusing of vehicles switch=1,MAX(0,Stock of discarded vehicles *S4 CE reuse of vehicle rate LA(Time)),MAX(0,Stock of discarded vehicles*Reuse of vehicle rate)))) Units: vehicle/Year

right saturation point= 76 Units: Year

ROW A= (world oil demand-ROW Perceived present condition)/Time to Perceive Perceived Present condition Units: MB/(Year*Year)

ROW Adjustment for Expected Growth in Demand= (ROW Trend)*Effective World Oil Recoverable Reserves Units: MB/Year

ROW Adjustment of Total Recoverable Resources Remaining= (ROW Required Total Recoverable Resources for Production-Effective World Oil Recoverable Reserves)/Time to Adjust Reserves Units: MB/Year

ROW available production years= Effective World Oil Recoverable Reserves/ROW Desired Recoverable Oil Units: Year

ROW B= (ROW Reference Trend-ROW Trend)/Time to Perceive Trend Units: 1/(Year*Year)

ROW C= (ROW Perceived present condition-ROW Reference Condition)/TERC Units: MB/(Year*Year)

row demand supply balance= (world oil demand)/(World Oil Potential Production) Units: Dmnl

ROW desired available oil ratio effect on price= MAX(0.5,Row Reference Year Production/ROW available production years) Units: Dmnl

ROW Desired Recoverable Oil= world oil demand+ROW Adjustment of Total Recoverable Resources Remaining+ROW Adjustment for Expected Growth in Demand Units: MB/Year

ROW Effect of Oil Demand Supply Balance on Price= (relative world oil demand supply balance^ELASTICITY OF OIL PRICE TO DEMAND SUPPLY BALANCE) Units: Dmnl

ROW Elasticity of Oil Price to Availability of Resource= 0.15 Units: Dmnl

ROW Elasticity of oil Price to supply demand balance= if then else (world oil demand supply balance<1, 0.7, 3) Units: Dmnl

row Gas demand supply balance= (natural gas demand*(1+Gas World Trend)^5)/(World Natural Gas Potential Production *(1+ROW Gas Potential Production Trend)^5) Units: Dmnl

ROW Gas Initial Trend Potential Production= 0.01 Units: 1/Year

ROW Gas Potential Production A= (World Natural Gas Potential Production-ROW Gas Potential Production Perceived present condition)/Time to Perceive Perceived Present condition Units: BCF/(Year*Year)

ROW Gas Potential Production B= (ROW Gas Potential Production Reference Trend-ROW Gas Potential Production Trend)/Time to Perceive Trend Units: 1/(Year*Year)

ROW Gas Potential Production C= (ROW Gas Potential Production Perceived present condition-ROW Gas Potential Production Reference Condition)/TERC Units: BCF/(Year*Year)

ROW Gas Potential Production Perceived present condition= INTEG (ROW Gas Potential Production A, World Natural Gas Potential Production/(1+Time to Perceive Perceived Present condition *ROW Gas Initial Trend Potential Production)) Units: BCF/Year

ROW Gas Potential Production Reference Condition= INTEG (ROW Gas Potential Production C, ROW Gas Potential Production Perceived present condition/(1+TERC*ROW Gas Initial Trend Potential Production)) Units: BCF/Year

ROW Gas Potential Production Reference Trend= (ROW Gas Potential Production Perceived present condition-ROW Gas Potential Production Reference Condition)/(ROW Gas Potential Production Reference Condition*TERC) Units: 1/Year

ROW Gas Potential Production Trend= INTEG (ROW Gas Potential Production B, ROW Gas Initial Trend Potential Production) Units: 1/Year

ROW initial Oil Price= INITIAL(real oil price) Units: usd15/Barrel

ROW Initial Trend Demand= 0.01 Units: 1/Year

ROW Initial Trend Potential Production= 0.01 Units: 1/Year

ROW Oil Actual Recoverable Reserves Demand Ratio= World Oil Recoverable Reserves/Effective ROW oil demand Units: Year

ROW Oil Actual Recoverable Reserves Production Ratio= World Oil Recoverable Reserves/World Oil Production rate Units: Year

ROW Oil Actual Reserves Demand Ratio= Indicated World Oil Potential Production from Reserves/Effective ROW oil demand Units: Dmnl

ROW Oil Actual Reserves Production Ratio= Effective world oil potential production from reserves/World Oil Production rate Units: Dmnl

ROW Perceived present condition= INTEG (ROW A, 22169) Units: MB/Year

ROW Potential Production A= (World Oil Potential Production-ROW Potential Production Perceived present condition)/Time to Perceive Perceived Present condition Units: MB/(Year*Year)

ROW Potential Production B= (ROW Potential Production Reference Trend-ROW Potential Production Trend)/ Time to Perceive Trend Units: 1/(Year*Year)

ROW Potential Production C= (ROW Potential Production Perceived present condition-ROW Potential Production Reference Condition)/TERC Units: MB/(Year*Year)

ROW Potential Production Perceived present condition= INTEG (ROW Potential Production A, World Oil Potential Production/(1+Time to Perceive Perceived Present condition *ROW Initial Trend Potential Production)) Units: MB/Year

ROW Potential Production Reference Condition= INTEG (ROW Potential Production C, ROW Potential Production Perceived present condition/(1+TERC*ROW Initial Trend Potential Production)) Units: MB/Year

ROW Potential Production Reference Trend= (ROW Potential Production Perceived present condition-ROW Potential Production Reference Condition)/(ROW Potential Production Reference Condition*TERC) Units: 1/Year

ROW Potential Production Trend= INTEG (ROW Potential Production B, ROW Initial Trend Potential Production) Units: 1/Year

ROW Reference Condition= INTEG (ROW C, ROW Perceived present condition/(1+TERC*ROW Initial Trend Demand)) Units: MB/Year

ROW Reference Trend= (ROW Perceived present condition-ROW Reference Condition)/(ROW Reference Condition *TERC) Units: 1/Year

Row Reference Year Production= INITIAL(ROW available production years) Units: Year

ROW Required Total Recoverable Resources for Production= Reference Reserve Production Ratio*world oil demand Units: MB

ROW Trend= INTEG (ROW B, ROW Initial Trend Demand) Units: 1/Year

rural built up area= Settlement Land-URBAN built up area Units: Ha

RURAL GDP= real gross domestic product-URBAN GDP Units: usd15/Year

RURAL POPULATION= total population-URBAN population Units: Person

RURUAL UNDER FIVE MORTALITY RATE= (under five mortality rate*2)-URBAN UNDER FIVE MORTALITY RATE Units: Dmnl

S1 CE curtailing demand policy= 0 Units: Dmnl/Year

S1 CE curtailing demand policy building= 0 Units: Dmnl/Year

S1 CE curtailing demand policy clothing= 0 Units: Dmnl/Year

S1 CE curtailing demand policy plastic= 0 Units: Dmnl/Year

S1 reduction in building demand CA([(2000,0)-(2050,0.3)],(2000,0),(2026,0),(2030,0.0025),(2040,0.0195),(2050, 0.05),(2060,0.1)) Units: Dmnl

S1 reduction in building demand HA([(2000,0)-(2050,0.3)],(2000,0),(2026,0),(2030,0.005),(2040,0.035),(2050,0.1),(2060,0.2)) Units: Dmnl

S1 reduction in building demand LA([(2000,0)-(2050,0.3)],(2000,0),(2026,0),(2030,0.00125),(2040,0.009),(2050, 0.025),(2060,0.05)) Units: Dmnl

S1 reduction in clothing demand CA([(2000,0)-(2050,0.3)],(2000,0),(2026,0),(2030,0.01),(2040,0.035),(2050,0.1)) Units: Dmnl

S1 reduction in clothing demand HA([(2000,0)-(2050,0.3)],(2000,0),(2026,0),(2030,0.02),(2040,0.075),(2050,0.2)) Units: Dmnl

S1 reduction in clothing demand LA([(2000,0)-(2050,0.3)],(2000,0),(2026,0),(2030,0.005),(2040,0.0175),(2050,0.05)) Units: Dmnl

S1 reduction in plastic demand CA([(2000,0)-(2040,0.5)],(2000,0),(2026,0),(2030,0.01),(2040,0.02)) Units: Dmnl

S1 reduction in plastic demand HA([(2000,0)-(2040,0.5)],(2000,0),(2026,0),(2030,0.02),(2040,0.04)) Units: Dmnl

S1 reduction in plastic demand LA([(2000,0)-(2040,0.5)],(2000,0),(2026,0),(2030,0.005),(2040,0.01)) Units: Dmnl

S1 reduction in vehicle demand CE CA([(2000,0)-(2050,0.3)],(2000,0),(2026,0),(2030,0.01),(2040,0.09),(2050,0.15)) Units: Dmnl

S1 reduction in vehicle demand CE HA([(2000,0)-(2050,0.3)],(2000,0),(2026,0),(2030,0.015),(2040,0.12),(2050,0.2)) Units: Dmnl

S1 reduction in vehicle demand CE LA([(2000,0)-(2050,0.3)],(2000,0),(2026,0),(2030,0.005),(2040,0.06),(2050,0.1)) Units: Dmnl

S10 CE share of material from landfills to be reused CA[metallic minerals material]([(2000,0.6)-(2020,0.7)],(2000,0),(2026,0),(2050,0.1)) S10 CE share of material from landfills to be reused CA[non metallic mineral material]([(2000,0.6)-(2020,0.7)],(2000,0),(2026,0),(2050,0.2)) S10 CE share of material from landfills to be reused CA[fossil fuel material]([(2024,0)-(2040,0.7)],(2024,0),(2026,0),(2050,0.2)) S10

CE share of material from landfills to be reused CA[biomass material]([(2000,0.6)-(2020,0.7)],(2000,0),(2026,0),(2050,0.2)) Units: Dmnl/Year

S10 CE share of material from landfills to be reused HA[metallic minerals material]([(2000,0.6)-(2020,0.7)],(2000,0),(2026,0),(2050,0.2)) S10 CE share of material from landfills to be reused HA[non metallic mineral material]([(2000,0.6)-(2020,0.7)],(2000,0),(2026,0),(2050,0.2)) S10 CE share of material from landfills to be reused HA[fossil fuel material]([(2024,0)-(2040,0.7)],(2024,0),(2026,0),(2050,0.2)) S10 CE share of material from landfills to be reused HA[biomass material]([(2000,0.6)-(2020,0.7)],(2000,0),(2026,0),(2050,0.2)) Units: Dmnl/Year

S10 CE share of material from landfills to be reused LA[metallic minerals material]([(2000,0.6)-(2020,0.7)],(2000,0),(2026,0),(2050,0.05)) S10 CE share of material from landfills to be reused LA[non metallic mineral material]([(2000,0.6)-(2020,0.7)],(2000,0),(2026,0),(2050,0.2)) S10 CE share of material from landfills to be reused LA[fossil fuel material]([(2024,0)-(2040,0.7)],(2024,0),(2026,0),(2050,0.2)) S10 CE share of material from landfills to be reused LA[biomass material]([(2000,0.6)-(2020,0.7)],(2000,0),(2026,0),(2050,0.2)) Units: Dmnl/Year

S10 recovery of materials for manufacturing CA= WITH LOOKUP (Time, ([(2000,0)-(2050,0.2)],(2000,0),(2026,0),(2050,0.08))) Units: Dmnl/Year

S10 recovery of materials for manufacturing HA= WITH LOOKUP (Time, ([(2000,0)-(2050,0.2)],(2000,0),(2026,0),(2050,0.12))) Units: Dmnl/Year

S10 recovery of materials for manufacturing LA= WITH LOOKUP (Time, ([(2000,0)-(2050,0.2)],(2000,0),(2026,0),(2050,0.04))) Units: Dmnl/Year

S10 recovery switch= 0 Units: Dmnl

S10 reusing plastic from landfills= 0 Units: Dmnl

S2 CE additional lifetime for building CA([(2000,0.9)-(2060,2)],(2000,1),(2026,1),(2030,1.01),(2040,1.1),(2060,1.7)) Units: Year

S2 CE additional lifetime for building HA([(2000,0.9)-(2060,2)],(2000,1),(2026,1),(2030,1.02),(2040,1.3),(2060,1.9)) Units: Year

S2 CE additional lifetime for building LA([(2000,0.9)-(2060,2)],(2000,1),(2026,1),(2030,1.005),(2040,1.05),(2060,1.5)) Units: Year

S2 CE additional lifetime for clothing CA([(2000,0)-(2050,2)],(2000,1),(2026,1),(2040,1.025),(2050,1.1)) Units: Year

S2 CE additional lifetime for clothing HA([(2000,0)-(2050,2)],(2000,1),(2026,1),(2040,1.05),(2050,1.15)) Units: Year

S2 CE additional lifetime for clothing LA([(2000,0)-(2050,2)],(2000,1),(2026,1),(2040,1.0125),(2050,1.05)) Units: Year

S2 CE additional lifetime for platic CA([(2000,0)-(2050,2)],(2000,1),(2026,1),(2040,1.12)) Units: Year

S2 CE additional lifetime for platic HA([(2000,0)-(2050,2)],(2000,1),(2026,1),(2040,1.17)) Units: Year

S2 CE additional lifetime for platic LA([(2000,0)-(2050,2)],(2000,1),(2026,1),(2040,1.07)) Units: Year

S2 lifetime for plastic switch= 0 Units: Dmnl

S3 additional energy efficiency gains in clothing production CA= 0.022 Units: Dmnl/Year

S3 additional energy efficiency gains in clothing production HA= 0.044 Units: Dmnl/Year

S3 additional energy efficiency gains in clothing production LA= 0.011 Units: Dmnl/Year

S3 additional energy efficiency gains in construction CA= 0.022 Units: Dmnl/Year

S3 additional energy efficiency gains in construction LA= 0.011 Units: Dmnl/Year

S3 additional energy efficiency gains in plastic production CA= 0.022 Units: Dmnl/Year

S3 additional energy efficiency gains in plastic production HA= 0.044 Units: Dmnl/Year

S3 additional energy efficiency gains in plastic production LA= 0.011 Units: Dmnl/Year

S3 additional energy efficiency gains in vehicle production CA= 0.022 Units: Dmnl/Year

S3 additional energy efficiency gains in vehicle production HA= 0.044 Units: Dmnl/Year

S3 additional energy efficiency gains in vehicle production LA= 0.011 Units: Dmnl/Year

S3 additional energy efficiency gains inconstruction HA= 0.044 Units: Dmnl/Year

S3 Additional material efficiency gains CA= WITH LOOKUP (Time, ([(2000,1)-(2026,2)],(2000,0),(2026,0),(2027,0.0105))) Units: Dmnl/Year

S3 Additional material efficiency gains HA= WITH LOOKUP (Time, ([(2000,1)-(2026,2)],(2000,0),(2026,0),(2027,0.0135))) Units: Dmnl/Year

S3 Additional material efficiency gains in building CA= WITH LOOKUP (Time, ([(2000,1)-(2026,2)],(2000,0),(2026,0),(2027,0.0105))) Units: Dmnl/Year

S3 Additional material efficiency gains in building HA= WITH LOOKUP (Time, ([(2000,1)-(2026,2)],(2000,0),(2026,0),(2027,0.0135))) Units: Dmnl/Year

S3 Additional material efficiency gains in building LA= WITH LOOKUP (Time, ([(2000,1)-(2026,2)],(2000,0),(2026,0),(2027,0.0025))) Units: Dmnl/Year

S3 Additional material efficiency gains in clothing production CA= WITH LOOKUP (Time, ([(2000,1)-(2026,2)],(2000,0),(2026,0),(2027,0.0105))) Units: Dmnl/Year

S3 Additional material efficiency gains in clothing production HA= WITH LOOKUP (Time, ([(2000,1)-(2026,2)],(2000,0),(2026,0),(2027,0.0135))) Units: Dmnl/Year

S3 Additional material efficiency gains in clothing production LA= WITH LOOKUP (Time, ([(2000,1)-(2026,2)],(2000,0),(2026,0),(2027,0.0025))) Units: Dmnl/Year

S3 Additional material efficiency gains in plastic production CA= WITH LOOKUP (Time, ([(2000,1)-(2026,2)],(2000,0),(2026,0),(2027,0.0105))) Units: Dmnl/Year

S3 Additional material efficiency gains in plastic production HA= WITH LOOKUP (Time, ([(2000,1)-(2026,2)],(2000,0),(2026,0),(2027,0.0135))) Units: Dmnl/Year

S3 Additional material efficiency gains in plastic production LA= WITH LOOKUP (Time, ([(2000,1)-(2026,2)],(2000,0),(2024,0),(2025,0.0025))) Units: Dmnl/Year

S3 Additional material efficiency gains LA= WITH LOOKUP (Time, ([(2000,1)-(2026,2)],(2000,0),(2026,0),(2027,0.005))) Units: Dmnl/Year

S3 CE energy efficiency building switch= 0 Units: Dmnl

S3 CE energy efficiency clothing switch= 0 Units: Dmnl

S3 CE energy efficiency plastic switch= 0 Units: Dmnl

S3 CE energy efficiency vehicle switch= 0 Units: Dmnl

S3 CE increased investment into public transport= 0 Units: Dmnl

S3 CE less intensive use of floor space= 0 Units: Dmnl/Year

S3 CE material efficiency building switch= Master Material efficiency switch Units: Dmnl/Year

S3 CE material efficiency clothing switch= Master Material efficiency switch Units: Dmnl/Year

S3 CE material efficiency plastic switch= Master Material efficiency switch Units: Dmnl/Year

S3 CE material efficiency vehicle switch= Master Material efficiency switch Units: Dmnl/Year

S3 energy efficiency SWITCH= 0 Units: Dmnl

S3 less intense use of floor space CA([(2000,0)-(2060,0.3)],(2000,0),(2026,0),(2030,0.0025),(2040,0.015),(2050,0.0375),(2060,0.1)) Units: Dmnl

S3 less intensive use of floor space HA([(2000,0)-(2060,0.3)],(2000,0),(2026,0),(2030,0.005),(2040,0.03),(2050,0.075),(2060,0.2)) Units: Dmnl

S3 less intensive use of floor space LA([(2000,0)-(2060,0.3)],(2000,0),(2026,0),(2030,0.00125),(2040,0.0075),(2050 ,0.0195),(2060,0.05)) Units: Dmnl

S3 reduction in vehicle demand from public transport CE CA([(2000,0)-(2050,0.5)],(2000,0),(2026,0),(2050,0.4)) Units: Dmnl

S3 reduction in vehicle demand from public transport CE HA([(2000,0)-(2050,0.5)],(2000,0),(2026,0),(2050,0.4)) Units: Dmnl

S3 reduction in vehicle demand from public transport CE LA([(2000,0)-(2050,0.5)],(2000,0),(2026,0),(2050,0.4)) Units: Dmnl

S3 transition to cotton CA([(2000,0)-(2050,0.3)],(2000,0),(2026,0),(2050,0.8)) Units: Dmnl

S3 transition to cotton HA([(2000,0)-(2050,0.3)],(2000,0),(2026,0),(2050,1)) Units: Dmnl

S3 transition to cotton LA([(2000,0)-(2050,0.3)],(2000,0),(2026,0),(2050,0.6)) Units: Dmnl

S3 transitioning to cotton= 0 Units: Dmnl/Year

S4 CE building refurbishing policy= 0 Units: Dmnl

S4 CE clothing reuse policy= 0 Units: Dmnl

S4 CE plastic reuse policy= 0 Units: Dmnl

S4 CE refurbishing of buildings CA([(1970,0)-(2050,0.5)],(1970,0),(2026,0),(2050,0.02)) Units: Dmnl/Year

S4 CE refurbishing of buildings HA([(1970,0)-(2050,0.5)],(1970,0),(2026,0),(2050,0.03)) Units: Dmnl/Year

S4 CE refurbishing of buildings LA([(1970,0)-(2050,0.5)],(1970,0),(2026,0),(2050,0.01)) Units: Dmnl/Year

S4 CE reuse of clothing rate CA([(1970,0)-(2050,0.5)],(1970,0.23),(2026,0.23),(2040,0.3),(2050,0.4)) Units: Dmnl/Year

S4 CE reuse of clothing rate HA([(1970,0)-(2050,0.5)],(1970,0.23),(2026,0.23),(2040,0.35),(2050,0.5)) Units: Dmnl/Year

S4 CE reuse of clothing rate LA([(1970,0)-(2050,0.5)],(1970,0.23),(2026,0.23),(2040,0.25),(2050,0.3)) Units: Dmnl/Year

S4 CE reuse of plastic rate CA([(1970,0)-(2050,0.5)],(1970,0.09),(2026,0.09),(2040,0.15),(2050,0.6)) Units: Dmnl/Year

S4 CE reuse of plastic rate HA([(1970,0)-(2050,0.5)],(1970,0.09),(2026,0.09),(2040,0.25),(2050,0.8)) Units: Dmnl/Year

S4 CE reuse of plastic rate LA([(1970,0)-(2050,0.5)],(1970,0.09),(2026,0.09),(2040,0.1),(2050,0.4)) Units: Dmnl/Year

S4 CE reuse of vehicle rate CA([(1970,0)-(2050,0.5)],(1970,0.033),(2025,0.033),(2030,0.04),(2040,0.05),(2050 ,0.183)) Units: Dmnl/Year

S4 CE reuse of vehicle rate HA([(1970,0)-(2050,0.5)],(1970,0.033),(2025,0.033),(2030,0.04),(2040,0.1),(2050 ,0.283)) Units: Dmnl/Year

S4 CE reuse of vehicle rate LA([(1970,0)-(2050,0.5)],(1970,0.033),(2025,0.033),(2030,0.033),(2040,0.04),(2050,0.083)) Units: Dmnl/Year

S4 CE reusing of vehicles switch= 0 Units: Dmnl

S9 CE share of material waste from clothing to be recycled CA[metallic minerals material]([(2000,0.6)-(2020,0.9)],(2000,0.07),(2026,0.07),(2050,0.3)) S9 CE share of material waste from clothing to be recycled CA[non metallic mineral material]([(2000,0.6)-(2020,0.9)],(2000,0.07),(2026,0.07),(2050,0.3)) S9 CE share of material waste from clothing to be recycled CA[fossil fuel material]([(2000,0.6)-(2020,0.9)],(2000,0.07),(2026,0.07),(2050,0.3)) S9 CE share of material waste from clothing to be recycled CA[biomass material]([(2000,0.6)-(2020,0.9)],(2000,0.07),(2026,0.07),(2050,0.3)) Units: Dmnl/Year

S9 CE share of material waste from clothing to be recycled HA[metallic minerals material]([(2000,0.6)-(2020,0.9)],(2000,0.07),(2026,0.07),(2050,0.45)) S9 CE share of material waste from clothing to be recycled HA[non metallic mineral material]([(2000,0.6)-(2020,0.9)],(2000,0.07),(2026,0.07),(2050,0.45)) S9 CE share of material waste from clothing to be recycled HA[fossil fuel material]([(2000,0.6)-(2020,0.9)],(2000,0.07),(2026,0.07),(2050,0.45)) S9 CE share of material waste from clothing to be recycled HA[biomass material]([(2000,0.6)-(2020,0.9)],(2000,0.07),(2026,0.07),(2050,0.45)) Units: Dmnl/Year

S9 CE share of material waste from clothing to be recycled LA[metallic minerals material]([(2000,0.6)-(2020,0.9)],(2000,0.07),(2026,0.07),(2050,0.15)) S9 CE share of material waste from clothing to be recycled LA[non metallic mineral material]([(2000,0.6)-(2020,0.9)],(2000,0.07),(2026,0.07),(2050,0.15)) S9 CE share of material waste from clothing to be recycled LA[fossil fuel material]([(2000,0.6)-(2020,0.9)],(2000,0.07),(2026,0.07),(2050,0.15)) S9 CE share of material waste from clothing to be recycled LA[biomass material]([(2000,0.6)-(2020,0.9)],(2000,0.07),(2026,0.07),(2050,0.15)) Units: Dmnl/Year

S9 CE share of material waste from vehicles to be recycled CA[metallic minerals material]([(2000,0.6)-(2020,0.9)],(2000,0.9),(2026,0.9),(2050,0.9)) S9 CE share of material waste from vehicles to be recycled CA[non metallic mineral material]([(2000,0.6)-(2020,0.7)],(2000,0.2),(2026,0.2),(2050,0.75)) S9 CE share of material waste from vehicles to be recycled CA[fossil fuel material]([(2000,0.6)-(2020,0.7)],(2000,0.25),(2026,0.25),(2050,0.75)) S9 CE share of material waste from vehicles to be recycled CA[biomass material]([(2000,0.6)-(2020,0.7)],(2000,0.05),(2026,0.05),(2050,0.75)) Units: Dmnl/Year

S9 CE share of material waste from vehicles to be recycled HA[metallic minerals material]([(2000,0.6)-(2020,0.9)],(2000,0.9),(2026,0.9),(2050,0.95)) S9 CE share of material waste from vehicles to be recycled HA[non metallic mineral material]([(2000,0.6)-(2020,0.7)],(2000,0.2),(2026,0.2),(2050,0.95)) S9 CE share of material waste from vehicles to be recycled HA[fossil fuel material]([(2000,0.6)-(2020,0.7)],(2000,0.25),(2026,0.25),(2050,0.95)) S9 CE share of material waste from vehicles to be recycled HA[biomass material]([(2000,0.6)-(2020,0.7)],(2000,0.05),(2026,0.05),(2050,0.95)) Units: Dmnl/Year

S9 CE share of material waste from vehicles to be recycled LA[metallic minerals material]([(2000,0.6)-(2020,0.9)],(2000,0.9),(2026,0.9),(2050,0.9)) S9 CE share of material waste from vehicles to be recycled LA[non metallic mineral material]([(2000,0.6)-(2020,0.7)],(2000,0.2),(2026,0.2),(2050,0.55)) S9 CE share of material waste from vehicles to be recycled LA[fossil fuel material]([(2000,0.6)-(2020,0.7)],(2000,0.25),(2026,0.25),(2050,0.55)) S9 CE share of material waste from vehicles to be recycled LA[biomass material]([(2000,0.6)-(2020,0.7)],(2000,0.05),(2026,0.05),(2050,0.55)) Units: Dmnl/Year

S9 S10 CE share of material from clothing waste to be reused CA[metallic minerals material]([(2000,0.6)-(2020,0.7)],(2000,0.12),(2026,0.12),(2050,0.4)) S9 S10 CE share of material from clothing waste to be reused CA[non metallic mineral material]([(2000,0.6)-(2020,0.7)],(2000,0.12),(2026,0.12),(2050,0.4)) S9 S10 CE share of material from clothing waste to be reused CA[fossil fuel material]([(2000,0.6)-(2020,0.7)],(2000,0),(2026,0),(2050,0.4)) S9 S10 CE share of material from clothing waste to be reused CA[biomass material]([(2000,0.6)-(2020,0.7)],(2000,0.12),(2026,0.12),(2050,0.4)) Units: Dmnl/Year

S9 S10 CE share of material from clothing waste to be reused HA[metallic minerals material]([(2000,0.6)-(2020,0.7)],(2000,0.12),(2026,0.12),(2050,0.55)) S9 S10 CE share of material from clothing waste to be reused HA[non metallic mineral material]([(2000,0.6)-(2020,0.7)],(2000,0.12),(2026,0.12),(2050,0.55)) S9 S10 CE share of material from clothing waste to be reused HA[fossil fuel material]([(2000,0.6)-(2020,0.7)],(2000,0),(2026,0),(2050,0.55)) S9 S10 CE share of material from clothing waste to be reused HA[biomass material]([(2000,0.6)-(2020,0.7)],(2000,0.12),(2026,0.12),(2050,0.55)) Units: Dmnl/Year

S9 S10 CE share of material from clothing waste to be reused LA[metallic minerals material]([(2000,0.6)-(2020,0.7)],(2000,0.12),(2026,0.12),(2050,0.2)) S9 S10 CE share of material from clothing waste to be reused LA[non metallic mineral material]([(2000,0.6)-(2020,0.7)],(2000,0.12),(2026,0.12),(2050,0.2)) S9 S10 CE share of material from clothing waste to be reused LA[fossil fuel material]([(2000,0.6)-(2020,0.7)],(2000,0),(2026,0),(2050,0.2)) S9 S10 CE share of material from clothing waste to be reused LA[biomass material]([(2000,0.6)-(2020,0.7)],(2000,0.12),(2026,0.12),(2050,0.2)) Units: Dmnl/Year

S9 S10 CE share of material from vehicles waste to be reused CA[metallic minerals material]([(2000,0.6)-(2020,0.7)],(2000,0.1),(2026,0.1),(2050,0.1)) S9 S10 CE share of material from vehicles waste to be reused CA[non metallic mineral material]([(2000,0.6)-(2020,0.7)],(2000,0.05),(2026,0.05)) S9 S10 CE share of material from vehicles waste to be reused CA[fossil fuel material]([(2000,0.6)-(2020,0.7)],(2000,0.05),(2026,0.05)) S9 S10 CE share of material from vehicles waste to be reused CA[biomass material]([(2000,0.6)-(2020,0.7)],(2000,0.1),(2026,0.1)) Units: Dmnl/Year

S9 S10 CE share of material from vehicles waste to be reused HA[metallic minerals material]([(2000,0.6)-(2020,0.7)],(2000,0.1),(2026,0.1),(2050,0.05)) S9 S10 CE share of material from vehicles waste to be reused HA[non metallic mineral material]([(2000,0.6)-(2020,0.7)],(2000,0.05),(2026,0.05),(2050,0.05)) S9 S10 CE share of material from vehicles waste to be reused HA[fossil fuel material]([(2000,0.6)-(2020,0.7)],(2000,0.05),(2026,0.05),(2050,0.05)) S9 S10 CE share of material from vehicles waste to be reused HA[biomass material]([(2000,0.6)-(2020,0.7)],(2000,0.1),(2026,0.1),(2050,0.05)) Units: Dmnl/Year

S9 S10 CE share of material from vehicles waste to be reused LA[metallic minerals material]([(2000,0.6)-(2020,0.7)],(2000,0.1),(2026,0.1),(2050,0.2)) S9 S10 CE share of material from vehicles waste to be reused LA[non metallic mineral material]([(2000,0.6)-(2020,0.7)],(2000,0.05),(2026,0.05)) S9 S10 CE share of material from vehicles waste to be reused LA[fossil fuel material]([(2000,0.6)-(2020,0.7)],(2000,0.05),(2026,0.05)) S9 S10 CE share of material from vehicles waste to be reused LA[biomass material]([(2000,0.6)-(2020,0.7)],(2000,0.1),(2026,0.1)) Units: Dmnl/Year

S9 S10 CE switch for construction recycling and reuse= 0 Units: Dmnl

S9 S10 recycling and reuse rates= 0 Units: Dmnl

Sale of buildings= DELAY FIXED(Desired stock of buildings-buildings currently in use-Refurbishing houses , time to update CE stock , Desired stock of buildings-buildings currently in use -Refurbishing houses) Units: sqm/Year

Sale of clothing= MAX(0,((Desired stock of clothing-clothing currently in use)/time to update CE stock)-reusing of used clothing) Units: Ton/Year

sale of EVs= Sale of vehicle*(if then else(CE policy switch=3:OR:CE push for EV switch= 3,CE Share of vehicles that are electric POLICY HA ,if then else(CE policy switch=2:OR:CE push for EV switch=2,CE Share of vehicles that are electric POLICY CA ,if then else (CE policy switch=1:OR:CE push for EV switch=1,CE Share of vehicles that are electric POLICY LA ,if then else(IEA NET ZERO SWITCH=1:AND:Time>2027,electrification switch,Share of vehicles that are electric))))) Units: vehicle/Year

Sale of plastic= MAX(0,((Desired stock of plastic-plastic currently in use)/time to update CE stock)-reusing of used plastic) Units: Ton/Year

Sale of vehicle= MAX(0,((Desired ownership for vehicles-Vehicles currently in use)/time to update CE stock)) Units: vehicle/Year

SAVEPER = 1 Units: Year

scenario master switch= LOW IMPACT DEVELOPMENT POLICY SWITCH*0 Units: Dmnl

school age: (AGE 6 - AGE 18)

Scrapping of clothing= MAX(0,Stock of discarded clothing/Time to scrap clothing) Units: Ton/Year

scrapping of EVs= Stock of discarded EVs/Time to scrap vehicles Units: vehicle/Year

Scrapping of plastic= MAX(0,Stock of discarded plastic/Time to scrap plastic) Units: Ton/Year

Scrapping of Vehicles= MAX(0,Stock of discarded vehicles/Time to scrap vehicles) Units: vehicle/Year

SDG ambition on reduction of post harvest losses CA= WITH LOOKUP (Time, ([(2000,0.4)-(2050,1)],(2000,1),(2026,1),(2050,0.7))) Units: Dmnl

SDG ambition on reduction of post harvest losses HA= WITH LOOKUP (Time, ([(2000,0.4)-(2050,1)],(2000,1),(2026,1),(2050,0.5))) Units: Dmnl

SDG ambition on reduction of post harvest losses LA= WITH LOOKUP (Time, ([(2000,0.4)-(2050,1)],(2000,1),(2026,1),(2050,0.9))) Units: Dmnl

SDG ambition on reduction of pre harvest losses CA= WITH LOOKUP (Time, ([(2000,0.4)-(2050,1)],(2000,1),(2026,1),(2050,0.7))) Units: Dmnl

SDG ambition on reduction of pre harvest losses HA= WITH LOOKUP (Time, ([(2000,0.4)-(2050,1)],(2000,1),(2026,1),(2050,0.5))) Units: Dmnl

SDG ambition on reduction of pre harvest losses LA= WITH LOOKUP (Time, ([(2000,0.4)-(2050,1)],(2000,1),(2026,1),(2050,0.9))) Units: Dmnl

second gen employment factor= 1.3e-006 Units: Person/lge

second last income class[IncClass]= if then else(IncClass=(ELMCOUNT(IncClass)-1), 1,0)*income distribution[IncClass] Units: Dmnl

secondary school age: (AGE 13- AGE 19)

secondary student crude death rate[sex]= SUM(deaths[sex, secondary school age!])/SUM(Population[sex, secondary school age !]) Units: Dmnl/Year

sector: INDUSTRY, transport, NONENERGY USE, other energy uses, HOUSEHOLDS

sectoral distribution of employment[employment distribution]= 0.4924,0.0699,0.0199,0.0074,0.2873,0.0024,0.0273,0.0342,0.0509,0.0012 ,0.0068,0.0002,0.0001 Units: Dmnl

sectoral kwh waste supply[energy sectors]= 0 Units: kWh/Year

sectors: agri, ind, serv

segregation cost per ton([(1970,0)-(2010,1000)],(1970,713.5),(2010,900)) Units: USD/Ton

segregation employment factor per ton= 0.00092 Units: Person/Ton

sequestration from growth of biomass= (carbon factor forest*Forest Land)*coefficient for biomass growth Units: Ton

services capital elasticity= 0.41 Units: Dmnl

services capital life= 30 Units: Year

services desired capital labor ratio= SMOOTH N(initial services capital labor ratio*relative average years of schooling ^elasticity of capital labour ration to average years of schooling services *relative average life expectancy^elasticity of capital labour ration to average life expectancy services *relative employment ratio^elasticity of capital

labor ratio to relative employment ratio , time for technology changes to affect average capital labor ratio , initial services capital labor ratio,1) Units: usd15/Person

services employment= INTEG (net change in services employment, initial services employment) Units: Person

services labor demand= (capital services/services desired capital labor ratio) Units: Person

services production= initial services production*relative capital services^services capital elasticity *relative employment services^elasticity of employment*total factor productivity services Units: usd15/Year

Services share of GDP= services production/SUM GDP Units: 1

Settlement Land= INTEG (arable to settlement+Forest to settlement+others to settlement+pasture to settlement , initial Settlement Land) Units: Ha

settlement land adjustment time= 1 Units: Year

"Sewage and refuse disposal, sanitation and similar activities employment"= total employment*sectoral distribution of employment[sds] Units: Person

sex : FEMALE,MALE

sexually active women[AG CHILDBEARING]= Population[FEMALE,AG CHILDBEARING]*(PROPORTION OF WOMEN MARRIED+PROPORTION OF WOMEN HAVING OUT OF WEDLOCK SEX) Units: Person

share of 2 wheel vehicles fuel consumption time series[ethanol]([(1970,0)-(2050,10)],(1970,0.55),(2000,0.55),(2005,1.02),(2010,2.03),(2015 ,1.98),(2020,1.94),(2025,2),(2030,2.02),(2035,2.01),(2040,2),(2045,1.99),(2050 ,1.98)) share of 2 wheel vehicles fuel consumption time series[gasoline power]([(2000,0)-(2050,1000)],(2000,99.45),(2005,98.98),(2010,97.97),(2015,98.02),(2020,98.06),(2025,98),(2030,97.98),(2035,97.99),(2040,98),(2045,98.01), (2050,98.02)) Units: Dmnl

share of 3 wheel vehicles fuel consumption time series[ethanol]([(1970,0)-(2050,10)],(1970,0.01),(2000,0.01),(2005,0.26),(2010,1.21),(2015 ,1.21),(2020,1.21),(2025,1.21),(2030,1.21),(2035,1.21),(2040,1.21),(2045,1.21),(2050,1.21)) share of 3 wheel vehicles fuel consumption time series[gasoline power]([(1970,0)-(2050,1000)],(1970,96),(2000,96.4912),(2005,96.4912),(2010,92.1053),(2015,92.1053),(2020,96.4912),(2025,98.79),(2030,98.79),(2035,98.79),(2040 ,98.79),(2045,98.79),(2050,98.79)) Units: Dmnl

share of agricultural land= agriculturland land wasted/Agricultural Land Units: 1/Year

Share of agriculture land harvested= WITH LOOKUP (Time, ([(1970,0.3)-(2050,0.4)],(1970,0.313227),(1971,0.311539),(1972,0.31216),(1973,0.312102),(1974,0.312091),(1975,0.311661),(1976,0.312438),(1977,0.313067),(1978,0.314654),(1979,0.3151),(1980,0.315058),(1981,0.315209),(1982,0.316695),(1983,0.317175),(1984,0.319849),(1985,0.321755),(1986,0.321461),(1987,0.321429),(1988,0.320807),(1989,0.320421),(1990,0.320546),(1991,0.320712),(1992,0.319699),(1993,0.319723),(1994,0.319282),(1995,0.319369),(1996,0.319255),(1997,0.320037),(1998,0.319894),(1999,0.320435),(2000,0.319929),(2001,0.320205),(2002,0.319936),(2003,0.32107),(2004,0.322158),(2005,0.323439),(2006,0.323474),(2007,0.324105),(2008,0.324636),(2009,0.326603),(2010,0.327531),(2011,0.330163),(2012,0.331575),(2013,0.332476),(2014,0.333291),(2015,0.334764),(2016,0.335187),(2017,0.336094),(2018,0.337149),(2019,0.337257),(2020,0.338649),(2021,0.339291),(2022,0.339368),(2023,0.339562),(2050,0.35))) Units: Dmnl

SHARE OF Biomas ELECTRICITY GENERATION= 0.4 Units: Dmnl

share of biomass cofiring in exisiting plants:= 0 Units: Dmnl

share of building waste collected[metallic minerals material]([(2000,0.6)-(2020,0.7)],(2000,0.35),(2020,0.35)) share of building waste collected[non metallic mineral material]([(2000,0.6)-(2020,0.7)],(2000,0.35),(2020,0.35)) share of building waste collected[fossil fuel material]([(2000,0.6)-(2020,0.7)],(2000,0.35),(2020,0.35)) share of building waste collected[biomass material]([(2000,0.6)-(2020,0.7)],(2000,0.35),(2020,0.35)) Units: Dmnl

share of bus by type[bus]([(2000,0)-(2050,10)],(2000,0.465),(2005,0.4621),(2010,0.4592),(2015,0.4564),(2020,0.4535),(2025,0.4507),(2030,0.4478),(2035,0.4449),(2040,0.4421),(2045,0.4392),(2050,0.4364)) share of bus by type[minibus]([(2000,0)-(2050,10)],(2000,0.535),(2005,0.5379),(2010,0.5408),(2015,0.5436),(2020,0.5465),(2025,0.5493),(2030,0.5522),(2035,0.5551),(2040,0.5579),(2045,0.5608),(2050,0.5636)) Units: Dmnl

SHARE OF BUS TRAVEL= SMOOTH(REFERENCE SHARE OF BUS TRAVEL(Time), 10) Units: Dmnl

share of buses fuel consumption time series[diesel]([(1970,0)-(2050,90)],(1970,79.6491),(2002,77.6316),(2010,77.6316),(2022,80.7018),(2035,81.5789),(2041,83.7719),(2045,83.7719),(2050,85.0877)) share of buses fuel consumption time series[gasoline power]([(2000,0)-(2050,100)],(2000,20.5),(2005,20.5),(2010,20.3),(2015,20.4),(2020,20.4),(2025,20.4),(2030,20.4),(2035,20.4),(2040,20.4),(2045,20.4),(2050,20.4)) share of buses fuel consumption time series[biodiesel]([(2000,0)-(2050,0.0001)],(2000,0),(2005,0),(2010,0),(2015,0),(2020,0),(2025

,0),(2030,0),(2035,0),(2040,0),(2045,0),(2050,0)) share of buses fuel consumption time series[ethanol]([(2000,0)-(2050,10)],(2000,0),(2005,0),(2010,0),(2015,0.002),(2020,0.002),(2025,0.002),(2030,0.002),(2035,0.002),(2040,0.002),(2045,0.002),(2050,0.002)) Units: Dmnl

share of car energy type time series[reg gasoline]([(1970,0)-(2050,1000)],(1970,98.8),(2000,98.8),(2005,98.2),(2010,97.4),(2015,97.4),(2020,97.3),(2025,97.4),(2030,97.4),(2035,97.3),(2040,97.3),(2045,97.3),(2050,97.2)) share of car energy type time series[hybrid gasoline]([(2000,0)-(2050,1000)],(2000,99.5),(2005,98.7),(2010,97.9),(2015,97.7),(2020,97.6),(2025,97.5),(2030,97.4),(2035,97.4),(2040,97.3),(2045,97.3),(2050,97.2)) share of car energy type time series[reg diesel]([(2000,0)-(2050,1000)],(2000,99.9),(2005,99.3),(2010,97.2),(2015,97.2),(2020,97.3),(2025,97.5),(2030,97.7),(2035,97.9),(2040,98.1),(2045,98.3),(2050,98.5)) share of car energy type time series[hybrid diesel]([(2000,0)-(2050,100)],(2000,96.7),(2005,79.2),(2010,24.8),(2015,24.9),(2020,27.5),(2025,20.1),(2030,6.8),(2035,7),(2040,7.2),(2045,7.4),(2050,7.6)) share of car energy type time series[V CNG]([(2000,0)-(2050,100)],(2000,13.6),(2005,13.3),(2010,13),(2015,12.9),(2020,12.6),(2025,13.5),(2030,14.5),(2035,15.7),(2040,16.9),(2045,18.2),(2050,19.5)) share of car energy type time series[V fuel cell]([(2000,0)-(2050,100)],(2000,13.6),(2005,13.3),(2010,13),(2015,12.9),(2020,12.6),(2025,13.5),(2030,14.5),(2035,15.7),(2040,16.9),(2045,18.2),(2050,19.5)) Units: Dmnl

share of car sales by type time series[reg gasoline]([(1970,0)-(2050,10)],(1970,0.8243),(2000,0.824321),(2005,0.808961),(2010,0.794717),(2015,0.796996),(2020,0.798618),(2025,0.800293),(2030,0.8032),(2035,0.804947),(2040,0.805468),(2045,0.804524),(2050,0.801893)) share of car sales by type time series[hybrid gasoline]([(1970,0)-(2050,0.1)],(1970,0.0006548),(2000,0.000654849),(2005,0.00210512),(2010,0.00358878),(2015,0.00541686),(2020,0.00723272),(2025,0.00846065),(2030,0.00977146),(2035,0.0106685),(2040,0.0115631),(2045,0.0124572),(2050,0.0133528)) share of car sales by type time series[reg diesel]([(1970,0)-(2050,0.2)],(1970,0.1589),(2000,0.158936),(4050,0.172996),(6100,0.185879),(8150,0.18255),(10200,0.179925),(12250,0.177787),(14300,0.174378),(16350,0.172511),(18400,0.171898),(20450,0.172765),(22500,0.175317)) share of car sales by type time series[hybrid diesel]([(1970,0)-(2050,0.0001)],(1970,1e-005),(2000,1e-005),(2005,1e-005),(2010, 1e-005),(2015,1e-005),(2020,1e-005),(2025,1e-005),(2030,1e-005),(2035,1e-005),(2040,1e-005),(2045,1e-005),(2050,1e-005)) share of car sales by type time series[V CNG]([(1970,0)-(2050,0.1)],(1970,0.01607),(2000,0.0160683),(2005,0.0159177),(2010,0.015705),(2015,0.0149274),(2020,0.0141142),(2025,0.0133496),(2030,0.0125401

),(2035,0.0117638),(2040,0.0109606),(2045,0.0101436),(2050,0.00932694)) share of car sales by type time series[V fuel cell]([(1970,0)-(2050,0.001)],(1970,1e-005),(2000,1e-005),(2005,1e-005),(2010,0.0001
),(2015,0.0001),(2020,0.0001),(2025,0.0001),(2030,0.0001),(2035,0.0001),(2040
,0.0001),(2045,0.0001),(2050,0.0001)) Units: Dmnl/Year

SHARE OF CAR TRAVEL= REFERENCE SHARE OF CAR TRAVEL(Time) Units: Dmnl

share of car travel reduction to buses= 0.15 Units: Dmnl

share of cars that are EVs= EVs in use/Vehicles currently in use Units: 1

share of CE impacted sectors in total GDP= CE impacted industry production/real gross domestic product Units: 1

share of CE in industry production= CE impacted industry production/industry production Units: 1

share of clothing waste collected[metallic minerals material]([(2000,0.6)-(2020,0.7)],(2000,0.2),(2020,0.2)) share of clothing waste collected[non metallic mineral material]([(2000,0.6)-(2020,0.7)],(2000,0.2),(2020,0.2)) share of clothing waste collected[fossil fuel material]([(2000,0.6)-(2020,0.7)],(2000,0.2),(2020,0.2)) share of clothing waste collected[biomass material]([(2000,0.6)-(2020,0.7)],(2000,0.2),(2020,0.2)) Units: Dmnl

share of energy consumption by heavy truck energy type tABLE[gasoline power] = share of energy consumption by heavy truck energy type time series[gasoline power](Time) share of energy consumption by heavy truck energy type tABLE[ethanol]= share of energy consumption by heavy truck energy type time series[ethanol](Time) share of energy consumption by heavy truck energy type tABLE[diesel]= share of energy consumption by heavy truck energy type time series[diesel] (Time) share of energy consumption by heavy truck energy type tABLE[biodiesel]= share of energy consumption by heavy truck energy type time series[biodiesel](Time) share of energy consumption by heavy truck energy type tABLE[hydrogen]= 1-share of energy consumption by heavy truck energy type tABLE[gasoline power]-share of energy consumption by heavy truck energy type tABLE [diesel]-share of energy consumption by heavy truck energy type tABLE[biodiesel]-share of energy consumption by heavy truck energy type tABLE [ethanol] Units: Dmnl

share of energy consumption by heavy truck energy type time series[gasoline power]([(1970,0)-(2050,10)],(1970,0.001),(2000,0.001),(2005,0.001),(2010,0.001),(
2015,0.001),(2020,0.001),(2025,0.001),(2030,0.001),(2035,0.001),(2040,0.001
),(2045,0.001),(2050,0.001)) share of energy consumption by heavy truck energy type time series[ethanol]([(2000,0)-
(2050,10)],(2000,0),(2005,0),(2010,0),(2015,0),(2020,0),(2025,0

),(2030,0),(2035,0),(2040,0),(2045,0),(2050,0)) share of energy consumption by heavy truck energy type time series[diesel]([(2000,0)-(2050,10)],(2000,0.999),(2005,0.999),(2010,0.999),(2015,0.999),(2020,0.999),(2025,0.999),(2030,0.999),(2035,0.999),(2040,0.999),(2045,0.999),(2050,0.999)) share of energy consumption by heavy truck energy type time series[biodiesel]([(2000,0)-(2050,10)],(2000,0),(2005,0.002),(2010,0.009),(2015,0.009),(2020,0.009),(2025,0.008),(2030,0.008),(2035,0.008),(2040,0.007),(2045,0.007),(2050,0.006)) Units: Dmnl

share of energy consumption by medium truck energy type tABLE[gasoline power]= share of energy consumption by medium truck energy type time series[gasoline power](Time) share of energy consumption by medium truck energy type tABLE[ethanol]= share of energy consumption by medium truck energy type time series[ethanol](Time) share of energy consumption by medium truck energy type tABLE[diesel]= share of energy consumption by medium truck energy type time series[diesel](Time) share of energy consumption by medium truck energy type tABLE[biodiesel]= share of energy consumption by medium truck energy type time series[biodiesel](Time) share of energy consumption by medium truck energy type tABLE[hydrogen]= 1-share of energy consumption by medium truck energy type tABLE[gasoline power]-share of energy consumption by medium truck energy type tABLE [diesel]-share of energy consumption by medium truck energy type tABLE[biodiesel]-share of energy consumption by medium truck energy type tABLE [ethanol] Units: Dmnl

share of energy consumption by medium truck energy type time series[gasoline power]([(2000,0)-(2050,10)],(2000,0.443),(2005,0.443),(2010,0.44),(2015,0.439),(2020,0.44),(2025,0.44),(2030,0.439),(2035,0.438),(2040,0.437),(2045,0.436),(2050 ,0.435)) share of energy consumption by medium truck energy type time series[ethanol] ([(2000,0)-(2050,10)],(2000,0.007),(2005,0.008),(2010,0.01),(2015,0.01),(2020,0.01),(2025,0.01),(2030,0.01),(2035,0.009),(2040,0.009),(2045,0.009),(2050 ,0.009)) share of energy consumption by medium truck energy type time series[diesel]([(2000,0)-(2050,10)],(2000,0.55),(2005,0.548),(2010,0.546),(2015,0.547),(2020,0.547),(2025,0.547),(2030,0.548),(2035,0.549),(2040,0.55),(2045,0.551),(2050,0.553)) share of energy consumption by medium truck energy type time series[biodiesel]([(2000,0)-(2050,10)],(2000,0),(2005,0.001),(2010,0.004),(2015,0.004),(2020,0.004),(2025,0.004),(2030,0.003),(2035,0.003),(2040,0.003),(2045,0.003),(2050,0.003)) Units: Dmnl

share of EV in vehicle stock= EVs in use/Vehicles currently in use Units: Dmnl

share of exports to industrialized countries([(0,0)-(10,10)],(1990,0.381),(1991,0.381),(1992,0.4995),(1993,0.3563),(1994

,0.5523),(1995,0.3877),(1996,0.36),(1997,0.362),(1998,0.411),(1999,0.405),(
2000,0.423),(2001,0.319),(2002,0.402)) Units: Dmnl

share of forest land= Forest Land/total land area Units: Dmnl

SHARE OF FOREST PRODUCT[fuelwood]([(1980,0)-
(2010,10)],(1980,0.450742),(1981,0.461041),(1982,0.472297),(1983
,0.459373),(1984,0.454983),(1985,0.456454),(1986,0.446536),(1987,0.439967),
(1988,0.439127),(1989,0.438431),(1990,0.437959),(1991,0.464368),(1992,0.474851
),(1993,0.477965),(1994,0.478418),(1995,0.476544),(1996,0.482295),(1997,0.479401
),(1998,0.479167),(1999,0.479753),(2000,0.474032),(2001,0.483264),(2002,0.47627
),(2003,0.471024),(2004,0.462715),(2005,0.464271),(2006,0.474874),(2007,0.468914))
SHARE OF FOREST PRODUCT[INDUSTRIALROUNDWOOD]([(1980,0)-
(2010,10)],(1980,0.42544),(1981,0.419355),(1982,0.409899),(1983
,0.420206),(1984,0.42579),(1985,0.423154),(1986,0.431929),(1987,0.436685),
(1988,0.437482),(1989,0.439783),(1990,0.440829),(1991,0.421594),(1992,0.413048
),(1993,0.41133),(1994,0.410738),(1995,0.416068),(1996,0.4108),(1997,0.414145
),(1998,0.415755),(1999,0.41575),(2000,0.424135),(2001,0.413719),(2002,0.418013
),(2003,0.423163),(2004,0.427624),(2005,0.427196),(2006,0.41384),(2007,0.423927))
SHARE OF FOREST PRODUCT[sawnwood]([(1980,0)-
(2010,10)],(1980,0.123819),(1981,0.119604),(1982,0.117804),(1983
,0.120421),(1984,0.119226),(1985,0.120392),(1986,0.121534),(1987,0.123349)
,(1988,0.123391),(1989,0.121786),(1990,0.121212),(1991,0.114039),(1992,0.112101
),(1993,0.110705),(1994,0.110844),(1995,0.107389),(1996,0.106905),(1997,0.106454
),(1998,0.105078),(1999,0.104497),(2000,0.101833),(2001,0.103018),(2002,0.105716
),(2003,0.105813),(2004,0.109661),(2005,0.108533),(2006,0.111286),(2007,0.107159))
Units: Dmnl

share of freight rail fuel consumption time series[diesel]([(1970,0)-
(2050,10)],(1970,0.885),(2000,0.877193),(2005,0.921053),(2010,0.877193
),(2015,0.921053),(2020,0.921053),(2025,0.921053),(2030,0.921053),(2035,0.904
),(2040,0.921053),(2045,0.908),(2050,0.91)) share of freight rail fuel consumption time
series[electricity]([(2000,0)-
(2050,10)],(2000,0.115),(2005,0.111),(2010,0.107),(2015,0.104),
(2020,0.102),(2025,0.1),(2030,0.098),(2035,0.096),(2040,0.094),(2045,0.092
),(2050,0.09)) Units: Dmnl

share of fuel cost for cogeneration power generation= 0.5 Units: Dmnl

share of fuel cost for diesel and fuel oil power generation= 0.8 Units: Dmnl

share of fuel cost for gas turbine power generation= 0.8 Units: Dmnl

share of fuel over diesel oil for electricity generation= 0.97 Units: Dmnl

share of global production that is buildings= real value added from buildings/real gross domestic product Units: 1

share of global production that is clothing= real value added from clothing manufacturing/real gross domestic product Units: 1

share of global production that is plastic= real value added from plastic manufacturing/real gross domestic product Units: 1

share of global production that is vehicles= real value added from vehicle manufacturing/real gross domestic product Units: 1

share of industry production that is buildings= real value added from buildings/industry production Units: 1

share of industry production that is clothing= real value added from clothing manufacturing/industry production Units: 1

share of industry production that is plastic= real value added from plastic manufacturing/industry production Units: 1

share of industry production that is vehicles= real value added from vehicle manufacturing/industry production Units: 1

SHARE OF INTERNATIONAL WATER TRAVEL[diesel]= 0.5 SHARE OF INTERNATIONAL WATER TRAVEL[residual fuel]= 0.5 Units: Dmnl

share of LFG for electricity= 1 Units: Dmnl

Share of material consumption that is waste in building production= 0.0407 Units: Dmnl

Share of material consumption that is waste in clothing production= 0.0166 Units: Dmnl

Share of material consumption that is waste in plastic production= 0.05 Units: Dmnl

Share of material consumption that is waste in vehicle production= WITH LOOKUP (Time, ([(2005,0.03)-(2023,0.05)],(2005,0.0346),(2006,0.0315),(2007,0.0317),(2008 ,0.0339),(2009,0.0322),(2010,0.0327),(2011,0.0339),(2012,0.04),(2013,0.0382),(2014,0.0411),(2015,0.0399),(2016,0.0394),(2017,0.0402),(2018,0.0415),(2019 ,0.0414),(2020,0.0438),(2021,0.0477),(2022,0.0457),(2023,0.0444))) Units: Dmnl

share of material from buildings waste to be reused[Materials]= if then else(CE policy switch=3:OR:S9 S10 CE switch for construction recycling and reuse =3,share of material from buildings waste to be reused HA[Materials](Time), if then else(CE policy switch=2:OR:S9 S10 CE switch for construction recycling and reuse =2,share of material from buildings waste to be reused CA[Materials](Time), if then else(CE policy switch=1:OR:S9 S10 CE switch for construction recycling and reuse =1,share of material

from buildings waste to be reused LA[Materials](Time), share of material from buildings waste to be reused BAU[Materials](Time)))) Units: Dmnl/Year

share of material from buildings waste to be reused BAU[metallic minerals material]([(2000,0.6)-(2020,0.7)],(2000,0.2),(2020,0.2)) share of material from buildings waste to be reused BAU[non metallic mineral material]([(2000,0.6)-(2020,0.7)],(2000,0.2),(2020,0.2)) share of material from buildings waste to be reused BAU[fossil fuel material]([(2000,0.6)-(2020,0.7)],(2000,0.2),(2020,0.2)) share of material from buildings waste to be reused BAU[biomass material]([(2000,0.6)-(2020,0.7)],(2000,0.2),(2020,0.2)) Units: Dmnl/Year

share of material from buildings waste to be reused CA[metallic minerals material]([(2000,0.6)-(2020,0.7)],(2000,0.2),(2026,0.2),(2050,0.25)) share of material from buildings waste to be reused CA[non metallic mineral material]([(2000,0.6)-(2020,0.7)],(2000,0.2),(2026,0.2),(2050,0.25)) share of material from buildings waste to be reused CA[fossil fuel material]([(2000,0.6)-(2020,0.7)],(2000,0.2),(2026,0.2),(2050,0.25)) share of material from buildings waste to be reused CA[biomass material]([(2000,0.6)-(2020,0.7)],(2000,0.2),(2026,0.2),(2050,0.25)) Units: Dmnl/Year

share of material from buildings waste to be reused HA[metallic minerals material]([(2000,0.6)-(2020,0.7)],(2000,0.2),(2026,0.2),(2050,0.2)) share of material from buildings waste to be reused HA[non metallic mineral material]([(2000,0.6)-(2020,0.7)],(2000,0.2),(2026,0.2),(2050,0.2)) share of material from buildings waste to be reused HA[fossil fuel material]([(2000,0.6)-(2020,0.7)],(2000,0.2),(2026,0.2),(2050,0.2)) share of material from buildings waste to be reused HA[biomass material]([(2000,0.6)-(2020,0.7)],(2000,0.2),(2026,0.2),(2050,0.3)) Units: Dmnl/Year

share of material from buildings waste to be reused LA[metallic minerals material]([(2000,0.6)-(2020,0.7)],(2000,0.2),(2026,0.2),(2050,0.2)) share of material from buildings waste to be reused LA[non metallic mineral material]([(2000,0.6)-(2020,0.7)],(2000,0.2),(2026,0.2),(2050,0.2)) share of material from buildings waste to be reused LA[fossil fuel material]([(2000,0.6)-(2020,0.7)],(2000,0.2),(2026,0.2),(2050,0.2)) share of material from buildings waste to be reused LA[biomass material]([(2000,0.6)-(2020,0.7)],(2000,0.2),(2026,0.2),(2050,0.2)) Units: Dmnl/Year

share of material from clothing waste to be reused[metallic minerals material]([(2000,0.6)-(2020,0.7)],(2000,0.12),(2020,0.12)) share of material from clothing waste to be reused[non metallic mineral material]([(2000,0.6)-(2020,0.7)],(2000,0.12),(2020,0.12)) share of material from clothing waste to be reused[fossil fuel material]([(2000,0.6)-(2020,0.7)],(2000,0),(2020,0)) share of material from clothing waste to be reused[biomass material]([(2000,0.6)-(2020,0.7)],(2000,0.12),(2020,0.12)) Units: Dmnl/Year

share of material from plastic waste to be reused[Materials]= if then else(CE policy switch=3:OR:CE policy switch reusing and recycling= 3,plastic reusing HA[Materials],if then else(CE policy switch=2:OR:CE policy switch reusing and recycling =2,plastic reusing CA[Materials],if then else(CE policy switch=1:OR:CE policy switch reusing and recycling =1,plastic reusing LA[Materials],plastic resuing BAU[Materials]))) Units: Dmnl/Year

share of material from plastic waste to be reused BAU[metallic minerals material]([(2000,0.6)-(2020,0.7)],(2000,0),(2026,0)) share of material from plastic waste to be reused BAU[non metallic mineral material]([(2000,0.6)-(2020,0.7)],(2000,0),(2026,0)) share of material from plastic waste to be reused BAU[fossil fuel material] ([(2000,0.6)-(2020,0.7)],(2024,0),(2026,0.098)) share of material from plastic waste to be reused BAU[biomass material]([(2000,0.6)-(2020,0.7)],(2000,0),(2026,0)) Units: Dmnl/Year

share of material from plastic waste to be reused CA[metallic minerals material]([(2000,0.6)-(2020,0.7)],(2000,0),(2026,0),(2040,0.45)) share of material from plastic waste to be reused CA[non metallic mineral material]([(2000,0.6)-(2020,0.7)],(2000,0),(2026,0),(2050,0.45)) share of material from plastic waste to be reused CA[fossil fuel material]([(2000,0.6)-(2020,0.7)],(2024,0),(2026,0.098),(2050,0.45)) share of material from plastic waste to be reused CA[biomass material]([(2000,0.6)-(2020,0.7)],(2000,0),(2026,0),(2050,0.45)) Units: Dmnl/Year

share of material from plastic waste to be reused HA[metallic minerals material]([(2000,0.6)-(2020,0.7)],(2000,0),(2026,0),(2040,0.65),(2050,0.74)) share of material from plastic waste to be reused HA[non metallic mineral material]([(2000,0.6)-(2020,0.7)],(2000,0),(2026,0),(2040,0.65),(2050,0.74)) share of material from plastic waste to be reused HA[fossil fuel material]([(2000,0.6)-(2020,0.7)],(2024,0),(2026,0.098),(2040,0.65),(2050,0.74)) share of material from plastic waste to be reused HA[biomass material]([(2000,0.6)-(2020,0.7)],(2000,0),(2026,0),(2040,0.65),(2050,0.74)) Units: Dmnl/Year

share of material from plastic waste to be reused LA[metallic minerals material]([(2000,0.6)-(2020,0.7)],(2000,0),(2026,0),(2040,0.25)) share of material from plastic waste to be reused LA[non metallic mineral material]([(2000,0.6)-(2020,0.7)],(2000,0),(2026,0),(2050,0.25)) share of material from plastic waste to be reused LA[fossil fuel material]([(2000,0.6)-(2020,0.7)],(2024,0),(2026,0.098),(2050,0.25)) share of material from plastic waste to be reused LA[biomass material]([(2000,0.6)-(2020,0.7)],(2000,0),(2026,0),(2050,0.25)) Units: Dmnl/Year

share of material from vehicles waste to be reused[metallic minerals material]([(2000,0.6)-(2020,0.7)],(2000,0.1),(2020,0.1)) share of material from vehicles waste to be reused[non metallic mineral material]([(2000,0.6)-(2020,0.7)],(2000,0.05),(2020,0.05)) share of material from vehicles waste to be reused[fossil fuel material]([(2000,0.6)-

(2020,0.7)],(2000,0.05),(2020,0.05)) share of material from vehicles waste to be reused[biomass material]([(2000,0.6)-(2020,0.7)],(2000,0.1),(2020,0.1)) Units: Dmnl/Year

share of material waste collected[metallic minerals material]([(2000,0.6)-(2020,0.7)],(2000,0.6),(2020,0.6)) share of material waste collected[non metallic mineral material]([(2000,0.6)-(2020,0.7)],(2000,0.6),(2020,0.6)) share of material waste collected[fossil fuel material]([(2000,0.6)-(2020,0.7)],(2000,0.6),(2020,0.6)) share of material waste collected[biomass material]([(2000,0.6)-(2020,0.7)],(2000,0.6),(2020,0.6)) Units: Dmnl

Share of material waste for buildings[Materials]= 0.05, 0.842, 0.073, 0.035 Units: Dmnl

Share of material waste for clothing[Materials]= 0.02, 0, 0.63, 0.35 Units: Dmnl

Share of material waste for plastic[Materials]= 0, 0, 0.95, 0.05 Units: Dmnl

Share of material waste for vehicles[Materials]= 0.75, 0.075, 0.15, 0.025 Units: Dmnl

share of material waste from buildings to be landfilled[Materials]= MAX(0,(1-share of material from buildings waste to be reused[Materials]-share of material waste from buildings to be recycled [Materials])) Units: 1/Year

share of material waste from buildings to be recycled[Materials]= if then else(CE policy switch=3:OR:S9 S10 CE switch for construction recycling and reuse =3,share of material waste from buildings to be recycled HA[Materials](Time),if then else(CE policy switch=2:OR:S9 S10 CE switch for construction recycling and reuse =2,share of material waste from buildings to be recycled CA[Materials](Time),if then else(CE policy switch=1:OR:S9 S10 CE switch for construction recycling and reuse =1,share of material waste from buildings to be recycled LA[Materials](Time),share of material waste from buildings to be recycled BAU[Materials](Time)))) Units: Dmnl/Year

share of material waste from buildings to be recycled BAU[metallic minerals material]([(2000,0.6)-(2020,0.7)],(2000,0.2),(2020,0.2)) share of material waste from buildings to be recycled BAU[non metallic mineral material]([(2000,0.6)-(2020,0.7)],(2000,0.2),(2020,0.2)) share of material waste from buildings to be recycled BAU[fossil fuel material]([(2000,0.6)-(2020,0.7)],(2000,0.2),(2020,0.2)) share of material waste from buildings to be recycled BAU[biomass material] ([(2000,0.6)-(2020,0.7)],(2000,0.2),(2020,0.2)) Units: Dmnl/Year

share of material waste from buildings to be recycled CA[metallic minerals material]([(2000,0.6)-(2020,0.7)],(2000,0.2),(2026,0.2),(2050,0.5)) share of material waste from buildings to be recycled CA[non metallic mineral material]([(2000,0.6)-(2020,0.7)],(2000,0.2),(2026,0.2),(2050,0.5)) share of material waste from buildings to be recycled CA[fossil fuel material]([(2000,0.6)-(2020,0.7)],(2000,0.2),(2026,0.2),(2050,0.5))

share of material waste from buildings to be recycled CA[biomass material]([(2000,0.6)-(2020,0.7)],(2000,0.2),(2026,0.2),(2050,0.5)) Units: Dmnl/Year

share of material waste from buildings to be recycled HA[metallic minerals material]([(2000,0.6)-(2020,0.7)],(2000,0.2),(2026,0.2),(2050,0.7)) share of material waste from buildings to be recycled HA[non metallic mineral material]([(2000,0.6)-(2020,0.7)],(2000,0.2),(2026,0.2),(2050,0.7)) share of material waste from buildings to be recycled HA[fossil fuel material]([(2000,0.6)-(2020,0.7)],(2000,0.2),(2026,0.2),(2050,0.7)) share of material waste from buildings to be recycled HA[biomass material]([(2000,0.6)-(2020,0.7)],(2000,0.2),(2026,0.2),(2050,0.7)) Units: Dmnl/Year

share of material waste from buildings to be recycled LA[metallic minerals material]([(2000,0.6)-(2020,0.7)],(2000,0.2),(2026,0.2),(2050,0.3)) share of material waste from buildings to be recycled LA[non metallic mineral material]([(2000,0.6)-(2020,0.7)],(2000,0.2),(2026,0.2),(2050,0.3)) share of material waste from buildings to be recycled LA[fossil fuel material]([(2000,0.6)-(2020,0.7)],(2000,0.2),(2026,0.2),(2050,0.3)) share of material waste from buildings to be recycled LA[biomass material]([(2000,0.6)-(2020,0.7)],(2000,0.2),(2026,0.2),(2050,0.3)) Units: Dmnl/Year

share of material waste from clothing to be landfilled[Materials]= MAX(0, (1-if then else(CE policy switch=3:OR:S9 S10 recycling and reuse rates=3,S9 CE share of material waste from clothing to be recycled HA [Materials](Time)+S9 S10 CE share of material from clothing waste to be reused HA [Materials](Time), if then else(CE policy switch=2:OR:S9 S10 recycling and reuse rates=2,S9 CE share of material waste from clothing to be recycled CA [Materials](Time)+S9 S10 CE share of material from clothing waste to be reused CA [Materials](Time), if then else(CE policy switch=1:OR:S9 S10 recycling and reuse rates=1,S9 S10 CE share of material from clothing waste to be reused LA [Materials](Time)+S9 CE share of material waste from clothing to be recycled LA [Materials](Time) ,share of material from clothing waste to be reused[Materials](Time) +share of material waste from clothing to be recycled [Materials](Time)))))) Units: 1/Year

share of material waste from clothing to be recycled[metallic minerals material]([(2000,0.6)-(2020,0.9)],(2000,0.07),(2020,0.07)) share of material waste from clothing to be recycled[non metallic mineral material]([(2000,0.6)-(2020,0.9)],(2000,0.07),(2020,0.07)) share of material waste from clothing to be recycled[fossil fuel material]([(2000,0.6)-(2020,0.9)],(2000,0.07),(2020,0.07)) share of material waste from clothing to be recycled[biomass material]([(2000,0.6)-(2020,0.9)],(2000,0.07),(2020,0.07)) Units: Dmnl/Year

share of material waste from plastic collected[metallic minerals material]([(2000,0.6)-(2020,0.7)],(2000,0.17),(2020,0.17)) share of material waste from plastic collected[non metallic mineral material]([(2000,0.6)-(2020,0.7)],(2000,0.17),(2020,0.17)) share of

material waste from plastic collected[fossil fuel material]([(2000,0.6)-(2020,0.7)],(2000,0.17),(2020,0.17)) share of material waste from plastic collected[biomass material]([(2000,0.6)-(2020,0.7)],(2000,0.17),(2020,0.17)) Units: Dmnl

share of material waste from plastic to be landfilled[Materials]= MAX(0,(1-share of material from plastic waste to be reused[Materials]-share of material waste from plastic to be recycled [Materials])) Units: 1/Year

share of material waste from plastic to be recycled[Materials]= if then else(CE policy switch=3:OR:CE policy switch reusing and recycling= 3,plastic recycling HA[Materials],if then else(CE policy switch=2:OR:CE policy switch reusing and recycling =2,plastic recycling CA[Materials],if then else(CE policy switch=1:OR:CE policy switch reusing and recycling =1,plastic recycling LA[Materials],plastic recycling BAU[Materials]))) Units: Dmnl/Year

share of material waste from plastic to be recycled BAU[metallic minerals material]([(2000,0.6)-(2020,0.9)],(2000,0.09),(2026,0.09)) share of material waste from plastic to be recycled BAU[non metallic mineral material]([(2000,0.6)-(2020,0.9)],(2000,0.09),(2026,0.09)) share of material waste from plastic to be recycled BAU[fossil fuel material]([(2000,0.6)-(2020,0.9)],(2000,0.09),(2026,0.09)) share of material waste from plastic to be recycled BAU[biomass material]([(2000,0.6)-(2020,0.9)],(2000,0.09),(2026,0.09)) Units: Dmnl/Year

share of material waste from plastic to be recycled CA[metallic minerals material]([(2000,0.6)-(2020,0.9)],(2000,0.09),(2026,0.09),(2040,0.12)) share of material waste from plastic to be recycled CA[non metallic mineral material]([(2000,0.6)-(2020,0.9)],(2000,0.09),(2026,0.09),(2050,0.12)) share of material waste from plastic to be recycled CA[fossil fuel material]([(2000,0.6)-(2020,0.9)],(2000,0.09),(2026,0.09),(2050,0.12)) share of material waste from plastic to be recycled CA[biomass material]([(2000,0.6)-(2020,0.9)],(2000,0.09),(2026,0.09),(2050,0.12)) Units: Dmnl/Year

share of material waste from plastic to be recycled HA[metallic minerals material]([(2000,0.6)-(2020,0.9)],(2000,0.09),(2026,0.09),(2040,0.18)) share of material waste from plastic to be recycled HA[non metallic mineral material]([(2000,0.6)-(2020,0.9)],(2000,0.09),(2026,0.09),(2050,0.18)) share of material waste from plastic to be recycled HA[fossil fuel material]([(2000,0.6)-(2020,0.9)],(2000,0.09),(2026,0.09),(2050,0.18)) share of material waste from plastic to be recycled HA[biomass material]([(2000,0.6)-(2020,0.9)],(2000,0.09),(2026,0.09),(2050,0.18)) Units: Dmnl/Year

share of material waste from plastic to be recycled LA[metallic minerals material]([(2000,0.6)-(2020,0.9)],(2000,0.09),(2026,0.09),(2040,0.07)) share of material waste from plastic to be recycled LA[non metallic mineral material]([(2000,0.6)-

(2020,0.9)],(2000,0.09),(2026,0.09),(2050,0.07)) share of material waste from plastic to be recycled LA[fossil fuel material]([(2000,0.6)-(2020,0.9)],(2000,0.09),(2026,0.09),(2050,0.07)) share of material waste from plastic to be recycled LA[biomass material]([(2000,0.6)-(2020,0.9)],(2000,0.09),(2026,0.09),(2050,0.07)) Units: Dmnl/Year

share of material waste from vehicles to be landfilled[Materials]= MAX(0,(1-materials from vehicles to be reused share[Materials]-materials from vehicles to be recycled share [Materials])) Units: 1/Year

share of material waste from vehicles to be recycled[metallic minerals material]([(2000,0.6)-(2020,0.9)],(2000,0.9),(2020,0.9)) share of material waste from vehicles to be recycled[non metallic mineral material]([(2000,0.6)-(2020,0.7)],(2000,0.2),(2020,0.2)) share of material waste from vehicles to be recycled[fossil fuel material]([(2000,0.6)-(2020,0.7)],(2000,0.25),(2020,0.25)) share of material waste from vehicles to be recycled[biomass material]([(2000,0.6)-(2020,0.7)],(2000,0.05),(2020,0.05)) Units: Dmnl/Year

share of minibuses fuel consumption time series[diesel]([(1970,0)-(2050,100)],(1970,33.9),(2000,33.9),(2005,33.9),(2010,34.1),(2015,34),(2020,34),(2025,33.9),(2030,33.8),(2035,33.8),(2040,33.7),(2045,33.7), (2050,33.6)) share of minibuses fuel consumption time series[gasoline power]([(1900,0)-(2050,100)],(1970,66.1),(2000,66.1),(2005,67.1053),(2010,71.0526),(2015,70.1754),(2020,69.7368),(2025,68.8596),(2030,69.2982),(2035,69.2982),(2040,68.8596),(2045,66.3),(2050,66.4)) share of minibuses fuel consumption time series[biodiesel]([(1970,0)-(2050,10)],(1970,0),(2000,0),(2005,0),(2010,0),(2015,0),(2020,0),(2025,0),(2030,0),(2035,0),(2040,0),(2045,0),(2050,0)) share of minibuses fuel consumption time series[ethanol]([(1970,0)-(2050,10)],(1970,0),(2000,0),(2005,0),(2010,0.001),(2015,0.002),(2020,0.002),(2025,0.002),(2030,0.002),(2035,0.002),(2040,0.002),(2045,0.002),(2050,0.002)) Units: Dmnl

"SHARE OF non-recyclers"= 1-share of recyclers Units: Dmnl

share of oil considered for transport= 0.5 Units: Dmnl

share of oil consumption= 0.5 Units: Dmnl

share of passenger rail fuel consumption time series[diesel]([(1970,0)-(2100,10)],(1970,0.454),(2000,0.482456),(2006,0.473684),(2010,0.482456),(2015,0.513158),(2050,0.535088)) share of passenger rail fuel consumption time series[electricity]([(2000,0)-(2050,10)],(2000,0.546),(2005,0.534),(2010,0.523),(2015,0.513),

(2020,0.504),(2025,0.496),(2030,0.487),(2035,0.48),(2040,0.472),(2045,0.465),(2050,0.458)) Units: Dmnl

share of plastics from landfills to be reused CE= 0.2 Units: Dmnl

share of population per gender[FEMALE]= SUM(Population[FEMALE, age!])/SUM(Population[sex!, age!]) share of population per gender [MALE]= 1-share of population per gender[FEMALE] Units: Dmnl

share of re= (biomass and waste+other renewables+hydro)/total primary energy demand Units: Dmnl

share of recyclers= INTEG (addition to share-reduction in share, initial share of recyclers) Units: Dmnl

share of renewable generation= (electricity generation rate[nuclear]+electricity generation rate[BIOMASS] +electricity generation rate[HYDROPOWER LARGE SCALE]+electricity generation rate [HYDROPOWER SMALL SCALE]+electricity generation rate[SOLAR LARGE SCALE]+electricity generation rate [SOLAR SMALL SCALE]+electricity generation rate[WIND ONSHORE]+electricity generation rate [WIND OFFSHORE]+electricity generation rate[WASTE GENERATION]+electricity generation rate [GEOTHERMAL])/SUM(electricity generation rate[power generation technology!]) Units: 1

share of selected coal power plants for bimass cofiring:= 0 Units: Dmnl

share of treated wastewater reused= initial share of treated wastewater reused*relative pc disposable income^elasticity of treated wastewater reused to water availability Units: Dmnl

share of truck by type[medium truck]([(2000,0)-(2050,10)],(2000,0.6274),(2005,0.6292),(2010,0.631),(2015,0.6332),(2020,0.6357),(2025,0.6375),(2030,0.6391),(2035,0.6405),(2040,0.6418),(2045,0.643),(2050,0.6441)) share of truck by type[heavy truck]([(2000,0)-(2050,10)],(2000,0.3726),(2005,0.3708),(2010,0.369),(2015,0.3668),(2020,0.3643),(2025,0.3625),(2030,0.3609),(2035,0.3595),(2040,0.3582),(2045,0.357),(2050,0.3559)) Units: Dmnl

SHARE OF TRUCK TRAVEL= REFERENCE SHARE OF TRUCK TRAVEL(Time) Units: Dmnl

share of usable waste for LFG= if then else(landfill gas power capacity use>0, 0.3, 0.3) Units: Dmnl

share of vehicle by type[two wheel]([(2000,0)-(2050,10)],(2000,0.9678),(2005,0.9719),(2010,0.976),(2015,0.9788),(2020,0.9813),(2025,0.983),(2030,0.9846),(2035,0.9858),(2040,0.987),(2045

,0.9881),(2050,0.9892)) share of vehicle by type[three wheel]([(2000,0)-(2050,0.1)],(2000,0.0322),(2005,0.0281),(2010,0.024),(2015,0.0212),(2020,0.0187),(2025,0.017),(2030,0.0154),(2035,0.0142),(2040,0.013),(2045,0.0119),(2050,0.0108)) Units: Dmnl

SHARE OF VEHICLE TRAVEL= REFERENCE SHARE OF VEHICLE TRAVEL(Time) Units: Dmnl

Share of vehicles that are electric= WITH LOOKUP (Time, ([(2000,0)-(2050,0.9)],(2000,0),(2010,0.000103641),(2011,0.000480633),(2012,0.00076257),(2013,0.00132533),(2014,0.00230425),(2015,0.0044356),(2016,0.0064484),(2017,0.0103191),(2018,0.0160557),(2019,0.0163463),(2020,0.0245651),(2021,0.0500259),(2022,0.0826564),(2023,0.107933),(2024,0.123832),(2050,0.2))) Units: Dmnl

Share of waste per material in building production[Materials]= 0.05, 0.842, 0.073, 0.035 Units: Dmnl

Share of waste per material in clothing production[Materials]= 0.01,0.01,0.68,0.3 Units: Dmnl

Share of waste per material in plastic production[Materials]= 0,0,0.96,0.04 Units: Dmnl

Share of waste per material in vehicle production[Materials]= 0.75,0.07,0.15,0.03 Units: Dmnl

share of yield[Cereals]([(1970,0)-(2010,10)],(1970,0.417738),(1971,0.439846),(1972,0.432812),(1973,0.434489),(1974,0.43078),(1975,0.434961),(1976,0.450653),(1977,0.442381),(1978,0.453853),(1979,0.443071),(1980,0.45016),(1981,0.457553),(1982,0.458684),(1983,0.444835),(1984,0.458732),(1985,0.461302),(1986,0.456307),(1987,0.443994),(1988,0.435854),(1989,0.449715),(1990,0.457622),(1991,0.448825),(1992,0.452868),(1993,0.435256),(1994,0.43982),(1995,0.424141),(1996,0.436962),(1997,0.437131),(1998,0.430385),(1999,0.419548),(2000,0.4081),(2001,0.410296),(2002,0.395409),(2003,0.396763),(2004,0.410278),(2005,0.404789),(2006,0.398392),(2007,0.407494))
share of yield[FibreCrops]([(1970,0)-(2010,0.1)],(1970,0.00614177),(1971,0.00610629),(1972,0.00655713),(1973,0.00639882),(1974,0.00623772),(1975,0.00564613),(1976,0.00531899),(1977,0.00589611),(1978,0.00550264),(1979,0.00563634),(1980,0.00565243),(1981,0.00583504),(1982,0.0054269),(1983,0.00536448),(1984,0.00607215),(1985,0.00652162),(1986,0.00543819),(1987,0.00569615),(1988,0.00603519),(1989,0.00539795),(1990,0.00561049),(1991,0.00621791),(1992,0.00535977),(1993,0.00491527),(1994,0.00523947),(1995,0.00545665),(1996,0.00518101),(1997,0.00508151),(1998,0.00469038),(1999,0.00458779),(2000,0.00460892),(2001,0.00509839),(2002,0.00469885),(2003,0.00469096),(2004,0.00533284),(2005,0.0053394),(2006,0.0053405),(2007

,0.00528628)) share of yield[VegetablesandFruit]([(1970,0)-
(2010,0.4)],(1970,0.171735),(1971,0.170812),(1972,0.171612),(1973
,0.171388),(1974,0.176406),(1975,0.177646),(1976,0.173707),(1977,0.173444)
,(1978,0.1716),(1979,0.179826),(1980,0.182379),(1981,0.178803),(1982,0.183901
),(1983,0.186942),(1984,0.182289),(1985,0.182871),(1986,0.189931),(1987,0.194341
),(1988,0.198235),(1989,0.193871),(1990,0.191404),(1991,0.194701),(1992,0.198859
),(1993,0.206678),(1994,0.209786),(1995,0.217929),(1996,0.216739),(1997,0.221306
),(1998,0.223693),(1999,0.233609),(2000,0.242125),(2001,0.244291),(2002,0.252226
),(2003,0.254074),(2004,0.246805),(2005,0.249548),(2006,0.256737),(2007,0.253645))
share of yield[Oilcrops]([(1970,0)-
(2010,0.1)],(1970,0.0122391),(1971,0.0124467),(1972,0.0123035),
(1973,0.0126546),(1974,0.0125425),(1975,0.0133034),(1976,0.0120633),(1977,
0.0135496),(1978,0.0134791),(1979,0.0146182),(1980,0.0143127),(1981,0.0148961
),(1982,0.0153075),(1983,0.0144214),(1984,0.0151109),(1985,0.0162848),(1986
,0.0160229),(1987,0.016926),(1988,0.0171392),(1989,0.0173431),(1990,0.0176697
),(1991,0.018369),(1992,0.0180734),(1993,0.0182645),(1994,0.019833),(1995,
0.020513),(1996,0.0196899),(1997,0.0204476),(1998,0.021181),(1999,0.0219618
),(2000,0.0218091),(2001,0.0219567),(2002,0.0223875),(2003,0.0235901),(2004
,0.0242546),(2005,0.0255834),(2006,0.0262316),(2007,0.0257838)) share of
yield[Pulses]([(1970,0)-
(2010,0.1)],(1970,0.0153652),(1971,0.0144407),(1972,0.0143058),
(1973,0.0135224),(1974,0.0139908),(1975,0.0129231),(1976,0.0137699),(1977,
0.0129609),(1978,0.012729),(1979,0.0118341),(1980,0.0118614),(1981,0.0116733
),(1982,0.0123439),(1983,0.0130822),(1984,0.0127987),(1985,0.0127826),(1986
,0.0129947),(1987,0.0135456),(1988,0.014014),(1989,0.0133922),(1990,0.0138371
),(1991,0.0130762),(1992,0.0118071),(1993,0.0126281),(1994,0.0127214),(1995
,0.0124892),(1996,0.0113475),(1997,0.0114753),(1998,0.0115993),(1999,0.0115559
),(2000,0.0110016),(2001,0.010905),(2002,0.011181),(2003,0.0111966),(2004,
0.0107207),(2005,0.0107547),(2006,0.0106351),(2007,0.0096782)) share of
yield[RootsandTubers]([(1970,0)-
(2010,0.3)],(1970,0.196019),(1971,0.179105),(1972,0.177489),(1973
,0.18677),(1974,0.178138),(1975,0.174154),(1976,0.166215),(1977,0.170452),
(1978,0.168021),(1979,0.165685),(1980,0.151734),(1981,0.151563),(1982,0.147366
),(1983,0.150262),(1984,0.148453),(1985,0.14216),(1986,0.140367),(1987,0.143725
),(1988,0.141887),(1989,0.139642),(1990,0.134536),(1991,0.137629),(1992,0.138542
),(1993,0.146388),(1994,0.136319),(1995,0.140747),(1996,0.139053),(1997,0.132662
),(1998,0.134519),(1999,0.135362),(2000,0.138721),(2001,0.133868),(2002,0.135954
),(2003,0.132564),(2004,0.131274),(2005,0.12869),(2006,0.124229),(2007,0.120897))
share of yield[Treenuts]([(1970,0)-
(2010,0.01)],(1970,0.00110802),(1971,0.00101094),(1972,0.00106909
),(1973,0.00107307),(1974,0.0010764),(1975,0.0010882),(1976,0.00104462),(1977
,0.00102911),(1978,0.00101381),(1979,0.00100023),(1980,0.00100434),(1981,0.001147

95),(1982,0.0010203),(1983,0.0010422),(1984,0.00101267),(1985,0.0010147),(1986
,0.000999622),(1987,0.00109351),(1988,0.00113598),(1989,0.00116361),(1990,
0.00111338),(1991,0.00121243),(1992,0.0012234),(1993,0.00124563),(1994,0.0013018
1),(1995,0.00124635),(1996,0.00126969),(1997,0.00138362),(1998,0.00129542),
(1999,0.00150847),(2000,0.00146033),(2001,0.00152848),(2002,0.00167239),(2003
,0.00167151),(2004,0.00164151),(2005,0.00179949),(2006,0.00189073),(2007,0.001878
94)) share of yield[Meat]([(1970,0)-
(2010,0.1)],(1970,0.0352625),(1971,0.0354744),(1972,0.0370641),
(1973,0.0347505),(1974,0.037034),(1975,0.0370438),(1976,0.0365397),(1977,0.037245
3),(1978,0.0365741),(1979,0.0382474),(1980,0.0397117),(1981,0.0390582),(1982
,0.0381232),(1983,0.0397346),(1984,0.0383671),(1985,0.0391339),(1986,0.0397984
),(1987,0.0413566),(1988,0.0432151),(1989,0.0418208),(1990,0.0422482),(1991
,0.0440397),(1992,0.0434884),(1993,0.0444538),(1994,0.0451971),(1995,0.0463027
),(1996,0.0439124),(1997,0.0451823),(1998,0.0464168),(1999,0.0462839),(2000
,0.0464662),(2001,0.0462742),(2002,0.0476101),(2003,0.0473141),(2004,0.0458914
),(2005,0.0469206),(2006,0.0471233),(2007,0.046643)) share of yield[Milk]([(1970,0)-
(2010,0.4)],(1970,0.137241),(1971,0.133614),(1972,0.139305),(1973
,0.131909),(1974,0.136476),(1975,0.135799),(1976,0.133406),(1977,0.135519)
,(1978,0.129816),(1979,0.13242),(1980,0.135223),(1981,0.131616),(1982,0.130029
),(1983,0.136299),(1984,0.129261),(1985,0.129694),(1986,0.129774),(1987,0.130669
),(1988,0.133396),(1989,0.128928),(1990,0.127156),(1991,0.12663),(1992,0.120653
),(1993,0.120735),(1994,0.11971),(1995,0.120697),(1996,0.115314),(1997,0.11487
),(1998,0.115516),(1999,0.114772),(2000,0.114762),(2001,0.1148),(2002,0.117609
),(2003,0.116966),(2004,0.113044),(2005,0.115659),(2006,0.118362),(2007,0.117706))
share of yield[Egg]([(1970,0)-
(2010,0.04)],(1970,0.00715067),(1971,0.00714386),(1972,0.00748351
),(1973,0.00704436),(1974,0.00731913),(1975,0.00743563),(1976,0.00728223),
(1977,0.0075228),(1978,0.00741105),(1979,0.00766115),(1980,0.00796159),(1981
,0.00785456),(1982,0.00779783),(1983,0.00801649),(1984,0.00790412),(1985,0.008235
39),(1986,0.00836767),(1987,0.0086529),(1988,0.00908829),(1989,0.008726),(1990
,0.00880242),(1991,0.00929959),(1992,0.00912513),(1993,0.00943618),(1994,0.010073
1),(1995,0.0104774),(1996,0.0105323),(1997,0.0104601),(1998,0.0107037),(1999
,0.010812),(2000,0.0109459),(2001,0.0109822),(2002,0.0112529),(2003,0.0111697
),(2004,0.0107579),(2005,0.0109157),(2006,0.0110583),(2007,0.010989)) Units: Dmnl

share recycling= 0.195113 Units: Dmnl

sinus for covid impacts= if then else (Time >2019.9, SIN(2*pi*Time/cycle time)+1,
1)*sinus reduction table Units: Dmnl

sinus reduction table= WITH LOOKUP (Time, ([(2020,0.4)-(2024,1)],(2020,1),(2022,0.2)))
Units: Dmnl

skill level employment per building[High]([(2000,0)-(2050,0.04)],(2000,0.0354327),(2001,0.0358314),(2002,0.0346718),(2003,0.0325347),(2004,0.0297626),(2005,0.0277849),(2006,0.0261902),(2007,0.0233262),(2008,0.0218729),(2009,0.0236635),(2010,0.0220965),(2011,0.0202534),(2012,0.0201849),(2013,0.0196498),(2014,0.0195551),(2015,0.0209518),(2016,0.0212629),(2017,0.0205628),(2018,0.0194849),(2019,0.0195149),(2020,0.0204314),(2021,0.0173483),(2022,0.0172498),(2023,0.0168786),(2024,0.0161923),(2050,0.00676701)) skill level employment per building[Middle]([(2000,0)-(2050,0.09)],(2000,0.0839801),(2001,0.0852603),(2002,0.0830437),(2003,0.0790611),(2004,0.0739476),(2005,0.0696275),(2006,0.065297),(2007,0.0574232),(2008,0.0535459),(2009,0.0576094),(2010,0.0532455),(2011,0.0492203),(2012,0.0486052),(2013,0.047119),(2014,0.0465445),(2015,0.0486243),(2016,0.0488496),(2017,0.0496718),(2018,0.0466123),(2019,0.046378),(2020,0.048297),(2021,0.0405983),(2022,0.0404247),(2023,0.0395859),(2024,0.0380049),(2050,0.0158828)) skill level employment per building[Low]([(2000,0)-(2050,0.2)],(2000,0.109623),(2001,0.109631),(2002,0.105352),(2003,0.0986325),(2004,0.0895923),(2005,0.0822379),(2006,0.0755849),(2007,0.064917),(2008,0.0597155),(2009,0.0637734),(2010,0.0573588),(2011,0.0510148),(2012,0.0487629),(2013,0.0459139),(2014,0.0442146),(2015,0.0449193),(2016,0.044605),(2017,0.043733),(2018,0.0404103),(2019,0.0404271),(2020,0.042126),(2021,0.0350496),(2022,0.0343181),(2023,0.0330603),(2024,0.0312318),(2050,0.0130523)) Units: people/building

skill level employment per clothing[High]([(2000,0)-(2050,0.7)],(2000,0.585738),(2001,0.626872),(2002,0.611998),(2003,0.597928),(2004,0.553161),(2005,0.520074),(2006,0.499528),(2007,0.449505),(2008,0.421879),(2009,0.473731),(2010,0.444625),(2011,0.412892),(2012,0.409604),(2013,0.425102),(2014,0.435404),(2015,0.481781),(2016,0.474693),(2017,0.459451),(2018,0.441172),(2019,0.46148),(2020,0.477266),(2021,0.419865),(2022,0.374904),(2050,0.226432)) skill level employment per clothing[Middle]([(2000,0)-(2050,2)],(2000,1.57422),(2001,1.70546),(2002,1.69184),(2003,1.68395),(2004,1.59851),(2005,1.53475),(2006,1.4767),(2007,1.30752),(2008,1.20933),(2009,1.30625),(2010,1.19585),(2011,1.11897),(2012,1.08642),(2013,1.11538),(2014,1.13869),(2015,1.23047),(2016,1.20569),(2017,1.15769),(2018,1.11108),(2019,1.16013),(2020,1.20307),(2021,1.06803),(2022,0.956509),(2050,0.580951)) skill level employment per clothing[Low]([(2000,0)-(2050,3)],(2000,2.6045),(2001,2.77386),(2002,2.66923),(2003,2.60243),(2004,2.37902),(2005,2.22599),(2006,2.08394),(2007,1.80135),(2008,1.66548),(2009,1.81278),(2010,1.63258),(2011,1.44851),(2012,1.35681),(2013,1.36526),(2014,1.35315),(2015,1.43899),(2016,1.38756),(2017,1.32548),(2018,1.24163),(2019,1.30865),(2020,1.35329),(2021,1.16765),(2022,1.0242),(2050,0.595256)) Units: people/Ton

skill level employment per plastic[High]([(2000,0.002)-(2024,0.005)],(2000,0.00429637),(2001,0.00409634),(2002,0.00386302),(2003,0.00380662),(2004,0.00374364),(2005,0.0036599),(2006,0.00341249),(2007,0.00328061),(2008,0.00351758),(2009,0.00332815),(2010,0.00333241),(2011,0.00312185),(2012,0.00309317),(2013,0.00302843),(2014,0.00297069),(2015,0.00289242),(2016,0.00278413),(2017,0.00281569),(2018,0.00290677),(2019,0.00277596),(2020,0.00269323),(2021,0.0028746),(2022,0.00280651),(2023,0.00277035),(2024,0.00273223)) skill level employment per plastic[Middle]([(2000,0.005)-(2024,0.01)],(2000,0.00964297),(2001,0.00931133),(2002,0.00883749),(2003,0.00881423),(2004,0.00869291),(2005,0.00860135),(2006,0.00785804),(2007,0.00749475),(2008,0.00807772),(2009,0.00740594),(2010,0.00726387),(2011,0.00675691),(2012,0.0066521),(2013,0.00656841),(2014,0.00638211),(2015,0.00608907),(2016,0.00574842),(2017,0.0059067),(2018,0.00614894),(2019,0.00586458),(2020,0.00569168),(2021,0.00608624),(2022,0.00594363),(2023,0.00585674),(2024,0.00577149)) skill level employment per plastic[Low]([(2000,0)-(2024,0.02)],(2000,0.0110181),(2001,0.0107313),(2002,0.0100661),(2003,0.0100347),(2004,0.00982628),(2005,0.00955008),(2006,0.00859971),(2007,0.00818815),(2008,0.00896138),(2009,0.00837758),(2010,0.00821532),(2011,0.00718578),(2012,0.00685753),(2013,0.00655096),(2014,0.00628144),(2015,0.00591654),(2016,0.0054267),(2017,0.00543053),(2018,0.00551429),(2019,0.00520063),(2020,0.00498633),(2021,0.00527574),(2022,0.00511087),(2023,0.0049867),(2024,0.00486989)) Units: people/Ton

skill level employment per vehicle[High]([(2000,0.1)-(2024,0.3)],(2000,0.171118),(2001,0.170404),(2002,0.173302),(2003,0.178145),(2004,0.179462),(2005,0.182342),(2006,0.185228),(2007,0.189131),(2008,0.184913),(2009,0.184355),(2010,0.191673),(2011,0.191246),(2012,0.194819),(2013,0.196808),(2014,0.203356),(2015,0.211591),(2016,0.21191),(2017,0.211963),(2018,0.20996),(2019,0.210211),(2020,0.239239),(2021,0.216595),(2022,0.231774),(2023,0.235873),(2024,0.233949)) skill level employment per vehicle[Middle]([(2000,0.3)-(2024,0.6)],(2000,0.349186),(2001,0.352076),(2002,0.363093),(2003,0.377477),(2004,0.38988),(2005,0.402925),(2006,0.412784),(2007,0.427752),(2008,0.421505),(2009,0.418325),(2010,0.427185),(2011,0.428741),(2012,0.432968),(2013,0.434968),(2014,0.445714),(2015,0.452942),(2016,0.448982),(2017,0.450391),(2018,0.444051),(2019,0.445282),(2020,0.508486),(2021,0.461556),(2022,0.49448),(2023,0.503237),(2024,0.499314)) skill level employment per vehicle[Low]([(2000,0.3)-(2024,0.5)],(2000,0.394317),(2001,0.396159),(2002,0.40532),(2003,0.416214),(2004,0.423136),(2005,0.429294),(2006,0.431628),(2007,0.437037),(2008,0.426344),(2009,0.432183),(2010,0.42133),(2011,0.41021),(2012,0.399488),(2013,0.390421),(2014,0.390945),(2015,0.391882),(2016,0.383282),(2017,0.375437),(2018,0.362927),(2019,0.366497),(2020,0.419288),(2021,0.372798),(2022,0.393462),(2023,0.394522),(2024,0.385895)) Units: people/vehicle

smooth function net change in carbon stock from land conversion= (DELAY1(net change in carbon stock from land conversion*C to CO2e,2)*-1)-(sequestration from growth of biomass*C to CO2e) Units: Ton/Year

SO2 emissions from biomass= biomass and waste in TJ*average SO2 emissions per TJ of biomass Units: Ton/Year

SO2 emissions from coal[sector]= normalized coal demand[sector]*average SO2 emissions per TJ of coal[sector] Units: Ton/Year

SO2 emissions from natural gas[sector]= normalized natural gas demand[sector]*average SO2 emissions per TJ of natural gas [sector] Units: Ton/Year

SO2 emissions from petroleum[sector]= normalized petroleum demand[sector]*average SO2 emissions per TJ of petroleum [sector] Units: Ton/Year

SO2 emissions from power generation[power generation technology]= fuel use for power generation in TJ[power generation technology]*SO2 emissions per TJ of fuel combusted [power generation technology]/KG PER TON Units: Ton/Year

SO2 emissions per TJ of fuel combusted[power generation technology]= 57.02, 57.02, 0, 444, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0 Units: Kg/Tj

social cost of carbon per ton of CO2e= 31 Units: USD/Ton

Soil biofuel demand for buildings= (Sale of buildings*Solid biofuels intensity per building(Time))/Energy efficiency in building construction Units: Tj/Year

Soil biofuel demand for clothing= (Sale of clothing*Solid biofuels intensity per clothing(Time))/Energy efficiency in clothing manufacturing Units: Tj/Year

Soil biofuel demand for plastic= (Sale of plastic*Solid biofuels intensity per plastic(Time))/Energy efficiency in plastic manufacturing Units: Tj/Year

Soil biofuel demand for vehicles= (Sale of vehicle*Solid biofuels intensity per vehicle(Time))/Energy efficiency in vehicle manufacturing Units: Tj/Year

soil quality= DELAY N(effect of chemical fertilizer use on soil quality*effect of organic fertilizer use on soil quality *effect of share of forest land on soil quality , 3, effect of chemical fertilizer use on soil quality*effect of organic fertilizer use on soil quality *effect of share of forest land on soil quality, 3) Units: Dmnl

SOLAR: SOLAR SMALL SCALE, SOLAR LARGE SCALE

solar capacity= INTEG (solar construction-solar discard, 47) Units: MW

solar capacity from green investment= solar green investment/solar cost per mw(Time)/solar construction time Units: MW

solar capital life= 25 Units: Year

solar construction= if then else(Time<2010, solar investment(Time)/solar cost per mw(Time)/solar construction time , (future solar investment /solar cost per mw(Time) /solar construction time)+solar capacity from green investment)*if then else (IEA NET ZERO SWITCH=1,"Increase in solar capacity IEA.NZ",1) Units: MW/Year

solar construction employment= solar construction*(solar manufacturing employment factor(Time)+solar construction employment factor (Time)) Units: Person/Year

solar construction employment factor([(2010,0)-(2030,25)],(2010,35.0623),(2011,32.2419),(2012,29.6436),(2013,27.2502),(2014,25.0459),(2015,23.0158),(2016,21.1466),(2017,19.4256),(2018,17.8413),(2019,16.3831),(2020,15.0411),(2021,14.6171),(2022,14.2022),(2023,13.796),(2024,13.3985),(2025,13.0094),(2026,12.6287),(2027,12.2561),(2028,11.8915),(2029,11.5347),(2030,11.1856)) Units: Person/MW

solar cost per mw([(2015,0)-(2030,8e+006)],(2015,3.05e+006),(2030,2.14e+006)) Units: usd15/MW

solar discard= solar capacity/solar capital life Units: MW/Year

solar electricity generation= min((TOTAL electricity demand accounting for distribution losses-hydro electricity generation -wind electricity generation), solar power capacity use/mwh to gwh) Units: GWh/Year

solar energy production in QDBTU= solar energy production in QDBTU table(Time) Units: qdbtu/Year

solar energy production in QDBTU table([(1971,0)-(2010,1)],(1971,0),(1972,0),(1973,0),(1974,9.53672e-005),(1975,0.000123619),(1976,0.000166883),(1977,0.000237549),(1978,0.000354992),(1979,0.000533376),(1980,0.00103229),(1981,0.00129631),(1982,0.00159832),(1983,0.00192842),(1984,0.00226311),(1985,0.0111827),(1986,0.0150228),(1987,0.0159013),(1988,0.0168106),(1989,0.0226018),(1990,0.0726272),(1991,0.074937),(1992,0.0768025),(1993,0.0810807),(1994,0.0869921),(1995,0.0918582),(1996,0.0960369),(1997,0.102816),(1998,0.109482),(1999,0.174614),(2000,0.187116),(2001,0.195625),(2002,0.210492),(2003,0.223415),(2004,0.241161),(2005,0.2692),(2006,0.305404),(2007,0.35485)) Units: qdbtu/Year

solar green investment= solar green investment fraction(Time)*power generation investment Units: usd15/Year

solar green investment fraction([(2011,0)-(2050,0.6)],(2011,0.35),(2050,0.35)) Units: Dmnl

solar investment([(1970,0)-(2010,4e+009)],(1970,5.31e+006),(1991,6.49e+006),(1992,7.67e+008),(1993,5.66e+008),(1994,4.25e+008),(1995,4.78e+008),(1996,6.22e+008),(1997,8.09e+008),(1998,1.14e+009),(1999,2.09e+009),(2000,2.21e+009),(2002,1.32e+009),(2004,1.75e+009),(2007,3.19e+009),(2008,8.19e+009)) Units: usd15

solar load factor([(2010,0.09)-(2050,0.2)],(2010,0.0923387),(2022,0.124666),(2023,0.114337),(2030,0.126148),(2035,0.132583),(2040,0.138026),(2050,0.149643)) Units: Dmnl

solar maintenance cost= solar capacity*solar maintenance cost per mw Units: usd15/Year

solar manufacturing employment factor([(2010,0)-(2030,10)],(2010,10.8897),(2011,10.0137),(2012,9.2067),(2013,8.4634),(2014,7.7788),(2015,7.1483),(2016,6.5677),(2017,6.0332),(2018,5.5412),(2019,5.0883),(2020,4.6715),(2021,4.5398),(2022,4.4109),(2023,4.2848),(2024,4.1613),(2025,4.0405),(2026,3.9222),(2027,3.8065),(2028,3.6933),(2029,3.5824),(2030 ,3.474)) Units: Person/MW

solar operation and maintenance employment= solar capacity*solar operation and maintenance employment factor(Time) Units: Person/Year

solar operation and maintenance employment factor([(2010,0)-(2030,1)],(2010,0.756),(2011,0.6952),(2012,0.6392),(2013,0.5876),(2014,0.54),(2015,0.4963),(2016,0.456),(2017,0.4188),(2018,0.3847),(2019,0.3532),(2020,0.3243),(2021,0.3152),(2022,0.3062),(2023,0.2975),(2024,0.2889),(2025,0.2805),(2026,0.2723),(2027,0.2643),(2028,0.2564),(2029,0.2487),(2030,0.2412)) Units: Person/MW

solar power capacity use= solar load factor(Time)*potential electricity solar Units: MWh/Year

solar share of power generation= solar electricity generation/total electricity generation Units: Dmnl

solar construction time= 1 Units: Year

solar maintenance cost per mw= 23625 Units: usd15/MW/Year

Solid biofuels intensity per building([(2000,0)-(2024,0.007)],(2000,0.00598662),(2001,0.00562658),(2002,0.00551935),(2003,0.00605096),(2004,0.00543566),(2005,0.00489824),(2006,0.00428678),(

2007,0.00374726),(2008,0.00347014),(2009,0.00346339),(2010,0.00303106),(2011
,0.00263009),(2012,0.00268168),(2013,0.00255881),(2014,0.00242487),(2015,0.002684
89),(2016,0.00241048),(2017,0.0027592),(2018,0.00270751),(2019,0.00276899),(2020
,0.0027611),(2021,0.00246603),(2022,0.00238317),(2023,0.00228451),(2024,0.0021449
8)) Units: Tj/building

Solid biofuels intensity per clothing([(2000,0)-
(2022,0.006)],(2000,0.00463441),(2001,0.00464725),(2002,0.00460748
),(2003,0.00484034),(2004,0.0044451),(2005,0.0041247),(2006,0.00557922),(2007
,0.00399169),(2008,0.00315508),(2009,0.00353382),(2010,0.00308516),(2011,0.002783
23),(2012,0.00294494),(2013,0.00258957),(2014,0.00246885),(2015,0.00287694),(
2016,0.00390853),(2017,0.00295398),(2018,0.00282081),(2019,0.00308322),(2020
,0.0033893),(2021,0.00311618),(2022,0.00274213)) Units: Tj/Ton

Solid biofuels intensity per plastic([(2000,0.0001)-
(2024,0.0004)],(2000,0.000309809),(2001,0.000267142),(2002,
0.000252995),(2003,0.000270748),(2004,0.000277295),(2005,0.00027421),(2006,
0.000253565),(2007,0.000246695),(2008,0.000259382),(2009,0.00024535),(2010,
0.000253964),(2011,0.000229237),(2012,0.000230238),(2013,0.000197093),(2014
,0.000187127),(2015,0.000176863),(2016,0.000166856),(2017,0.000169331),(2018
,0.000177384),(2019,0.000166134),(2020,0.000158975),(2021,0.000177199),(2022
,0.000170802),(2023,0.000166815),(2024,0.000162389)) Units: Tj/Ton

Solid biofuels intensity per vehicle([(2000,0.003)-
(2024,0.006)],(2000,0.00548108),(2001,0.00497339),(2002,0.00493618
),(2003,0.00457186),(2004,0.0042671),(2005,0.00413319),(2006,0.00405375),(2007
,0.00405412),(2008,0.00388422),(2009,0.00404914),(2010,0.00382224),(2011,0.003793
25),(2012,0.00402717),(2013,0.00392173),(2014,0.00378793),(2015,0.00397551),(
2016,0.00425547),(2017,0.00455612),(2018,0.00437364),(2019,0.0043764),(2020
,0.00504814),(2021,0.00457497),(2022,0.00489925),(2023,0.00498685),(2024,0.004931
19)) Units: Tj/vehicle

SOX COEF coal= 1.364e-006 Units: Kg/BTU

SOX COEF natural gas= 1.7e-008 Units: Kg/BTU

SOX COEF petroleum= 9e-008 Units: Kg/BTU

spawning: (fishyr2-fishyr15)

spawning stock[spawning]= FISH STOCK[FISH FEMALE, spawning] Units: Ton

squared KILOmeters per hectare= 0.01 Units: Km*Km/Ha

std dev of income ln= (LN(1+variance of per capita income/mean income^2))^0.5 Units:
Dmnl

std dev of per capita income= mean income* std dev over mean ratio table(gini coefficient(Time)) Units: Dmnl

std dev over mean ratio table([(0,0)-(0.8,6)],(0.05183,0.1),(0.10898,0.2),(0.16275,0.3),(0.21335,0.4),(0.26047,0.5),(0.30396,0.6),(0.34279,0.7),(0.38008,0.8),(0.41303,0.9),(0.4429,1),(0.46996,1.1),(0.49449,1.2),(0.51674,1.3),(0.53698,1.4),(0.55543,1.5),(0.57227,1.6),(0.58771,1.7),(0.60188,1.8),(0.61493,1.9),(0.62697,2),(0.63813,2.1),(0.64848,2.2),(0.6581,2.3),(0.66708,2.4),(0.67547,2.5),(0.68333,2.6),(0.6907,2.7),(0.69763,2.8),(0.70417,2.9),(0.71033,3),(0.71616,3.1),(0.72167,3.2),(0.7269,3.3),(0.73187,3.4),(0.7366,3.5),(0.7411,3.6),(0.74539,3.7),(0.74948,3.8),(0.7534,3.9),(0.75715,4),(0.76073,4.1),(0.76417,4.2),(0.76748,4.3),(0.77065,4.4),(0.7737,4.5),(0.77663,4.6),(0.77946,4.7),(0.78219,4.8),(0.78482,4.9),(0.78735 ,5)) Units: Dmnl

steel allowance share of EITE= steel average two years emissions*total allowances share of eite/average two years emissions Units: Dmnl

steel average two years emissions= (steel emission one+steel emission two)/2 Units: Ton/Year

steel average two years production= (steel production one+steel production two)/2 Units: Ton/Year

steel carbon intensity= steel average two years emissions/steel average two years production Units: Dmnl

steel coal consumption= total steel production*steel energy intensity[coal energy]*(1-energy efficiency ratio from green investment industry) Units: ktoe/Year

steel coal consumption IN MBTU= steel coal consumption*KTOE TO MBTU Units: Mbtu/Year

steel coal emissions= steel coal consumption IN MBTU*coal emission factor*MBTU TO TJ Units: Kg/Year

steel coal intensity([(1971,0)-(2010,10)],(1971,0.000120291),(1972,0.000122698),(1973,0.000124026),(1974,0.000120162),(1975,0.000110352),(1976,0.000105344),(1977,0.000102597),(1978,0.000108444),(1979,0.000108602),(1980,0.000121336),(1981,0.000115459),(1982,0.000106229),(1983,0.000118407),(1984,0.000122701),(1985,0.000105785),(1986,0.000102327),(1987,0.00010052),(1988,0.000102453),(1989,9.53751e-005),(1990,0.000103582),(1991,0.000102345),(1992,0.000103567),(1993,0.000105522),(1994,0.000106281),(1995,0.000115203),(1996,0.000112484),(1997,0.00011355),(1998,0.000103016),(1999,9.72131e-005),(2000,9.67634e-005),(2001,8.90759e-005

),(2002,9.23847e-005),(2003,9.6681e-005),(2004,9.84797e-005),(2005,0.000102679
),(2006,0.000103759),(2007,0.0001022)) Units: ktoe/Ton

steel coal price= Coal Price per MBTU Units: USD/Mbtu

steel demand over supply= total Steel demand/total steel production Units: Dmnl

Steel demand per unit of GDP([(1981,2e-005)-(2009,5e-005)],(1981,4.26677e-
005),(1982,4.0284e-005),(1983 ,3.52846e-005),(1984,3.46196e-005),(1985,3.46744e-
005),(1986,3.39515e-005), (1987,3.24054e-005),(1988,3.21882e-005),(1989,3.31591e-
005),(1990,3.25924e-005),(1991,3.18189e-005),(1992,2.96149e-005),(1993,2.84972e-
005),(1994,2.80943e-005),(1995,2.75673e-005),(1996,2.78243e-005),(1997,2.70054e-
005),(1998,2.79497e-005),(1999,2.66986e-005),(2000,2.62621e-005),(2001,2.73731e-
005),(2002,2.66825e-005),(2003,2.7645e-005),(2004,2.91665e-005),(2005,3.11922e-
005),(2006,3.3073e-005),(2007,3.5253e-005),(2008,3.72752e-005),(2009,3.56528e-
005)) Units: Ton/usd15

steel ELECTRICITY consumption= total steel production*steel energy
intensity[electricity]*(1-energy efficiency ratio from green investment industry) Units:
ktoe/Year

steel ELECTRICITY consumption IN MBTU= steel ELECTRICITY consumption*KTOE TO
MBTU Units: Mbtu/Year

steel electricity emissions= steel ELECTRICITY consumption IN MBTU*electricity
emission factor Units: Kg/Year

steel electricity intensity([(1971,0)-(2010,10)],(1971,3.20794e-005),(1972,3.38398e-
005),(1973,3.60085e-005),(1974,3.75442e-005),(1975,3.52874e-005),(1976,3.6481e-
005),(1977,3.6118e-005),(1978,3.67318e-005),(1979,3.75171e-005),(1980,3.56471e-
005),(1981,3.36158e-005),(1982,3.23523e-005),(1983,3.64018e-005),(1984,3.83004e-
005),(1985,3.66969e-005),(1986,3.56063e-005),(1987,3.67236e-005),(1988,3.7666e-
005),(1989,3.63196e-005),(1990,3.52953e-005),(1991,3.42854e-005),(1992,3.4749e-
005),(1993,3.57742e-005),(1994,3.62903e-005),(1995,3.79956e-005),(1996,3.67199e-
005),(1997,3.79025e-005),(1998,3.47257e-005),(1999,3.61241e-005),(2000,3.89352e-
005),(2001,3.62023e-005),(2002,3.77517e-005),(2003,3.82863e-005),(2004,3.86712e-
005),(2005,3.72876e-005),(2006,3.71929e-005),(2007,3.77002e-005)) Units: ktoe/Ton

steel electricity price= reference electricity price Units: USD/kWh

steel electricity price in mbtu= steel electricity price*kwh to mbtu Units: USD/Mbtu

steel emission one= DELAY FIXED (steel emissions, 1 , steel emissions) Units: Ton/Year

steel emission two= DELAY FIXED (steel emissions, 2 ,steel emissions) Units: Ton/Year

steel emissions= steel total emissions in tons Units: Ton/Year

steel employment per unit of output([(1995,0)-(2010,0.01)],(1995,0.005725),(1996,0.004765),(1997,0.00515),(1998,0.003285),(1999,0.0041),(2000,0.003481),(2001,0.003282),(2002,0.002956),(2003,0.002795),(2004,0.002621),(2005,0.002656),(2006,0.003813)) Units: Person/Ton

steel energy cost= steel coal consumption IN MBTU*steel coal price+steel oil consumption IN MBTU *steel oil price+steel ELECTRICITY consumption IN MBTU *steel electricity price in mbtu +steel natural gas consumption IN MBTU*steel natural gas price+steel residual fuel consumption IN MBTU *steel renewables price Units: USD/Year

steel energy cost over total cost= steel energy cost/steel total production cost Units: Dmnl

steel energy intensity[electricity]= INTEG (steel energy intensity change[electricity], steel electricity intensity(Time)) steel energy intensity[diesel]= INTEG (steel energy intensity change[diesel], steel oil intensity(Time)) steel energy intensity[natural gas]= INTEG (steel energy intensity change[natural gas], steel natural gas intensity(Time)) steel energy intensity[ethanol]= INTEG (steel energy intensity change[ethanol], steel renewables intensity(Time)) steel energy intensity[coal energy]= INTEG (steel energy intensity change[coal energy], steel coal intensity(Time)) Units: ktoe/Ton

steel energy intensity change[electricity]= steel indicated energy intensity[electricity]-steel energy intensity[electricity] steel energy intensity change[diesel]= steel indicated energy intensity[diesel]-steel energy intensity[diesel] steel energy intensity change[natural gas]= steel indicated energy intensity[natural gas]-steel energy intensity[natural gas] steel energy intensity change[ethanol]= steel indicated energy intensity[ethanol]-steel energy intensity[ethanol] steel energy intensity change[coal energy]= steel indicated energy intensity[coal energy]-steel energy intensity[coal energy] Units: ktoe/Ton

steel indicated energy intensity[electricity]= if then else(Time<2008, steel electricity intensity(Time), steel energy intensity [electricity]/percentage increase in efficiency) steel indicated energy intensity[diesel]= if then else(Time<2008, steel oil intensity(Time), steel energy intensity [diesel]/percentage increase in efficiency) steel indicated energy intensity[natural gas]= if then else(Time<2008, steel natural gas intensity(Time), steel energy intensity [natural gas]/percentage increase in efficiency) steel indicated energy intensity[ethanol]= if then else(Time<2008, steel renewables intensity(Time), steel energy intensity [ethanol]/percentage increase in efficiency) steel indicated energy intensity[coal energy]= if then else(Time<2008, steel coal intensity(Time), steel energy intensity [coal energy]/percentage increase in efficiency) Units: ktoe/Ton

steel labor cost= total steel employment*steel labor cost table(Time) Units: USD/Year

steel labor cost table([(1995,0)-(2010,100000)],(1995,18800),(1996,17000),(1997,16600),(1998,15800),(1999,15000),(2000,13300),(2001,13100),(2002,13000),(2003,15900),(2004,19400),(2005,19100),(2006,11100)) Units: USD/Person

steel market price= steel market price table(Time) Units: USD/Ton

steel market price table([(1995,0)-(2010,1000)],(1995,911.83),(1996,705.56),(1997,739.27),(1998,499.17),(1999,514.08),(2000,430.37),(2001,385.23),(2002,355.9),(2003,430.66),(2004,591.24),(2005,664.3),(2006,726.78)) Units: USD/Ton

steel material and capital production cost= total steel production*steel unit cost(Time) Units: USD/Year

steel material cost= INTEG (steel material cost change, steel unit cost(Time)) Units: USD/Ton

steel material cost change= indicated steel material cost-steel material cost Units: USD/Ton

steel natural gas consumption= total steel production*steel energy intensity[natural gas]*(1-energy efficiency ratio from green investment industry) Units: ktoe/Year

steel natural gas consumption IN MBTU= steel natural gas consumption*KTOE TO MBTU Units: Mbtu/Year

steel natural gas emissions= steel natural gas consumption IN MBTU*natural gas emission factor*MBTU TO TJ Units: Kg/Year

steel natural gas intensity([(1971,0)-(2010,10)],(1971,3.44042e-005),(1972,3.5202e-005),(1973,3.66589e-005),(1974,3.74782e-005),(1975,3.64176e-005),(1976,3.70562e-005),(1977,3.84076e-005),(1978,3.93142e-005),(1979,3.97479e-005),(1980,3.97908e-005),(1981,3.74836e-005),(1982,3.71958e-005),(1983,4.06045e-005),(1984,4.05929e-005),(1985,4.16875e-005),(1986,4.11263e-005),(1987,4.20927e-005),(1988,4.15909e-005),(1989,3.90222e-005),(1990,3.20922e-005),(1991,2.89039e-005),(1992,2.83952e-005),(1993,2.85015e-005),(1994,2.74484e-005),(1995,3.71567e-005),(1996,3.65166e-005),(1997,3.64419e-005),(1998,3.38362e-005),(1999,3.33592e-005),(2000,3.78443e-005),(2001,3.34251e-005),(2002,3.37681e-005),(2003,3.17212e-005),(2004,3.4159e-005),(2005,3.08057e-005),(2006,2.8219e-005),(2007,2.635e-005)) Units: ktoe/Ton

steel natural gas price= Natural Gas Price per MBTU Units: USD/Mbtu

steel net allocations variable shares= min(steel production based allocation,steel upper limit allocation variable shares) Units: USD/Year

steel oil consumption= total steel production*steel energy intensity[diesel]*(1-energy efficiency ratio from green investment industry) Units: ktoe/Year

steel oil consumption IN MBTU= steel oil consumption*KTOE TO MBTU Units: Mbtu/Year

steel oil emissions= steel oil consumption IN MBTU*distillate fuel oil emission factor *MBTU TO TJ Units: Kg/Year

steel oil intensity([(1971,0)-(2050,0.0001)],(1971,4.20805e-005),(1972,4.23619e-005),(1973,4.54679e-005),(1974,4.283e-005),(1975,3.72179e-005),(1976,3.60543e-005),(1977,3.22915e-005),(1978,2.99193e-005),(1979,3.03226e-005),(1980,2.70577e-005),(1981,2.07178e-005),(1982,1.88385e-005),(1983,1.8011e-005),(1984,1.80677e-005),(1985,1.64281e-005),(1986,1.64051e-005),(1987,1.62689e-005),(1988,1.58863e-005),(1989,1.59475e-005),(1990,1.43198e-005),(1991,1.3349e-005),(1992,1.33893e-005),(1993,1.26735e-005),(1994,1.38387e-005),(1995,1.37653e-005),(1996,1.32235e-005),(1997,1.3166e-005),(1998,1.14222e-005),(1999,1.20874e-005),(2000,1.27951e-005),(2001,1.07796e-005),(2002,1.04633e-005),(2003,9.87234e-006),(2004,8.59229e-006),(2005,8.34003e-006),(2006,7.21848e-006),(2007,6.24868e-006)) Units: ktoe/Ton

steel oil price= Oil Price per MBtu Units: USD/Mbtu

steel operating margin= steel operating surplus/steel revenues Units: Dmnl

steel operating surplus= steel revenues-steel total production cost Units: USD/Year

steel price= INTEG (steel price change, steel market price table(Time)) Units: USD/Ton

steel price change= indicated steel price-steel price Units: USD/Ton

steel production based allocation= steel average two years production*steel carbon intensity*allowance price per ton Units: USD/Year

steel production one= DELAY FIXED (total steel production, 1 , total steel production) Units: Ton/Year

steel production two= DELAY FIXED (total steel production, 2 , total steel production) Units: Ton/Year

steel profit share([(1992,-0.8)-(2030,1)],(2000,0),(2001,-0.51),(2002,-0.1814),(2003,-0.2286) ,(2004,0.3487),(2005,0.3981),(2006,0.5337),(2007,0.6042)) Units: Dmnl

steel profits over revenues= real steel profit/real steel revenues Units: Dmnl

steel renewables intensity([(1971,0)-(2010,10)],(1971,2.84976e-006),(1972,3.06401e-006),(1973,3.07685e-006),(1974,3.4552e-006),(1975,3.89213e-006),(1976,3.44493e-006),(1977,3.51922e-006),(1978,3.48991e-006),(1979,3.93742e-006),(1980,3.99116e-

006),(1981,3.43053e-006),(1982,3.36429e-006),(1983,4.15271e-006),(1984,5.07306e-006),(1985,5.04384e-006),(1986,5.45053e-006),(1987,5.43901e-006),(1988,5.65493e-006),(1989,6.04872e-006),(1990,6.46867e-006),(1991,5.95157e-006),(1992,6.11195e-006),(1993,1.45713e-005),(1994,1.26938e-005),(1995,1.20253e-005),(1996,1.06142e-005),(1997,1.03263e-005),(1998,9.33282e-006),(1999,9.89287e-006),(2000,1.04254e-005),(2001,9.73871e-006),(2002,9.5312e-006),(2003,9.43317e-006),(2004,9.10879e-006),(2005,9.96474e-006),(2006,9.44788e-006),(2007,8.93479e-006)) Units: ktoe/Ton

steel renewables price= Renewable Resource price per MBTU(Time) Units: USD/Mbtu

steel residual fuel consumption= total steel production*steel energy intensity[ethanol]*(1-energy efficiency ratio from green investment industry) Units: ktoe/Year

steel residual fuel consumption IN MBTU= steel residual fuel consumption*KTOE TO MBTU Units: Mbtu/Year

steel residual fuel emissions= steel residual fuel consumption IN MBTU*residual fuel oil emission factor* MBTU TO TJ Units: Kg/Year

steel revenues= steel market price*total steel production Units: USD/Year

steel total demand growth rate= ((total Steel demand-previous steel total demand)/previous steel total demand)/GROWTH RATE base period Units: Dmnl/Year

steel total emissions in tons= (steel coal emissions+steel oil emissions+steel electricity emissions +steel natural gas emissions+steel residual fuel emissions)/1000 Units: Ton/Year

steel total production cost= steel labor cost+steel material and capital production cost+steel energy cost -steel net allocations variable shares Units: USD/Year

steel total production cost growth rate= ((steel total production cost-previous steel total production cost)/previous steel total production cost)/GROWTH RATE base period Units: Dmnl/Year

steel total real unit cost= steel total unit cost/gdp deflator Units: usd15/Ton

steel total real unit cost growth rate= ((steel total real unit cost-previous steel total real unit cost)/previous steel total real unit cost)/GROWTH RATE base period Units: Dmnl/Year

steel total unit cost= steel total production cost/total steel production Units: USD/Ton

steel unit cost([(1995,0)-(2010,1000)],(1995,516),(1996,409),(1997,418),(1998,294),(1999,298

),(2000,241),(2001,210),(2002,199),(2003,242),(2004,348),(2005,405),(2006,461)) Units: USD/Ton

steel upper limit allocation variable shares= total allowance value*steel allowance share of EITE Units: USD/Year

steepness= 5.5 Units: Dmnl

Stock of discarded buildings= INTEG (Discard of building-Refurbishing houses-Demolition of old buildings, 5e+008) Units: building

Stock of discarded clothing= INTEG (Discard of clothing-reusing of used clothing-Scrapping of clothing, 1e+007) Units: Ton

Stock of discarded EVs= INTEG (Discard of EVs-reusing of EVs-scrapping of EVs, 0) Units: vehicle

Stock of discarded plastic= INTEG (Discard of plastic-reusing of used plastic-Scrapping of plastic, 2.1e+007) Units: Ton

Stock of discarded vehicles= INTEG (Discard of Vehicle-reusing of used vehicles-Scrapping of Vehicles, 2.1e+007) Units: vehicle

stock ratio= total fish stock/carrying capacity Units: 1

sum check= Agriculture share of GDP+Industry share of GDP+Services share of GDP Units: 1

SUM GDP= agriculture production+industry production+services production Units: usd15/Year

sum of age groups= SUM(age group weight[sex!,age group!]) Units: Dmnl

sum of building waste shares= SUM(Share of material waste for buildings[Materials!]) Units: 1

sum of investment shares= fraction of investment agriculture+fraction of investment industry+fraction of investment services Units: Dmnl

sum of material waste compared to total= (SUM(material waste generated per material[Materials!])/Share of material consumption that is waste in vehicle production) Units: 1

sum of material waste compared to total for buildings= (SUM(material waste generated per material of building[Materials!])/Share of material consumption that is waste in building production) Units: 1

sum of material waste compared to total for clothing= (SUM(material waste generated per material of clothing[Materials!])/Share of material consumption that is waste in clothing production) Units: 1

sum of material waste compared to total for plastic= (SUM(material waste generated per material for plastic[Materials!])/Share of material consumption that is waste in plastic production) Units: 1

sum of waste plastic shares= SUM(Share of material waste for plastic[Materials!]) Units: 1

sum of waste shares= SUM(Share of material waste for vehicles[Materials!]) Units: 1

sum of waste shares for clothing= SUM(Share of material waste for clothing[Materials!]) Units: 1

surface discharge= surface water/surface water discharge time Units: Km3/Year

surface evaporation =temperature*surface water area*evaporation per hectare per degree per year Units: Km3/Year

surface recharge= total water internally produced*fraction of rain to surface Units: Km3/Year

surface water = INTEG(-surface discharge+ground water emergence+surface recharge -surface evaporation -reservoirs recharge,initial surface water) Units: Km3

surface water area= (surface water/average depth of surface water)/squared KILOmeters per hectare Units: Ha

surface water discharge time= 20 Units: Year

sustainable fish catch= TOTAL FISH BABIES Units: Ton/Year

sustainable vessel capacity= sustainable fish catch/initial catch per unit vessel Units: vessel/Year

SWITCH OFF PUBLIC TRANSPORT= 0 Units: Dmnl

SWITCH policy deforestation= 0 Units: Dmnl

target years of schooling= initial target years of schooling*relative education expenditure per pupil ^elasticity of education expenditure on target years of schooling Units: Year

tech progress rate of change= if then else(World Oil technology enhancement-indicated tech progress>0,World Oil technology enhancement -indicated tech progress, 0)/time to improve technology Units: Dmnl/Year

Technology effect on renewable resources industrial utilization= 3 Units: Dmnl

Technology effect on renewable resources utilization= 6 Units: Dmnl

technology enhancement table([(0,0.8)-(1.5,2)],(0.5,1),(1,1),(1.1,1.03),(1.25,1.15),(1.35,1.3),(1.4,1.34),(1.5,1.35)) Units: Dmnl

temperature= 25 Units: c

TERC= 5 Units: Year

test le[sex]= SUM(measured le[sex,age group!]) Units: Year

test le 2[sex]= SUM(age group weight[sex,age group!]) Units: Dmnl

test measured le[sex, age group]= LOOKUP INVERT(death rates table[sex,age group], effective death rates per age group [sex,age group]) Units: 1

test power= coal energy electricity generation+diseal and fuel oil energy electricity generation +gas turbine energy electricity generation Units: GWh/Year

test real gross domestic product= DELAY FIXED (agriculture production+industry production+services production,0.5,1.95704e+013) Units: usd15/Year

test1= ccs green investment fraction(Time)+"co-generation green investment fraction" (Time)+geothermal green investment fraction(Time)+hydro green investment fraction (Time)+nuclear green investment fraction(Time)+solar green investment fraction (Time)+tidal green investment fraction(Time)+wave green investment fraction (Time)+wind green investment fraction(Time) Units: 1

Textile allowance share of EITE= Textile average two years emissions*total allowances share of eite/average two years emissions Units: Dmnl

Textile average two years emissions= (Textile emission one+Textile emission two)/2 Units: Ton/Year

Textile average two years production= (Textile production one+Textile production two)/2 Units: Ton/Year

Textile carbon intensity= Textile average two years emissions/Textile average two years production Units: Dmnl

Textile coal consumption= total Textile production*Textile energy Intensity[coal energy]*(1-energy efficiency ratio from green investment industry) Units: ktoe/Year

Textile coal consumption IN MBTU= Textile coal consumption*KTOE TO MBTU Units: Mbtu/Year

Textile coal emissions= Textile coal consumption IN MBTU*coal emission factor*MBTU TO TJ Units: Kg/Year

Textile coal intensity([(1971,0)-(2010,10)],(1971,2.54719e-007),(1972,2.88241e-007),(1973,2.69855e-007),(1974,2.36613e-007),(1975,2.32816e-007),(1976,2.39438e-007),(1977,2.37496e-007),(1978,2.1819e-007),(1979,2.07252e-007),(1980,4.94123e-007),(1981,5.07053e-007),(1982,5.05689e-007),(1983,5.03875e-007),(1984,5.02879e-007),(1985,4.70257e-007),(1986,4.70153e-007),(1987,4.94911e-007),(1988,4.99761e-007),(1989,4.77311e-007),(1990,4.65141e-007),(1991,4.42697e-007),(1992,4.35195e-007),(1993,3.91711e-007),(1994,4.04921e-007),(1995,4.3627e-007),(1996,3.24156e-007),(1997,2.69167e-007),(1998,3.04041e-007),(1999,2.36522e-007),(2000,1.97001e-007),(2001,1.84838e-007),(2002,1.85227e-007),(2003,1.69761e-007),(2004,2.31049e-007),(2005,2.70318e-007),(2006,2.34208e-007),(2007,2.41203e-007)) Units: Mbtu/Ton

Textile coal price= Coal Price per MBTU Units: USD/Mbtu

Textile demand from CE sectors= Sale of clothing*textile demand per ton of clothing Units: Ton/Year

Textile demand over supply= total Textile demand/total Textile production Units: Dmnl

textile demand per ton of clothing= 1.2 Units: Dmnl

Textile demand per unit of GDP([(1995,0.0004)-(2006,0.0008)],(1995,0.000651131),(1996,0.000697014),(1997,0.000736311),(1998,0.000644751),(1999,0.000608904),(2000,0.000635877),(2001,0.000654463),(2002,0.000608021),(2003,0.000682115),(2004,0.00057238),(2005,0.000475801),(2006,0.000522897)) Units: Ton/usd15

Textile ELECTRICITY consumption= total Textile production*Textile energy Intensity[electricity]*(1-energy efficiency ratio from green investment industry) Units: ktoe/Year

Textile ELECTRICITY consumption IN MBTU= Textile ELECTRICITY consumption*KTOE TO MBTU Units: Mbtu/Year

Textile electricity emissions= Textile ELECTRICITY consumption IN MBTU*electricity emission factor Units: Kg/Year

Textile ELECTRICITY intensity([(1971,0)-(2010,10)],(1971,4.0033e-007),(1972,4.2106e-007),(1973,4.46205e-007),(1974,4.44789e-007),(1975,4.34423e-007),(1976,4.45442e-007),(1977,4.31412e-007),(1978,4.27956e-007),(1979,4.17539e-007),(1980,4.03053e-007),(1981,3.91902e-007),(1982,3.80455e-007),(1983,3.81332e-007),(1984,3.9362e-007),(1985,3.9149e-007),(1986,3.88429e-007),(1987,4.08141e-007),(1988,4.04819e-007),(1989,4.00765e-007),(1990,4.1979e-007),(1991,4.11635e-007),(1992,3.95173e-007),(1993,3.89665e-007),(1994,3.9009e-007),(1995,3.89459e-007),(1996,3.41398e-

007),(1997,3.24255e-007),(1998,3.55958e-007),(1999,3.56791e-007),(2000,3.48882e-007),(2001,3.36232e-007),(2002,3.60585e-007),(2003,3.24177e-007),(2004,3.97441e-007),(2005,4.75363e-007),(2006,4.54773e-007),(2007,4.71919e-007)) Units: Mbtu/Ton

Textile electricity price= reference electricity price Units: USD/kWh

Textile electricity price in mbtu= Textile electricity price*kwh to mbtu Units: USD/Mbtu

Textile emission one= DELAY FIXED (Textile emissions, 1 , Textile emissions) Units: Ton/Year

Textile emission two= DELAY FIXED (Textile emissions, 2 ,Textile emissions) Units: Ton/Year

Textile emissions= Textile total emissions in tons Units: Ton/Year

Textile employment per unit of output([(1990,0)-(2052,0.004)],(1990,0.00361446),(1991,0.00369705),(1992,0.00360324),(1993,0.00342531),(1994,0.00341021),(1995,0.00330092),(1996,0.0030107),(1997 ,0.00278601),(1998,0.00309394),(1999,0.00312907),(2000,0.0029077),(2001,0.00282005),(2002,0.00295058),(2003,0.0025128),(2004,0.00292421),(2005,0.00343207),(2006 ,0.0032161),(2007,0.00305626),(2008,0.00294043),(2009,0.00294894),(2010,0.00283994),(2011,0.00273601),(2012,0.00267964),(2013,0.00268733),(2014,0.00261553),(2015,0.00254648),(2016,0.00241684),(2017,0.00218978),(2018,0.0021223),(2019 ,0.00218473),(2020,0.00219043),(2021,0.00205281),(2022,0.00194107),(2023,0.00193063),(2051.24,0.00117544)) Units: Person/Ton

Textile energy cost= Textile coal consumption IN MBTU*Textile coal price+Textile oil consumption IN MBTU *Textile oil price+Textile natural gas consumption IN MBTU *Textile natural gas price+Textile residual fuel consumption IN MBTU*Textile reNEWABLES price +Textile ELECTRICITY consumption IN MBTU *Textile electricity price in mbtu Units: USD/Year

Textile energy cost over total cost= Textile energy cost/Textile total production cost Units: Dmnl

Textile energy intensity change[electricity]= Textile indicated energy intensity[electricity]-Textile energy Intensity[electricity] Textile energy intensity change[diesel]= Textile indicated energy intensity[diesel]-Textile energy Intensity[diesel] Textile energy intensity change[natural gas]= Textile indicated energy intensity[natural gas]-Textile energy Intensity[natural gas] Textile energy intensity change[ethanol]= Textile indicated energy intensity[ethanol]-Textile energy Intensity[ethanol] Textile energy intensity change[coal energy]= Textile indicated energy intensity[coal energy]-Textile energy Intensity[coal energy] Units: Mbtu/Ton

Textile energy Intensity[electricity]= INTEG (Textile energy intensity change[electricity], Textile ELECTRICITY intensity(Time)) Textile energy Intensity[diesel]= INTEG (Textile energy intensity change[diesel], Textile oil intensity(Time)) Textile energy Intensity[natural gas]= INTEG (Textile energy intensity change[natural gas], Textile natural gas intensity(Time)) Textile energy Intensity[ethanol]= INTEG (Textile energy intensity change[ethanol], Textile renewables intensity(Time)) Textile energy Intensity[coal energy]= INTEG (Textile energy intensity change[coal energy], Textile coal intensity(Time)) Units: Mbtu/Ton

Textile indicated energy intensity[electricity]= if then else(Time<2008, Textile ELECTRICITY intensity(Time), Textile energy Intensity [electricity]/percentage increase in efficiency) Textile indicated energy intensity[diesel]= if then else(Time<2008, Textile oil intensity(Time), Textile energy Intensity [diesel]/percentage increase in efficiency) Textile indicated energy intensity[natural gas]= if then else(Time<2008, Textile natural gas intensity(Time), Textile energy Intensity [natural gas]/percentage increase in efficiency) Textile indicated energy intensity[ethanol]= if then else(Time<2008, Textile renewables intensity(Time), Textile energy Intensity [ethanol]/percentage increase in efficiency) Textile indicated energy intensity[coal energy]= if then else(Time<2008, Textile coal intensity(Time), Textile energy Intensity [coal energy]/percentage increase in efficiency) Units: Mbtu/Ton

Textile labor cost= total Textile employment*Textile labor cost table(Time) Units: USD/Year

Textile labor cost table([(1995,0)-(2010,100000)],(1995,10900),(1996,10200),(1997,10400),(1998,8640),(1999,8280),(2000,7870),(2001,7700),(2002,7560),(2003,9620),(2004,12200),(2005,11300),(2006,4920)) Units: USD/Person

Textile market price= Textile market price table(Time) Units: USD/Ton

Textile market price table([(1995,0)-(2010,100)],(1995,12.14),(1996,9.5),(1997,10.94),(1998,8.84),(1999,9.44),(2000,7.07),(2001,5.89),(2002,6.21),(2003,6.44),(2004,8.11),(2005,10.52),(2006,10.16)) Units: USD/Ton

Textile material and capital production cost= total Textile production*textile unit cost(Time) Units: USD/Year

Textile material cost= INTEG (Textile material cost change, textile unit cost(Time)) Units: USD/Ton

Textile material cost change= indicated Textile material cost-Textile material cost Units: USD/Ton

Textile natural gas consumption= total Textile production*Textile energy Intensity[natural gas]*(1-energy efficiency ratio from green investment industry) Units: ktoe/Year

Textile natural gas consumption IN MBTU= Textile natural gas consumption*KTOE TO MBTU Units: Mbtu/Year

Textile natural gas emissions= Textile natural gas consumption IN MBTU*natural gas emission factor*MBTU TO TJ Units: Kg/Year

Textile natural gas intensity([(1971,0)-(2010,10)],(1971,3.63124e-008),(1972,4.88902e-008),(1973,5.03599e-008),(1974,5.43052e-008),(1975,5.38318e-008),(1976,5.87639e-008),(1977,6.0175e-008),(1978,8.1058e-008),(1979,8.40397e-008),(1980,9.34029e-008),(1981,8.97918e-008),(1982,8.57675e-008),(1983,8.63232e-008),(1984,8.06118e-008),(1985,7.57144e-008),(1986,7.59538e-008),(1987,7.90789e-008),(1988,8.21644e-008),(1989,8.548e-008),(1990,9.65635e-008),(1991,1.05191e-007),(1992,1.01983e-007),(1993,1.13157e-007),(1994,1.10956e-007),(1995,1.99261e-007),(1996,1.84747e-007),(1997,1.7315e-007),(1998,1.92312e-007),(1999,1.90226e-007),(2000,2.1914e-007),(2001,1.99688e-007),(2002,2.17118e-007),(2003,1.83977e-007),(2004,1.9796e-007),(2005,1.88056e-007),(2006,1.63659e-007),(2007,1.55295e-007)) Units: Mbtu/Ton

Textile natural gas price= Natural Gas Price per MBTU Units: USD/Mbtu

Textile net allocations variable shares= min(Textile production based allocation,Textile upper limit allocation variable shares) Units: USD/Year

Textile oil consumption= total Textile production*Textile energy Intensity[diesel]*(1-energy efficiency ratio from green investment industry) Units: ktoe/Year

Textile oil consumption IN MBTU= Textile oil consumption*KTOE TO MBTU Units: Mbtu/Year

Textile oil emissions= Textile oil consumption IN MBTU*distillate fuel oil emission factor*MBTU TO TJ Units: Kg/Year

Textile oil intensity([(1971,0)-(2010,10)],(1971,5.47075e-007),(1972,5.87735e-007),(1973,6.81102e-007),(1974,6.55391e-007),(1975,6.29941e-007),(1976,6.48471e-007),(1977,5.87213e-007),(1978,5.61126e-007),(1979,5.14438e-007),(1980,5.52167e-007),(1981,5.90577e-007),(1982,5.41864e-007),(1983,4.67778e-007),(1984,4.06086e-007),(1985,3.47089e-007),(1986,3.42077e-007),(1987,3.27224e-007),(1988,3.16863e-007),(1989,3.39011e-007),(1990,2.61513e-007),(1991,2.50824e-007),(1992,2.48337e-007),(1993,2.44922e-007),(1994,2.38829e-007),(1995,2.78033e-007),(1996,2.47587e-007),(1997,2.24766e-007),(1998,2.61047e-007),(1999,2.8361e-007),(2000,2.465e-007),(2001,2.28951e-007),(2002,2.28765e-007),(2003,1.79677e-007),(2004,2.02439e-007),(2005,2.20078e-007),(2006,1.68627e-007),(2007,1.52926e-007)) Units: Mbtu/Ton

Textile oil price= Oil Price per MBtu Units: USD/Mbtu

Textile operating margin= Textile operating surplus/Textile revenues Units: Dmnl

Textile operating surplus= Textile revenues-Textile total production cost Units: USD/Year

Textile price= INTEG (Textile price change, Textile market price table(Time)) Units: USD/Ton

Textile price change= indicated Textile price-Textile price Units: USD/Ton

Textile production based allocation= Textile average two years production*Textile carbon intensity*allowance price per ton Units: USD/Year

Textile production one= DELAY FIXED (total Textile production, 1 , total Textile production) Units: Ton/Year

Textile production two= DELAY FIXED (total Textile production, 2 , total Textile production) Units: Ton/Year

Textile profit share([(1992,-0.8)-(2030,1)],(2000,0),(2001,-0.51),(2002,-0.1814),(2003,-0.2286) ,(2004,0.3487),(2005,0.3981),(2006,0.5337),(2007,0.6042)) Units: Dmnl

Textile profits over revenues= real Textile profit/real Textile revenues Units: Dmnl

Textile renewables intensity([(1971,0)-(2010,10)],(1971,5.34171e-008),(1972,5.25307e-008),(1973,4.97865e-008),(1974,4.68232e-008),(1975,4.70602e-008),(1976,4.41813e-008),(1977,4.71853e-008),(1978,5.10171e-008),(1979,5.31491e-008),(1980,4.94382e-008),(1981,3.62245e-008),(1982,3.68889e-008),(1983,3.94452e-008),(1984,4.24885e-008),(1985,4.72535e-008),(1986,4.72629e-008),(1987,4.56085e-008),(1988,4.07464e-008),(1989,3.71627e-008),(1990,8.30884e-008),(1991,8.05181e-008),(1992,9.88826e-008),(1993,1.933e-007),(1994,1.65228e-007),(1995,1.36698e-007),(1996,9.72199e-008),(1997,8.3871e-008),(1998,9.62847e-008),(1999,8.71823e-008),(2000,9.47233e-008),(2001,9.23217e-008),(2002,9.48329e-008),(2003,8.35173e-008),(2004,1.10898e-007),(2005,1.49985e-007),(2006,1.41963e-007),(2007,1.51045e-007)) Units: Mbtu/Ton

Textile reNEWABLES price= Renewable Resource price per MBTU(Time) Units: USD/Mbtu

Textile residual fuel consumption= total Textile production*Textile energy Intensity[ethanol]*(1-energy efficiency ratio from green investment industry) Units: ktoe/Year

Textile residual fuel consumption IN MBTU= Textile residual fuel consumption*KTOE TO MBTU Units: Mbtu/Year

Textile residual fuel emissions= Textile residual fuel consumption IN MBTU*residual fuel oil emission factor *MBTU TO TJ Units: Kg/Year

Textile revenues= Textile market price*total Textile production Units: USD/Year

Textile total demand growth rate= ((total Textile demand-previous Textile total demand)/previous Textile total demand)/GROWTH RATE base period Units: Dmnl/Year

Textile total emissions in tons= (Textile coal emissions+Textile oil emissions+Textile electricity emissions + +Textile natural gas emissions+Textile residual fuel emissions)/1000 Units: Ton/Year

Textile total production cost= Textile labor cost+Textile material and capital production cost+Textile energy cost -Textile net allocations variable shares Units: USD/Year

Textile total production cost growth rate= ((Textile total production cost-previous Textile total production cost)/previous Textile total production cost)/GROWTH RATE base period Units: Dmnl/Year

Textile total real unit cost= Textile total unit cost/gdp deflator Units: usd15/Ton

Textile total real unit cost growth rate= ((Textile total real unit cost-previous Textile total real unit cost)/previous Textile total real unit cost)/GROWTH RATE base period Units: Dmnl/Year

Textile total unit cost= Textile total production cost/total Textile production Units: USD/Ton

textile unit cost([(1995,0)-(2010,10)],(1995,5.14),(1996,4.2),(1997,4.62),(1998,3.97),(1999,4.32),(2000,3.14),(2001,2.42),(2002,2.58),(2003,2.66),(2004,3.44),(2005,4.55),(2006,3.95)) Units: USD/Ton

Textile upper limit allocation variable shares= total allowance value*Textile allowance share of EITE Units: USD/Year

thermal electricity generation= geothermal electricity generation+solar electricity generation+tidal energy electricity generation +wave energy electricity generation+nuclear energy electricity generation+landfill gas electricity generation +waste energy electricity generation+coal energy electricity generation+"co-generation energy electricity generation" +gas turbine energy electricity generation+diseal and fuel oil energy electricity generation Units: GWh/Year

thermal fuel employment= (coal energy electricity generation*coal extraction and conversion jobs factor)+(diseal and fuel oil energy electricity generation+gas turbine

energy electricity generation)*natural gas extraction and conversion jobs Units: Person/Year

three wheel vehicle energy consumption by energy type[ethanol]= (vehicles energy consumption[three wheel]*share of 3 wheel vehicles fuel consumption time series [ethanol](Time))/100 three wheel vehicle energy consumption by energy type[gasoline power]= (vehicles energy consumption[three wheel]*share of 3 wheel vehicles fuel consumption time series [gasoline power](Time))/100 Units: mtoe/Year

tidal capacity from green investment= tidal green investment/tidal energy cost per mw(Time)/tidal energy construction time Units: MW

tidal energy capacity= INTEG (tidal energy construction-tidal energy discard, 100) Units: MW

tidal energy construction= if then else(Time<2010, tidal energy investment(Time)/tidal energy cost per mw (Time)/tidal energy construction time, (future tidal energyl investment /tidal energy cost per mw(Time)/tidal energy construction time)+tidal capacity from green investment)*if then else(IEA NET ZERO SWITCH=1,"Increase in tidal capacity IEA.NZ",1) Units: MW/Year

tidal energy construction employment= tidal energy construction*(tidal energy construction employment factor(Time)+tidal energy manufacturing employment factor(Time)) Units: Person/Year

tidal energy construction employment factor([(2010,0)-(2030,20)],(2010,14.4),(2011,13.1108),(2012,11.9352),(2013,10.8632),(2014,9.8858),(2015,8.9947),(2016,8.1826),(2017,7.4424),(2018,6.7679),(2019,6.1533),(2020,5.5934),(2021,5.0835),(2022,4.619),(2023,4.1961),(2024,3.8111),(2025,3.4606),(2026,3.1416),(2027,2.8513),(2028,2.5871),(2029,2.3469),(2030,2.1283)) Units: Person/MW

tidal energy construction time= 1 Units: Year

tidal energy cost per mw([(2015,0)-(4000,8e+006)],(2015,3.52e+006),(2930,2.69e+006)) Units: usd15/MW

tidal energy discard= tidal energy capacity/tidal energycapital life time Units: MW/Year

tidal energy electricity generation= MAX(0, min((TOTAL electricity demand accounting for distribution losses-hydro electricity generation -wind electricity generation-solar electricity generation-geothermal electricity generation), tidal energy power capacity use /mwh to gwh)) Units: GWh/Year

tidal energy investment([(1970,0)-(2010,6e+006)],(1970,4.39e+006),(1990,3.51e+006),(1998,4.39e+006),(2007,4.39e+006)) Units: usd15

tidal energy load factor([(1970,0)-(2030,10)],(1970,0.42),(2030,0.45)) Units: Dmnl

tidal energy maintenance cost= tidal energy capacity*tidal energy maintenance cost per mw Units: usd15/Year

tidal energy maintenance cost per mw= 143125 Units: usd15/MW/Year

tidal energy manufacturing employment factor([(2010,0)-(2030,10)],(2010,1.6),(2011,1.4568),(2012,1.3261),(2013,1.207),(2014,1.0984),(2015,0.9994),(2016,0.9092),(2017,0.8269),(2018,0.752),(2019,0.6837),(2020,0.6215),(2021,0.5648),(2022,0.5132),(2023,0.4662),(2024,0.4235),(2025,0.3845),(2026,0.3491),(2027,0.3168),(2028,0.2875),(2029,0.2608),(2030,0.2365)) Units: Person/MW

tidal energy operation and maintenance employment= tidal energy capacity*tidal energy operation and maintenance employment factor (Time) Units: Person/Year

tidal energy operation and maintenance employment factor([(2010,0)-(2030,1)],(2010,0.512),(2011,0.4662),(2012,0.4244),(2013,0.3862),(2014,0.3515),(2015,0.3198),(2016,0.2909),(2017,0.2646),(2018,0.2406),(2019,0.2188),(2020,0.1989),(2021,0.1807),(2022,0.1642),(2023,0.1492),(2024,0.1355),(2025,0.123),(2026,0.1117),(2027,0.1014),(2028,0.092),(2029,0.0834),(2030 ,0.0757)) Units: Person/MW

tidal energy power capacity use= tidal energy load factor(Time)*potential electricity generation tidal energy Units: MWh/Year

tidal energycapital life time= 30 Units: Year

tidal green investment= tidal green investment fraction(Time)*power generation investment Units: usd15/Year

tidal green investment fraction([(2011,0)-(2050,0.3)],(2011,0.01),(2050,0.01)) Units: Dmnl

tidal share of power generation= tidal energy electricity generation/total electricity generation Units: Dmnl

"Tide, wave and ocean energy production IN QDBTU"= "Tide, wave and ocean GENERATION IN QDBTU TABLE"(Time) Units: qdbtu/Year

"Tide, wave and ocean GENERATION IN QDBTU TABLE"([(1971,0)-(2010,0.01)],(1971,0.00159325),(1972,0.00175226),(1973,0.0017777

),(1974,0.00189854),(1975,0.00164413),(1976,0.0013929),(1977,0.00144696),(1978
,0.00149467),(1979,0.00157735),(1980,0.00157417),(1981,0.00178724),(1982,0.001904
9),(1983,0.00191762),(1984,0.00194307),(1985,0.00199077),(1986,0.00196851),(
1987,0.0019208),(1988,0.00186992),(1989,0.0018572),(1990,0.00189854),(1991,
0.00195897),(1992,0.00194307),(1993,0.0018731),(1994,0.00189218),(1995,0.0019112
6),(1996,0.0018413),(1997,0.00191444),(1998,0.00197805),(1999,0.00194625),(2000
,0.00192398),(2001,0.00182858),(2002,0.00180632),(2003,0.00181904),(2004,0.001745
9),(2005,0.00179678),(2006,0.00174908),(2007,0.00174908)) Units: qdbtu/Year

time delay for biofuel from crops investment= 0 Units: Year

time delay for biofuel from waste investment= 1 Units: Year

time delay for bioproduct from crops investment= 0 Units: Year

time delay for bioproduct from waste investment= 1 Units: Year

"time delay for by-product recovery investment"= 1 Units: Year

time delay for electricity from biomass cofiring existing plant investment= 0 Units: Year

time delay for electricity from biomass cofiring new plant= 1 Units: Year

time delay for electricity from biomass existing plant investment= 1 Units: Year

time delay for electricity from LFG investment= 1 Units: Year

time delay for natural gas generation from LFG investment= 1 Units: Year

time delay for recycling investment= 0 Units: Year

time delay to process material for reuse= 1 Units: Year

time for changes in desired children per woman= 2 Units: Year

time for changes in productivity to affect arable land demand= 2 Units: Year

time for changes in productivity to affect pasture land demand= 2 Units: Year

time for income changes to affect life expectancy= 5 Units: Year

time for technology changes to affect average capital labor ratio= 10 Units: Year

time for units= 1 Units: Year

time needed to reach saturation= 5 Units: Year

TIME STEP = 0.125 Units: Year

time to adapt demand to price changes= 1 Units: Year

time to adapt demand to price changes 0= 1 Units: Year

time to adjust agric labor demand= 2 Units: Year

time to adjust agriculture employment= 6 Units: Year

time to adjust agriculture employment brown= 6 Units: Year

time to adjust agriculture employment green= 6 Units: Year

time to adjust energy demand reference condition= 5 Units: Year

time to adjust industry employment= 6 Units: Year

Time to Adjust Reserves= 25 Units: Year

time to adjust reservoirs capacity= 2 Units: Year

time to adjust services employment= 5 Units: Year

time to become recyclers= 1/4 Units: Year

time to empty reservoir= 1 Units: Year

time to fill reservoirs= 1 Units: Year

time to improve technology= 1 Units: Year

time to manufacture compost= 1 Units: Year

time to perceive change in under five mortality rate= 5 Units: Year

time to perceive energy demand trend= 5 Units: Year

Time to Perceive Perceived Present condition= 0.2*TERC Units: Year

time to perceive present condition= 5 Units: Year

Time to Perceive Trend= 5 Units: Year

Time to scrap buildings= 0.5 Units: Year

Time to scrap clothing= 0.5 Units: Year

Time to scrap plastic= 0.5 Units: Year

Time to scrap vehicles= 0.5 Units: Year

Time to update building stock= 1 Units: Years

time to update CE stock= 0.5 Units: Year

time to use incinerator waste= 1 Units: Year

time to use waste= 1 Units: Year

time to withdraw ground water= 1 Units: Year

TJ of coal to QDBTU= 9.478e-007 Units: qdbtu/Tj

TJ of electricity to QDBTU= 9.478e-007 Units: qdbtu/Tj

TJ of oil to QDBTU= 9.478e-007 Units: qdbtu/Tj

tj per mwh= 0.0036 Units: Tj/MWh

TJ per vehicle= Oil per vehicle*41868 Units: Tj/vehicle

ton of waste generated per discarded building= 1042.8 Units: Kg/building

ton of waste generated per discarded clothing= 1 Units: Dmnl

ton of waste generated per discarded plastic= 1 Units: Kg/Ton

ton of waste generated per discarded vehicle= WITH LOOKUP (Time, ([(2005,60)-(2023,100)],(2005,67.43),(2006,61.33),(2007,61.66),(2008,66.03),(2009,62.78),(2010,63.71),(2011,66.04),(2012,77.85),(2013,74.36),(2014,79.99),(2015,77.68),(2016,76.72),(2017,78.18),(2018,80.89),(2019,80.62),(2020,85.34),(2021,92.87),(2022,89.04),(2023,86.45))) Units: Kg/vehicle

ton per bushel= 0.0254 Units: Ton/Bushel

ton per short ton= 0.91 Units: short ton/Ton

ton to gallon= 0.84 Units: gallon/Ton

TON to KG= 1000 Units: Kg/Ton

ton to mtoe= 1e+006 Units: Ton/mtoe

total adult deaths= SUM(deaths[sex!,adult age!]) Units: Person/Year

total agriculture employment= additional employment due to shift to organic farming+agriculture employment Units: Person

total agriculture energy demand= agriculture coal demand+agriculture electricity demand+agriculture natural gas demand +agriculture petroleum demand+agriculture renewable resources demand Units: qdbtu/Year

total agriculture indicated energy demand= indicated agriculture coal demand+indicated agricultureelectricity net demand +indicated agriculture natural gas demand+indicated agriculture petroleum demand +indicated agriculture renewable resources demand Units: qdbtu/Year

total agriculture water use= AGRICULTURAL LAND IN USE(Time)*average water use per ha(Time) Units: gallon/Year

total allowance value= (total allowances(Time)*10)*allowance price per ton Units: usd15/Year

total allowances([(2011,0)-(2050,1e+009)],(2011,0),(2012,9.16146e+007),(2013,8.99712e+007),(2014,7.57201e+008),(2015,7.28958e+008),(2016,7.83712e+008),(2017,7.53417e+008),(2018,7.23994e+008),(2019,6.94887e+008),(2020,6.53242e+008),(2021,6.14305e+008),(2022,5.76807e+008),(2023,5.40489e+008),(2024,5.05125e+008),(2025,4.71177e+008),(2026,3.94569e+008),(2027,3.25459e+008),(2028,2.63355e+008),(2029,2.08203e+008),(2030,1.56246e+008),(2033,0)) Units: Ton/Year

total allowances share of eite= 0.466 Units: Dmnl

total aluminium demand from CE sectors in tons= (aluminium demand for buildings+aluminium demand for vehicles)/KG PER TON Units: Ton/Year

total Aluminum demand= (real gross domestic product*Aluminum demand per unit of GDP(Time))+total aluminium demand from CE sectors in tons Units: Ton/Year

total Aluminum employment= total Aluminum production*Aluminum employment per unit of output(Time) Units: Person/Year

total Aluminum production= total Aluminum demand Units: Ton/Year

total annual ammonia emissions from power generation= SUM(ammonia emissions from power generation[power generation technology!]) Units: Ton/Year

total annual black carbon emissions from power generation= SUM(black carbon emissions from power generation[power generation technology !]) Units: Ton/Year

total annual CH4 emissions from power generation= SUM(CH4 emissions from power generation[power generation technology!]) Units: Ton/Year

total annual CO emissions from power generation= SUM(CO emissions from power generation[power generation technology!]) Units: Ton/Year

total annual co2 emissions from power generation= SUM(co2 emissions from power generation[power generation technology!]) Units: Ton/Year

total annual co2e emissions= total emissions from energy+total emissions from industry+total emissions from land +total emissions from waste+total emissions from agriculture Units: Ton/Year

"total annual deaths from ambient air pollution (proxy)"[country]= "annual deaths from ambient air pollution (proxy)"+"annual deaths from indoor air pollution (proxy)" Units: Person/Year

total annual MDGs investment water= 1.84e+010 Units: usd15/Year

total annual N2O emissions from power generation= SUM(N2O emissions from power generation[power generation technology!]) Units: Ton/Year

Total annual NMVOC emissions from power generation= SUM(NMVOC emissions from power generation[power generation technology!]) Units: Ton/Year

total annual NOx emissions from power generation= SUM(NOx emissions from power generation[power generation technology!]) Units: Ton/Year

total annual organic carbon emissions from power generation= SUM(organic carbon emissions from power generation[power generation technology !]) Units: Ton/Year

total annual pm10 emissions from power generation= SUM(pm10 emissions from power generation[power generation technology!]) Units: Ton/Year

"total annual pm2.5 emissions from power generation"= SUM("pm2.5 emissions from power generation"[power generation technology!]) Units: Ton/Year

total annual SO2 emissions from power generation= SUM(SO2 emissions from power generation[power generation technology!]) Units: Ton/Year

total area addressed= SUM(normalized income distribution area[IncClass!]) Units: Dmnl

total biocapacity= WITH LOOKUP (Time, ([(1970,0)-(2010,20)],(1970,11.6),(1975,11.6),(1980,11.7),(1985,11.7),(1990,11.9),(1995,12),(2000,12),(2005,11.9),(2006,11.9))) Units: Dmnl

total biofuel production IN MB= total biomass production*ktoe to MB Units: MB

total biofuels production= total biofuels production in mtoe/ktoe to mtoe Units: ktoe/Year

total biofuels production in Lge= "1st generation biofuel production"+"2nd generation biofuels production" Units: lge

total biofuels production in mtoe= total biofuels production in Lge*lge to mtoe Units: mtoe/Year

Total biomass demand for CE sectors= Biomass demand for vehicles +Biomass demand for clothing +Biomass demand for plastic +Biomass demand for buildings Units: Ton/Year

total biomass production= biogas production+total biofuels production+Other liquid biofuels+Primary solid biomass Units: ktoe/Year

total births= SUM(births [sex!]) Units: Person/Year

total black carbon emissions from biomass= black carbon emissions from biomass Units: Ton/Year

total black carbon emissions from coal= SUM(black carbon emissions from coal[sector!]) Units: Ton/Year

total black carbon emissions from energy and power= total annual black carbon emissions from power generation+total black carbon emissions from energy consumption Units: Ton/Year

total black carbon emissions from energy consumption= total black carbon emissions from biomass +total black carbon emissions from coal +total black carbon emissions from natural gas +total black carbon emissions from petroleum Units: Ton/Year

total black carbon emissions from natural gas= SUM(black carbon emissions from natural gas[sector!]) Units: Ton/Year

total black carbon emissions from petroleum= SUM(black carbon emissions from petroleum[sector!]) Units: Ton/Year

total bus sales= MAX(desired bus stock-SUM(Bus stock[bus type!]), 0) Units: vehicle

total buses= SUM(Bus stock[bus type!]) Units: vehicle

total buses energy consumption= SUM(buses energy consumption[bus type!]) Units: mtoe/Year

total bushel production= agricultural yield for biofuels fresh matter/ton per bushel Units: Bushel/Year

total calories consumed= animal consumption in tons*calories per ton of meat+food vegetables consumption in tons *calories per ton of food vegetables Units: Kal/Year

total car sales= MAX(desired car stock-SUM(Car Stocks[vehicle tech type!]), 0) Units: vehicle

total carbon stock= carbon stock pasture land +carbon stock other land +carbon stock forest +carbon stock settlement land +carbon stock arable land Units: Ton

total cars= SUM(Car Stocks[vehicle tech type!]) Units: vehicle

total cars CO2 emissions= ((cars energy consumption by energy[gasoline power]*CO2 EMISSION FACTORS[gasoline power])+(cars energy consumption by energy[diesel]*CO2 EMISSION FACTORS [diesel])+(cars energy consumption by energy[CNG]*CO2 EMISSION FACTORS[CNG])) Units: mtoe/Year

total cars energy consumption= SUM(cars energy consumption by car type[vehicle tech type!]) Units: mtoe/Year

total CH4 emissions from biomass= CH4 emissions from biomass Units: Ton/Year

total CH4 emissions from coal= SUM(CH4 emissions from coal[sector!]) Units: Ton/Year

total CH4 emissions from energy and power= total annual CH4 emissions from power generation+total CH4 emissions from energy consumption Units: Ton/Year

total CH4 emissions from energy consumption= total CH4 emissions from biomass +total CH4 emissions from coal +total CH4 emissions from natural gas +total CH4 emissions from petroleum Units: Ton/Year

total CH4 emissions from natural gas= SUM(CH4 emissions from natural gas[sector!]) Units: Ton/Year

total CH4 emissions from petroleum= SUM(CH4 emissions from petroleum[sector!]) Units: Ton/Year

total Chemical and plastics demand= (real gross domestic product*Chemical and plastics demand per unit of GDP(Time))+Sale of plastic Units: Ton/Year

total Chemical and plastics employment= total Chemical and plastics production*Chemical and plastics employment per unit of output (Time) Units: Person/Year

total Chemical and plastics production= total Chemical and plastics demand Units: Ton/Year

total CO emissions from biomass= CO emissions from biomass Units: Ton/Year

total CO emissions from coal= SUM(CO emissions from coal[sector!]) Units: Ton/Year

total CO emissions from energy and power= total annual CO emissions from power generation+total CO emissions from energy consumption Units: Ton/Year

total CO emissions from energy consumption= total CO emissions from biomass +total CO emissions from coal +total CO emissions from natural gas +total CO emissions from petroleum Units: Ton/Year

total CO emissions from natural gas= SUM(CO emissions from natural gas[sector!]) Units: Ton/Year

total CO emissions from petroleum= SUM(CO emissions from petroleum[sector!]) Units: Ton/Year

"TOTAL CO-GENERATION ENERGY EMPLOYMENT"= "co-generation energy construction employment"+"co-generation energy operation and maintenance employment" Units: Person

TOTAL CO2 EMISSION by buses= (SUM(CO2 emissions by bus type[bus type!])) Units: mtoe/Year

total co2 emission from power generation= co2 emission from coal demand for power generation in ton+co2 emission from gas demand for power generation in ton +co2 emission from oil demand for power generation in ton Units: Ton/Year

total co2 emissions from biomass= co2 emissions from biomass Units: Ton/Year

total co2 emissions from coal 0= SUM(co2 emissions from coal 0[sector!]) Units: Ton/Year

total CO2 emissions from energy and power= total annual co2 emissions from power generation+total co2 emissions from energy consumption Units: Ton/Year

total co2 emissions from energy consumption= total co2 emissions from biomass +total co2 emissions from coal 0 +total co2 emissions from natural gas +total co2 emissions from petroleum Units: Ton/Year

total co2 emissions from natural gas= SUM(co2 emissions from natural gas[sector!]) Units: Ton/Year

total co2 emissions from petroleum= SUM(co2 emissions from petroleum[sector!]) Units: Ton/Year

total co2 emissions from power generation bau= WITH LOOKUP (Time, ([(1970,0)-(2050,3e+010)],(1970,3.54609e+009),(1971,3.5912e+009),(1972,3.67879e+009),(1973,3.7899e+009),(1974,3.96423e+009),(1975,4.04791e+009),(1976,4.24787e+009),(1977,4.45111e+009),(1978,4.6569e+009),(1979,4.89016e+009),(1980,4.91373e+009),(1981,4.94414e+009),(1982,4.88394e+009),(1983,5.09028e+009),(1984,5.5831e+009),(1985,5.85213e+009),(1986,6.13007e+009),(1987,6.49191e+009),(1988,7.05891e+009),(1989,7.23229e+009),(1990,7.42226e+009),(1991,7.60099e+009),(1992,7.60372e+009),(1993,7.64596e+009),(1994,7.85495e+009),(1995,8.08239e+009),(1996,8.21748e+009),(1997,8.37163e+009),(1998,8.46404e+009),(1999,8.70719e+009),(2000,8.9826e+009),(2001,9.273e+009),(2002,9.53102e+009),(2003,9.9839e+009),(2004,1.03949e+010),(2005,1.0949e+010),(2006,1.15103e+010),(2007,1.19514e+010),(2008,1.24349e+010

),(2009,1.29509e+010),(2010,1.34678e+010),(2011,1.39304e+010),(2012,1.42778e+010
),(2013,1.45686e+010),(2014,1.48584e+010),(2015,1.51563e+010),(2016,1.54832e+010
),(2017,1.58071e+010),(2018,1.61268e+010),(2019,1.64436e+010),(2020,1.67529e+010
),(2021,1.70269e+010),(2022,1.72598e+010),(2023,1.74756e+010),(2024,1.76875e+010
),(2025,1.78969e+010),(2026,1.81212e+010),(2027,1.83221e+010),(2028,1.84572e+010
),(2029,1.85652e+010),(2030,1.86547e+010),(2031,1.88362e+010),(2032,1.9017e+010
),(2033,1.91963e+010),(2034,1.93733e+010),(2035,1.95206e+010),(2036,1.96569e+010
),(2037,1.97692e+010),(2038,1.98549e+010),(2039,1.99189e+010),(2040,1.99568e+010
),(2041,1.99905e+010),(2042,2.00188e+010),(2043,2.00623e+010),(2044,2.01594e+010
),(2045,2.02974e+010),(2046,2.04613e+010),(2047,2.06416e+010),(2048,2.0833e+010
),(2049,2.10435e+010),(2050,2.12658e+010))) Units: Ton/Year

total CO2e emissions= cobalt CO2e emissions+copper CO2e emissions+lithium CO2e emissions+nickel CO2e emissions Units: TonCO2e/Year

total coal consumption from CE sectors= coal consumption from vehicles+coal consumption from plastic+coal consumption from clothing +coal consumption from building Units: Tj/Year

total coal consumption in qdbtu= World Coal Production in qdbtu*(1-fraction of coal use with ccs) Units: qdbtu/Year

TOTAL COAL ENERGY POWER EMPLOYMENT= coal energy construction employment+coal energy operation and maintenance employment Units: Person

total commercial energy demand= commercial coal demand+commercial electricity demand+commercial natural gas demand +commercial petroleum demand+commercial renewable resources demand Units: qdbtu/Year

total commercial indicated energy demand= indicated commercial coal demand+indicated commercial electricity net demand +indicated commercial natural gas demand+indicated commercial petroleum demand +indicated commercial renewable resources demand Units: qdbtu/Year

total contacts of recyclers per time period= contact rate*share of recyclers*total population Units: Person/Year

"total cumulative deaths from air pollution (proxy)"= "cumulative deaths from ambient air pollution (proxy)"+"cumulative deaths from indoor air pollution (proxy)" Units: Person

total deaths= SUM(deaths[sex!,age!]) Units: Person/Year

total distribution losses= agric yield for food-agric yield available for food Units: Ton/Year

total ecological footprint= "built-up land footprint"+carbon footprint+cropland footprint+fishing ground footprint +forest footprint+grazingland footprint Units: Dmnl

total electricity consumption from CE sectors= electricity consumption from vehicles+electricity consumption from clothing +electricity consumption from plastic+electricity consumption from building Units: Tj/Year

total electricity customers= commercial electricity customers+industrial electricity customers+other electricity customers +residential electricity customers Units: customers

TOTAL electricity demand= total net electrcity demand Units: GWh/Year

TOTAL electricity demand accounting for distribution losses= (total net electrcity demand*(1+distribution losses share))*1.025 Units: GWh/Year

total electricity demand from renewable sources= TOTAL electricity demand accounting for distribution losses-coal energy electricity generation -diseal and fuel oil energy electricity generation-gas turbine energy electricity generation -nuclear energy electricity generation Units: GWh/Year

total electricity demand from renewable sources in bkwh= total electricity demand from renewable sources*gwh to bkwh Units: BKWH/Year

TOTAL electricity demand in bkwh= TOTAL electricity demand accounting for distribution losses*gwh to bkwh Units: BKWH/Year

TOTAL electricity demand in qdbtu= TOTAL electricity demand in bkwh/QDBTU to BKWH Units: qdbtu/Year

total electricity generation= hydro electricity generation+thermal electricity generation+wind electricity generation Units: GWh/Year

total electricity generation from ccs plant= ccs coal energy electricity generation+ccs gs turbine energy electricity generation Units: GWh/Year

total electricity generation from renewables in qdbtu= total electricity demand from renewable sources in bkwh/QDBTU to BKWH Units: qdbtu/Year

total electricity generation in QDBTU= TOTAL electricity demand in bkwh/QDBTU to BKWH Units: qdbtu/Year

total electrification from transport= MAX(0,(indicated transportation oil demand*electrification switch)-mtoe of oil demand reduction)*MTOE to MB Units: MB/Year

total emissions from agriculture= Agricultural Land*co2e emissions per hectare of agricultural land Units: Ton/Year

total emissions from energy= emissions from coal consumotion+ emissions from natural gas consumption+ emissions from oil consumption+ emissions from renewable resources consumption+ emission from electricity consumption Units: Ton/Year

total emissions from industry= IPPU emissions per GDP*industry production Units: usd15*Ton/(Year*USD)

total emissions from land= smooth function net change in carbon stock from land conversion Units: Ton/Year

total emissions from waste= emissions from land fills Units: Ton/Year

total employment= total agriculture employment+industry employment+services employment Units: Person

TOTAL EMPLOYMENT CHECK= total employment-total agriculture employment-industry employment-services employment Units: Person

total employment ger sectors= biofuel employment+coal extraction employment+forestry employment+gas extraction employment +oil extraction employment +total power employment no fuel+total transportation employment+water employment +total upstream employment from waste+new fishery employment Units: Person

total employment global plus ger= total employment ger sectors+total agriculture employment+net industry employment +net services employment Units: Person

total employment in CE sectors= total skilled employment in the building sector+total skilled employment in the clothing sector +total skilled employment in the plastic sector+total skilled employment in the vehicle sector Units: Person/Year

total energy burned petroleum= fossil fuel consumption petroleum*(1-NON FUEL ENERGY CONSUMPTION petroleum) Units: BTU/Year

total energy burned petroleum coal= fossil fuel consumption coal*(1-NON FUEL ENERGY CONSUMPTION coal) Units: BTU/Year

total energy burned petroleum natural gas= fossil fuel consumption natural gas*(1-NON FUEL ENERGY CONSUMPTION natural gas) Units: BTU/Year

total energy consumption= cobalt energy consumption+copper energy consumption+lithium energy consumption +nickel energy consumption Units: Tj/Year

total energy demand= total agriculture energy demand+total commercial energy demand+total Fishing energy demand +Total Industrial Energy Demand+"total non-energy use energy demand"+total Others energy demand +total residential energy demand+total transportation energy demand Units: qdbtu/Year

Total energy demand for buildings= Captured energy demand for buildings +Coal and peat demand for buildings +Heat demand for buildings +Nuclear demand for buildings +Oil and natural gas demand for buildings +Soil biofuel demand for buildings Units: Tj/Year

Total energy demand for clothing manufacturing= Captured energy demand for clothing +Coal and peat demand for clothing +Heat demand for clothing +Nuclear demand for clothing +Oil and natural gas demand for clothing +Soil biofuel demand for clothing Units: Tj/Year

Total energy demand for plastic manufacturing= Captured energy demand for plastic +Coal and peat demand for plastic +Heat demand for plastic +Nuclear demand for plastic +Oil and natural gas demand for plastic +Soil biofuel demand for plastic Units: Tj/Year

Total energy demand for vehicle manufacturing= Captured energy demand for vehicles +Coal and peat demand for vehicles +Heat demand for vehicles +Nuclear demand for vehicles +Oil and natural gas demand for vehicles +Soil biofuel demand for vehicles Units: Tj/Year

total energy production= world biofuel production in qdbtu+World Coal Production in qdbtu+World Natural Gas Production in qdbtu +World Oil Production in qdbtu Units: qdbtu/Year

total energy production emissions= CO2 emission in kg+CH4 CO2 equivalent+N2O CO2 equivalent Units: Kg/Year

total energy supply= total energy production Units: qdbtu/Year

total expansion cost due to shift in travel volume= cost of buses expansion due to shift in travel volume+cost of passenger train expansion due to shift in travel volume Units: usd15/Year

total expansion cost due to shift in travel volume delayed= DELAY FIXED(total expansion cost due to shift in travel volume, 1, total expansion cost due to shift in travel volume) Units: usd15/Year

total extraction rate= cobalt production+copper production+lithium production+nickel production Units: Ton/Year

TOTAL FACTOR PRODUCTIVITY AGRICULTURE= effect of capital*"effect of R&D"*effect of labor*effect of soil quality Units: Dmnl

total factor productivity industry= effect of average years of schooling on labor productivity industry*effect of average life expectancy on total factor productivity industry *EFFECT OF WATER STRESS ON INDUSTRY PRODUCTIVITY*EFFECT OF WASTE RECYCLE ON INDUSTRY PRODUCTION *effect of energy spending on industry tfp *effect of emissions on industry tfp*effect of technology on industry tfp Units: Dmnl

total factor productivity services= effect of average years of schooling on services labor productivity*effect of average life expectancy on total factor productivity services *effect of emission on service tfp*effect of energy spending on service tfp Units: Dmnl

total fat consumed= animal consumption in tons*fat per ton of meat+food vegetables consumption in tons *fat per ton of food vegetables Units: gr/Year

total fertility rate= consciously controlled fertility rate*effective contraceptive prevalence rate + UNCONSCIOUSLY DETERMINED FERTILITY RATE*(1-effective contraceptive prevalence rate) Units: Dmnl

total fertilizer use= chemical fertilizer use+organic fertilizer use Units: Ton/Year

TOTAL FISH BABIES= SUM(fish babies[FISHSEX!]) Units: Ton/Year

total fish stock= SUM(FISH STOCK[FISHSEX!,fish age!]) Units: Ton

total fisheries employment= direct fisheries employment+indirect fisheries employment Units: persons

total Fishing energy demand= Fishing coal demand+Fishing electricity demand+Fishing natural gas demand+ Fishing petroleum demand+Fishing renewable resources demand Units: qdbtu/Year

total Fishing indicated energy demand= indicated Fishing coal demand+indicated Fishing electricity net demand+indicated Fishing natural gas demand +indicated Fishing petroleum demand+indicated Fishing renewable resources demand Units: qdbtu/Year

total food losses= total distribution losses+total harvest losses+total yield for animal feed Units: Ton/Year

TOTAL FOREST INVESTMENT= avoided deforestation cost+cost of afforestation investment Units: usd15/Year

total forestry waste= forest area *forestry waste per ha time series Units: Ton/Year

Total fossil fuel based material demand for CE sectors= Fossil fuel demand for vehicles +Fossil fuel demand for clothing +Fossil fuel demand for plastic +Fossil fuel demand for buildings Units: Ton/Year

total fossil fuel consumption= fossil fuel consumption coal+fossil fuel consumption natural gas+fossil fuel consumption petroleum Units: BTU/Year

total gendered employment in the building sector= SUM(employment per gender in building sector[sex!]) Units: Person/Year

total gendered employment in the clothing sector= SUM(employment per gender in clothing sector[sex!]) Units: Person/Year

total gendered employment in the plastic sector= SUM(employment per gender in plastic sector[sex!]) Units: Person/Year

total gendered employment in the vehicle sector= SUM(employment per gender in vehicle sector[sex!]) Units: Person/Year

TOTAL GEOTHERMAL EMPLOYMENT= geothermal construction employment+geothermal operation and maintenance employment Units: Person

total GHG from power generation fuel use= total annual co2 emissions from power generation +total annual CH4 emissions from power generation*CH4 TO CO2 +total annual N2O emissions from power generation*N2O TO CO2 Units: Ton/Year

total government investment for promoting waste management= INTEG (government investment for promoting waste management, 0) Units: usd15/Year

total harvest losses= crops yield in volume-agric yield after harvest in volume Units: Ton/Year

TOTAL HYDRO EMPLOYMENT= hydro construction employment+hydro operation and maintenance employment Units: Person

Total Industrial Energy Demand= industrial coal demand+industrial electricity demand+industrial natural gas demand +industrial petroleum demand+Industrial renewable resources demand Units: qdbtu/Year

Total Industrial Indicated Energy Demand= Indicated industrial coal demand+Indicated industrial electricity net demand +Indicated industrial natural gas demand+Indicated industrial petroleum demand +indicated Industrial renewable resources demand Units: qdbtu/Year

total industrial power demand= industry power demand Units: GWh/Year

total industry co2 emissions= Aluminum total emissions in tons+Chemical and plastics total emissions in tons +Leather total emissions in tons+Paper and pulp total emissions in tons+steel total emissions in tons +Textile total emissions in tons Units: Ton/Year

Total land= Forest Land+Total used land Units: Ha

total land area= 1.29602e+010 Units: Ha

Total land requirement from CE sectors= Land demand from building construction+Land demand from clothing production +Land demand from plastic production+Land demand from vehicle production Units: Ha/Year

TOTAL LANDFILL GAS ENERGY EMPLOYMENT= landfill gas construction employment+landfill gas operation and maintenance employment Units: Person

total Leather demand= real gross domestic product*Leather demand per unit of GDP(Time) Units: Ton/Year

total Leather employment= total Leather production*Leather employment per unit of output(Time) Units: Person/Year

total Leather production= total Leather demand Units: Ton/Year

total metallic demand for CE sectors= Metallic minerals demand for buildings +Metallic minerals demand for clothing +Metallic minerals demand for plastic +Metallic minerals demand for vehicles Units: Ton/Year

total micronutrients consumed= food vegetables consumption in tons*micronutrients per ton of food vegetables +animal consumption in tons*micronutrients per ton of meat Units: gr/Year

total N2O emissions from biomass= N2O emissions from biomass Units: Ton/Year

total N2O emissions from coal= SUM(N2O emissions from coal[sector!]) Units: Ton/Year

total n2o emissions from energy and power= total annual N2O emissions from power generation+total N2O emissions from energy consumption Units: Ton/Year

total N2O emissions from energy consumption= total N2O emissions from biomass +total N2O emissions from coal +total N2O emissions from natural gas +total N2O emissions from petroleum Units: Ton/Year

total N2O emissions from natural gas= SUM(N2O emissions from natural gas[sector!]) Units: Ton/Year

total N2O emissions from petroleum= SUM(N2O emissions from petroleum[sector!]) Units: Ton/Year

total natural death= SUM(natural death[FISHSEX!,fish age!]) Units: Ton/Year

total natural gas consumption in qdbtu= World Natural Gas Production in qdbtu*(1-fraction of natural gas with ccs) Units: qdbtu/Year

total net electrcity demand= commercial power demand+other power demand+residential power demand+total industrial power demand Units: GWh/Year

total NH3 emissions from biomass= NH3 emissions from biomass Units: Ton/Year

total NH3 emissions from coal= SUM(NH3 emissions from coal[sector!]) Units: Ton/Year

total nh3 emissions from energy and power= total annual ammonia emissions from power generation+total NH3 emissions from energy consumption Units: Ton/Year

total NH3 emissions from energy consumption= total NH3 emissions from biomass +total NH3 emissions from coal +total NH3 emissions from natural gas +total NH3 emissions from petroleum Units: Ton/Year

total NH3 emissions from natural gas= SUM(NH3 emissions from natural gas[sector!]) Units: Ton/Year

total NH3 emissions from petroleum= SUM(NH3 emissions from petroleum[sector!]) Units: Ton/Year

total NMVOC emissions from biomass= NMVOC emissions from biomass Units: Ton/Year

total NMVOC emissions from coal= SUM(NMVOC emissions from coal[sector!]) Units: Ton/Year

total NMVOC emissions from energy and power= Total annual NMVOC emissions from power generation+total NMVOC emissions from energy consumption Units: Ton/Year

total NMVOC emissions from energy consumption= total NMVOC emissions from biomass +total NMVOC emissions from coal +total NMVOC emissions from natural gas +total NMVOC emissions from petroleum Units: Ton/Year

total NMVOC emissions from natural gas= SUM(NMVOC emissions from natural gas[sector!]) Units: Ton/Year

total NMVOC emissions from petroleum= SUM(NMVOC emissions from petroleum[sector!]) Units: Ton/Year

Total Nominal Energy Expenditure= Nominal Net Electricity Expenditure+Total Nominal Primary Energy Expenditure Units: USD/Year

Total Nominal Primary Energy Expenditure= Nominal Coal Expenditure+Nominal Natural Gas Expenditure+Nominal Petroleum Expenditure Units: USD/Year

"total non-energy use energy demand"= "non-energy use coal demand"+"non-energy use electricity demand"+"non-energy use natural gas demand" +"non-energy use petroleum demand"+"non-energy use renewable resources demand" Units: qdbtu/Year

"total non-energy use indicated energy demand"= "indicated non-energy use coal demand"+"indicated non-energy use electricity net demand" +"indicated non-energy use natural gas demand"+"indicated non-energy use petroleum demand" +"indicated non-energy use renewable resources demand" Units: qdbtu/Year

"Total non-metallic mineral demand for CE sectors"= "Non-metallic minerals for demand for buildings" +"Non-metallic minerals for demand for clothing" +"Non-metallic minerals for demand for plastic" +"Non-metallic minerals for demand for vehicles" Units: Ton/Year

total NOx emissions from biomass= NOx emissions from biomass Units: Ton/Year

total NOx emissions from coal= SUM(NOx emissions from coal[sector!]) Units: Ton/Year

total NOx emissions from energy and power= total annual NOx emissions from power generation+total NOx emissions from energy consumption Units: Ton/Year

total NOx emissions from energy consumption= total NOx emissions from biomass +total NOx emissions from coal +total NOx emissions from natural gas +total NOx emissions from petroleum Units: Ton/Year

total NOx emissions from natural gas= SUM(NOx emissions from natural gas[sector!]) Units: Ton/Year

total NOx emissions from petroleum= SUM(NOx emissions from petroleum[sector!]) Units: Ton/Year

TOTAL NUCLEAR ENERGY EMPLOYMENT= nuclear energy construction employment+nuclear energy operation and maintenance employment Units: Person

total oil and natural gas consumption from CE sectors= oil consumption from vehicles+oil consumption from plastic+oil consumption from clothing +oil consumption from building Units: Tj/Year

TOTAL OIL FOR POWER ENERGY EMPLOYMENT= diseal and fuel oil energy construction employment+diseal and fuel oil energy operation and maintenance employment Units: Person

total organic carbon emissions from biomass= organic carbon emissions from biomass Units: Ton/Year

total organic carbon emissions from coal= SUM(organic carbon emissions from coal[sector!]) Units: Ton/Year

total organic carbon emissions from energy and power= total annual organic carbon emissions from power generation+total organic carbon emissions from energy consumption Units: Ton/Year

total organic carbon emissions from energy consumption= total organic carbon emissions from biomass +total organic carbon emissions from coal +total organic carbon emissions from natural gas +total organic carbon emissions from petroleum Units: Ton/Year

total organic carbon emissions from natural gas= SUM(organic carbon emissions from natural gas[sector!]) Units: Ton/Year

total organic carbon emissions from petroleum= SUM(organic carbon emissions from petroleum[sector!]) Units: Ton/Year

total Others energy demand= Others coal demand+Others electricity demand+Others natural gas demand+Others petroleum demand +Others renewable resources demand Units: qdbtu/Year

total Others indicated energy demand= indicated Others coal demand+indicated Others electricity net demand+indicated Others natural gas demand +indicated Others petroleum demand+indicated Others renewable resources demand Units: qdbtu/Year

total Paper and pulp demand= real gross domestic product*Paper and pulp demand per unit of GDP(Time) Units: Ton/Year

total Paper and pulp employment= total Paper and pulp production*Paper and pulp employment per unit of output (Time) Units: Person/Year

total Paper and pulp production= total Paper and pulp demand Units: Ton/Year

total petroleum consumption in qdbtu= World Oil Production in qdbtu Units: qdbtu/Year

total pm10 emissions from biomass= pm10 emissions from biomass Units: Ton/Year

total pm10 emissions from coal= SUM(pm10 emissions from coal[sector!]) Units: Ton/Year

total pm10 emissions from energy and power= total annual pm10 emissions from power generation+total pm10 emissions from energy consumption Units: Ton/Year

total pm10 emissions from energy consumption= total pm10 emissions from biomass +total pm10 emissions from coal +total pm10 emissions from natural gas +total pm10 emissions from petroleum Units: Ton/Year

total pm10 emissions from natural gas= SUM(pm10 emissions from natural gas[sector!]) Units: Ton/Year

total pm10 emissions from petroleum= SUM(pm10 emissions from petroleum[sector!]) Units: Ton/Year

"total pm2.5 emissions from biomass 0"= "pm2.5 emissions from biomass 0" Units: Ton/Year

"total pm2.5 emissions from coal new"= SUM("pm2.5 emissions from coal new"[sector!]) Units: Ton/Year

"total pm2.5 emissions from energy and power"= "total annual pm2.5 emissions from power generation"+"total pm2.5 emissions from energy consumption" Units: Ton/Year

"total pm2.5 emissions from energy consumption"= "total pm2.5 emissions from biomass 0" +"total pm2.5 emissions from coal new" +"total pm2.5 emissions from natural gas new" +"total pm2.5 emissions from petroleum new" Units: Ton/Year

"total pm2.5 emissions from natural gas new"= SUM("pm2.5 emissions from natural gas"[sector!]) Units: Ton/Year

"total pm2.5 emissions from petroleum new"= SUM("pm2.5 emissions from petroleum new"[sector!]) Units: Ton/Year

total population= SUM(Population[sex!,age!]) Units: Person

total power employment= ccs employment+total power fuel employment+energy efficiency jobs+"co-generation energy construction employment" +"co-generation energy operation and maintenance employment" +coal energy construction employment +coal energy operation and maintenance employment+diseal and fuel oil energy construction employment +diseal and fuel oil energy operation and maintenance employment +geothermal construction employment+geothermal operation and maintenance employment +hydro construction employment+hydro operation and maintenance employment +landfill gas construction employment+landfill gas operation and maintenance employment +nuclear energy construction employment +nuclear energy operation and maintenance employment+solar construction employment +solar operation and maintenance employment +tidal energy construction employment+tidal energy operation and maintenance employment +waste energy construction employment +waste energy operation and maintenance employment+wave energy construction employment +wave energy operation and maintenance employment +wind construction employment+wind operation and maintenance employment Units: Person

total power employment no fuel= total power employment-thermal fuel employment Units: Person

total power fuel employment= thermal fuel employment+renewable fuel employment Units: Person/Year

total power generated= coal energy electricity generation+diseal and fuel oil energy electricity generation +gas turbine energy electricity generation+total renewable energy production power Units: GWh/Year

total primary energy demand= biomass and waste+hydro+nuclear+other renewables+World Coal Production in qdbtu +World Natural Gas Production in qdbtu+World Oil Production in qdbtu Units: qdbtu/Year

total primary energy demand mtoe= total primary energy demand*qdbtu to Mtoe Units: mtoe/Year

total private cars urban= indicated private car users population*average car ownership rates Units: vehicle/Year

total proteins consumed= animal consumption in tons*proteins per ton of meat+food vegetables consumption in tons *proteins per ton of food vegetable Units: gr/Year

total public transport urban= public transport users population/average population public transport ratio Units: vehicle/Year

total re power employment= renewable fuel employment+"co-generation energy construction employment"+"co-generation energy operation and maintenance employment" +geothermal construction employment +geothermal operation and maintenance employment+hydro construction employment +hydro operation and maintenance employment +landfill gas construction employment+landfill gas operation and maintenance employment +solar construction employment+solar operation and maintenance employment +tidal energy construction employment+tidal energy operation and maintenance employment +waste energy construction employment +waste energy operation and maintenance employment+wave energy construction employment +wave energy operation and maintenance employment +wind construction employment+wind operation and maintenance employment Units: Person

Total real Primary Energy Expenditure= Total Nominal Primary Energy Expenditure/gdp deflator Units: usd15/Year

total recycling capacity= initial recycling capacity time series+new recycling capacity Units: Ton/Year

total recycling investment= INTEG (recycling investment, 0) Units: usd15/Year

total renewable energy production in qdbtu= hydro energy production in QDBTU+nonhydro renewable energy production in qdbtu Units: qdbtu/Year

total renewable energy production power= "co-generation energy electricity generation"+geothermal electricity generation +hydro electricity generation+landfill gas electricity generation+nuclear energy electricity generation +solar electricity generation+tidal energy electricity generation+waste energy electricity generation +wave energy electricity generation+wind electricity generation Units: GWh/Year

total renewable water= 5.471e+014 Units: gallon/Year

total renewable water resources= total water internally produced-surface evaporation Units: Km3/Year

total residential energy demand= residential coal demand+residential electricity demand+residential natural gas demand +residential petroleum demand+residential renewable resources demand Units: qdbtu/Year

total residential indicated energy demand= indicated residential coal demand+indicated residential electricity net demand +indicated residential natural gas demand+indicated residential petroleum demand +indicated residential renewable resources demand Units: qdbtu/Year

total reuse of material= SUM(building materials to be reused[Materials!])+SUM(clothing materials to be reused [Materials!])+SUM(plastic materials to be reused[Materials!])+SUM(plastic materials to be reused [Materials!]) Units: Ton/Year

total revenues= cobalt revenues+copper revenues+lithium revenues+nickel revenues Units: USD/Year

total skilled employment in the building sector= SUM(employment per skill level in the building sector[Employee skill level !]) Units: Person/Year

total skilled employment in the clothing sector= SUM(employment per skill level in the clothing sector[Employee skill level !]) Units: Person/Year

total skilled employment in the plastic sector= SUM(employment per skill level in the plastic sector[Employee skill level!]) Units: Person/Year

total skilled employment in the vehicle sector= SUM(employment per skill level in the vehicle sector[Employee skill level!]) Units: Person/Year

total SO2 emissions from biomass= SO2 emissions from biomass Units: Ton/Year

total SO2 emissions from coal= SUM(SO2 emissions from coal[sector!]) Units: Ton/Year

total SO2 emissions from energy and power= total annual SO2 emissions from power generation+total SO2 emissions from energy consumption Units: Ton/Year

total SO2 emissions from energy consumption= total SO2 emissions from biomass+total SO2 emissions from coal+total SO2 emissions from natural gas +total SO2 emissions from petroleum Units: Ton/Year

total SO2 emissions from natural gas= SUM(SO2 emissions from natural gas[sector!]) Units: Ton/Year

total SO2 emissions from petroleum= SUM(SO2 emissions from petroleum[sector!]) Units: Ton/Year

TOTAL SOLAR ENERGY EMPLOYMENT= solar construction employment+solar operation and maintenance employment Units: Person

total spawning stock= SUM(spawning stock[spawning!]) Units: Ton

total Steel demand= real gross domestic product*Steel demand per unit of GDP(Time) Units: Ton/Year

total steel employment= total steel production*steel employment per unit of output(Time) Units: Person/Year

total steel production= total Steel demand Units: Ton/Year

total supply chain employment= employment for energy provisioning+employment for extraction+employment for water provisioning Units: Person/Year

total Textile demand= (real gross domestic product*Textile demand per unit of GDP(Time))+Textile demand from CE sectors Units: Ton/Year

total Textile employment= total Textile production*Textile employment per unit of output(Time) Units: Person/Year

total Textile production= total Textile demand Units: Ton/Year

total thermal power employment= total power employment-energy efficiency jobs-total re power employment Units: Person

TOTAL TIDAL ENERGY EMPLOYMENT= tidal energy construction employment+tidal energy operation and maintenance employment Units: Person

total ton of resource demand= Total biomass demand for CE sectors+Total fossil fuel based material demand for CE sectors +total metallic demand for CE sectors+"Total non-metallic mineral demand for CE sectors" Units: Ton/Year

total transport co2 emission in tons= TOTAL TRANSPORTATION CO2 EMISSION*ton to mtoe Units: Ton/Year

total transport co2 emissions in tons 1pct= WITH LOOKUP (Time, ([(1970,0)-(2050,2e+010)],(1970,2.92787e+009),(1971,3.22034e+009),(1972,3.30666e+009),(1973,3.57615e+009),(1974,3.61904e+009),(1975,3.48484e+009),(1976,3.54557e+009),(1977,3.58437e+009),(1978,3.69837e+009),(1979,3.80349e+009),(1980,3.79239e+009),(1981,3.69299e+009),(1982,3.42029e+009),(1983,3.32604e+009),(1984,3.43535e+009),(1985,3.43848e+009),(1986,3.54138e+009),(1987,3.60624e+009),(1988,3.70254e+009),(1989,3.64176e+009),(1990,3.58043e+009),(1991,3.39606e+009),(1992,3.33671e+009),(1993,3.27195e+009),(1994,3.29942e+009),(1995,3.47788e+009),(1996,3.5203e+009),(1997,3.50664e+009),(1998,3.50648e+009),(1999,3.5048e+009),(2000,3.39318e+009),(2001,3.32152e+009),(2002,3.30066e+009),(2003,3.46175e+009),(2004,3.73536e+009),(2005,3.92895e+009),(2006,4.1126e+009),(2007,4.29799e+009),(2008,4.45583e+009),(2009,4.58243e+009),(2010,4.68869e+009),(2011,4.72193e+009),(2012,4.75656e+009),(2013,4.80065e+009),(2014,4.84784e+009),(2015,4.93335e+009),(2016,5.02645e+009),(2017,5.12208e+009),(2018,5.21842e+009),(2019,5.33581e+009),(2020,5.43546e+009),(2021,5.55405e+009),(2022,5.66981e+009),(2023,5.78145e+009),(2024,5.86383e+009),(2025,5.93556e+009),(2026,5.99997e+009),(2027,6.05806e+009),(2028,6.11043e+009),(2029,6.15662e+009),(2030,6.19492e+009),(2031,6.2492e+009),(2032,6.30251e+009),(2033,6.34551e+009),(2034,6.37975e+009),(2035,6.41821e+009),(2036,6.45403e+009),(2037,6.485e+009),(2038,6.50878e+009),(2039,6.52146e+009),(2040,6.52483e+009),(2041,6.54637e+009),(2042,6.56084e+009),(2043,6.56873e+009),(2044,6.572e+009),(2045,6.57477e+009),(2046,6.57805e+009),(2047,6.58092e+009),(2048,6.58172e+009),(2049,6.57918e+009),(2050,6.57308e+009))) Units: Ton/Year

total transport oil consumption in qdbtu= total transport oil consumption mb/convertor to MB*crude oil to refined oil factor Units: qdbtu/Year

total transport oil consumption mb= total transport oil consumption mtoe*MTOE to MB Units: MB/Year

total transport oil consumption mtoe= indicated transportation oil demand Units: mtoe/Year

TOTAL TRANSPORTATION CO2 EMISSION= air CO2 emissions+freight rail CO2 emissions+passenger rail CO2 emissions+ TOTAL CO2 EMISSION by buses+TOTAL TRUCKS CO2 EMISSION +total cars CO2 emissions+TOTAL water travel CO2 emissions+total vehicle co2 emission Units: mtoe/Year

total transportation employment= air travel employment+bus production and maintenance employment+car production and maintenance employment +freight rail travel employment+passenger rail travel employment+trucks production and maintenance employment +vehicle production and maintenance employment+water travel employment Units: Person

total transportation energy demand= transportation coal demand+transportation electricity demand+transportation natural gas demand +transportation petroleum demand+transportation renewable resources demand Units: qdbtu/Year

total transportation indicated energy demand= indicated transportation coal demand+indicated transportation electricity net demand +indicated transportation natural gas demand+indicated transportation petroleum demand +indicated transportation renewable resources demand Units: qdbtu/Year

total travel volume= initial total travel volume*relative total population^elasticity of total travel volume to population *EFFECT OF RELATIVE GDP ON TRAVEL VOLUME Units: Km/Year

total travel volume reduction due to efficiency= reduction in total travel volume due to efficiency*total travel volume Units: Km/Year

total trucks= SUM(Truck stock[truck type!]) Units: vehicle/Year

TOTAL TRUCKS CO2 EMISSION= (SUM(CO2 emissions by trucks type[truck type!])) Units: mtoe/Year

total trucks energy consumption= SUM(trucks energy consumption[truck type!]) Units: mtoe/Year

total trucks sales[medium truck]= MAX(desired truck stock medium trucks-Truck stock[medium truck], 0)*(1-reduction in total travel volume due to efficiency) total trucks sales[heavy truck]= MAX(desired truck stock heavy trucks-Truck stock[heavy truck], 0)*(1-reduction in total travel volume due to efficiency) Units: vehicle

total upstream cost= collection cost per ton(Time)+public cleansing cost per ton(Time)+segregation cost per ton (Time)+transfer cost per ton(Time) Units: USD/Ton

total upstream employment factor per ton= collection employment factor per ton+public cleansing employment factor per ton +segregation employment factor per ton+transfer employment factor per ton Units: Person/Ton

total upstream employment from waste= biomass waste upstream employment+"c&d waste upstream employment"+industrial waste upstream employment +"e-waste upstream employment"+municipal waste upstream employment Units: Person

total urban buses co2 emission= SUM(buses co2 emission urban[bus type!]) Units: mtoe/Year

total urban tranport co2= total urban buses co2 emission+urban passenger rail co2 emission+private cars co2 emission urban Units: mtoe/Year

total urban transport expansion cost= cost of urban buses expansion due to investment+cost of urban passenger train expansion due to investment Units: usd15/Year

Total used land= Arable Land+Other Land+Pasture Land+Settlement Land Units: Ha

total vehicle co2 emission= SUM(vehicles CO2 emissions["2or3 wheel type"!]) Units: mtoe/Year

total vehicle energy consumption= SUM(vehicles energy consumption["2or3 wheel type"!]) Units: mtoe/Year

total vehicle sales[two wheel]= MAX(desired vehicles stock two wheel-(vehicle stock[two wheel]), 0) total vehicle sales[three wheel]= MAX(desired vehicles stock three wheel-(vehicle stock[three wheel]), 0) Units: vehicle

total vehicles= SUM(vehicle stock["2or3 wheel type"!]) Units: vehicle

total waste= biomass waste+"e-waste"+industrial waste+municipal waste collected+"c&d waste" Units: Ton/Year

TOTAL WASTE ENERGY EMPLOYMENT= waste energy construction employment+waste energy operation and maintenance employment Units: Person

total waste recycled from green investment= "e-waste waste recycled from green investment"+industrial waste recycled from green investment +municipal waste recycled from green investment Units: Ton/Year

total water available= ground water potential supply+reservoirs potential supply+treated wastewater reused Units: Km3/Year

TOTAL WATER consumption= total water demand*fraction of water available Units: Km3/Year

total water consumption 0= cobalt water consumption+copper water consumption+lithium water consumption +nickel water consumption Units: liter/Year

total water demand= AGRICULTURAL WATER DEMAND+INDUSTRY WATER DEMAND+municipal water demand Units: Km3/Year

total water dia= total water demand Units: Km3/Year

total water internally produced= (precipitation*FRACTION OF PRECIPITATION INTO RENEWABLE WATER)+CONVENTIONAL WATER SUPPLY Units: Km3/Year

total water transport energy consumption= international water travel energy consumption+national water travel energy consumption [diesel]+national water travel energy consumption [residual fuel] Units: mtoe/Year

TOTAL water travel CO2 emissions= (water travel CO2 emissions by energy type[diesel])+(water travel CO2 emissions by energy type [residual fuel]) Units: mtoe/Year

total water use from CE sectors= water use from building construction+water use from clothing production+water use from plastic production +water use from vehicle production Units: m3/Year

total water withdrawal= ground water withdrawal+reservoirs use+usable discharge water Units: Km3/Year

TOTAL WAVE ENERGY EMPLOYMENT= wave energy construction employment+wave energy operation and maintenance employment Units: Person

TOTAL WIND ENERGY EMPLOYMENT= wind construction employment+wind operation and maintenance employment Units: Person

total world oil resource base= World Oil Cumulative Production+World Oil Discovered Reserves+World Oil Undiscovered Resources Units: MB

total yield for animal feed= agric yield after harvest in volume-agric yield for food Units: Ton/Year

Tourism employment= total employment*sectoral distribution of employment[tou] Units: Person

tourism green investment= green economy investment*tourism green investment fraction(Time) Units: usd15/Year

tourism green investment fraction([(2011,0)-(2050,0.3)],(2011,0),(2050,0)) Units: Dmnl

transfer cost per ton([(1970,0)-(2010,20)],(1970,4),(1990,10),(2010,17.5)) Units: USD/Ton

transfer employment factor per ton= 0.00028 Units: Person/Ton

transition to cotton CA= S3 transition to cotton CA(Time) Units: Dmnl

transition to cotton HA= S3 transition to cotton HA(Time) Units: Dmnl

transition to cotton LA=

S3 transition to cotton LA(Time) Units: Dmnl

transport expansion cost per year= total expansion cost due to shift in travel volume-total expansion cost due to shift in travel volume delayed Units: usd15/Year

transport modal share: pvtcars, ptransport, wcycling

transport modes: road, rail, air, water

"Transport. Land transport, transport via pipelines employment"= total employment*sectoral distribution of employment[tlt] Units: Person

transportation coal demand= DELAY N((indicated transportation coal demand 0*Coal Price Substitutability ^transportation elasticity of coal demand to coal price), time to adapt demand to price changes,(indicated transportation coal demand 0 *Coal Price Substitutability^transportation elasticity of coal demand to coal price), 3) Units: qdbtu/Year

transportation coal gdp intensity= normalized transportation coal demand/real gross domestic product Units: qdbtu/usd15

transportation cost of co2 emission abatement per ton of co2([(2011,0)-(2050,4000)],(2011,885),(2030,1946),(2050,2500)) Units: usd15/Ton

transportation elasticity of coal demand to coal price= -0.05 Units: Dmnl

transportation elasticity of electricity demand to electricity price= -0.05 Units: Dmnl

transportation elasticity of natural gas demand to natural gas price= -0.02 Units: Dmnl

transportation elasticity of petroleum demand to oil price= -0.01 Units: Dmnl

transportation elasticity of petroleum demand to price([(1980,0)-(2050,0.5)],(1980,0),(2000,0.05),(2006,0.05),(2010,0.1),(2020,0.2),(2030,0.25),(2050,0.25)) Units: Dmnl

transportation elasticity of renewable resources demand to renewable resources price = -0.05 Units: Dmnl

transportation electricity demand= DELAY N((indicated transportation electricity net demand 0*Electricity Price Substitutability ^transportation elasticity of electricity demand to electricity price), time to adapt demand to price changes,(indicated transportation electricity net demand 0 *Electricity Price Substitutability ^transportation elasticity of electricity demand to electricity price), 3) Units: qdbtu/Year

transportation electricity GDP Intensity= normalized transportation electricity net demand/real gross domestic product Units: qdbtu/usd15

transportation emission abatement= actual transportation emission abatement Units: Ton/Year

transportation emission abatement cost= industries green investment after co2 abatement Units: usd15/Year

transportation green investment= green economy investment*transportation green investment fraction(Time) Units: usd15/Year

transportation green investment after expansion of travel volume= transportation green investment-transport expansion cost per year Units: usd15/Year

transportation green investment fraction([(2011,0)-(2050,0.3)],(2011,0),(2050,0)) Units: Dmnl

transportation natural gas demand= DELAY N((indicated transportation natural gas demand 0*Natural Gas Price Substitutability ^transportation elasticity of natural gas demand to natural gas price), time to adapt demand to price changes,(indicated transportation natural gas demand 0 *Natural Gas Price Substitutability ^transportation elasticity of natural gas demand to natural gas price), 3) Units: qdbtu/Year

transportation natural gas GDP Intensity= normalized transportation natural gas demand/real gross domestic product Units: qdbtu/usd15

transportation other fuel demand([(1980,0)-(2006,3)],(1980,1.88),(1981,1.69),(1982,1.52),(1983,1.36),(1984,1.39),(1985,1.33),(1986,1.38),(1987,1.41),(1988,1.44),(1989,1.47),(1990,1.47),(1991,1.44),(1992,1.42),(1993,1.21),(1994,1.09),(1995,1.03),(1996,0.95),(1997,0.83),(1998,0.8),(1999,0.79),(2000,0.98),(2001,0.71),(2002,0.77),(2003,0.68),(2004,0.71)) Units: qdbtu/Year

transportation petroleum demand= DELAY N((indicated transportation petroleum demand 0*Oil Price Substitutability ^transportation elasticity of petroleum demand to oil price), time to adapt demand to price changes ,(indicated transportation petroleum demand 0 *Oil Price Substitutability^transportation elasticity of petroleum demand to oil price), 3) Units: qdbtu/Year

transportation petroleum gdp intensity= normalized transportation petroleum demand/real gross domestic product Units: qdbtu/usd15

transportation renewable resources demand= DELAY N((indicated transportation renewable resources demand 0*Renewable Resources Price Substitutability ^transportation elasticity of renewable resources demand to renewable resources price), time to adapt demand to price changes, (indicated transportation renewable resources demand 0 *Renewable Resources Price Substitutability ^ transportation elasticity of renewable resources demand to renewable resources price), 3) Units: qdbtu/Year

transportation renewable resources GDP intensity= normalized transportation renewable resources demand/real gross domestic product Units: qdbtu/usd15

transportation storage and communication employment= total employment*sectoral distribution of employment[tsc] Units: Person

trasport modal share policy[transport modal share]= 0.266, 0.365, 0.369 Units: Dmnl

travel modes: road, rail, air, water

travel volume by travel modes[travel modes]= actual total travel volume*INDICATED share of travel volume BY TRAVEL MODES [travel modes] Units: Km/Year

treated wastewater reused= wastewater produced*share of treated wastewater reused Units: Km3/Year

treatment and disposal cost per ton of compost([(1970,0)-(2010,40)],(1970,2),(1990,6.5),(2010,32.5)) Units: USD/Ton

treatment and disposal cost per ton of incinerator([(1970,0)-(2010,40)],(1970,2),(1990,6.5),(2010,32.5)) Units: USD/Ton

treatment and disposal land filling cost per ton([(1970,0)-(2010,40)],(1970,2),(1990,6.5),(2010,32.5)) Units: USD/Ton

treatment cost of energy recovery cost per ton= 275 Units: USD/Ton

treatment cost of recycle per ton= 100 Units: USD/Ton

truck disposal[truck type]= Truck stock[truck type]/AVRAGE LIFE trucks[truck type] Units: vehicle/Year

truck sales[truck type]= (share of truck by type[truck type](Time)*total trucks sales[truck type])/ vehicle sales adjustment time Units: vehicle/Year

Truck stock[truck type]= INTEG (truck sales[truck type]-truck disposal[truck type], initial trucks stock[truck type]) Units: vehicle

truck type: medium truck, heavy truck

trucks average regular diesel efficiency TABLE[medium truck]([(1970,0)-(2050,1)],(1970,0.245614),(1999,0.153509),(2010,0.114035),(2015,0.105263),(2030,0.0877193),(2050,0.068)) trucks average regular diesel efficiency TABLE[heavy truck]([(1970,0)-(2050,1)],(1970,0.495614),(1999,0.486842),(2012,0.385965),(2024,0.381579),(2033,0.399123),(2041,0.377193),(2050,0.359649)) Units: litre/Km

trucks average regular diesel efficiency time series[medium truck]= trucks average regular diesel efficiency TABLE[medium truck](Time) trucks average regular diesel efficiency time series[heavy truck]= trucks average regular diesel efficiency TABLE[heavy truck](Time) Units: litre/Km

trucks employment factor= 0.075 Units: Person/vehicle/Year

trucks energy consumption[medium truck]= trucks average regular diesel efficiency time series[medium truck]*trucks travel volume [medium truck]*convert LITRE to mtoe*(1-efficiency ratio transport from green investment) trucks energy consumption[heavy truck]= trucks average regular diesel efficiency time series[heavy truck]*trucks travel volume [heavy truck]*convert LITRE to mtoe*(1-efficiency ratio transport from green investment) Units: mtoe/Year

trucks production and maintenance employment= total trucks*(car direct employment factor+car operations employment factor) Units: Person

trucks travel volume[truck type]= INDICATED TRUCK travel volume[truck type] Units: Km/Year

two wheel vehicle energy consumption by energy type[ethanol]= (vehicles energy consumption[two wheel]*share of 2 wheel vehicles fuel consumption time series [ethanol](Time))/100 two wheel vehicle energy consumption by energy type[gasoline power]= (vehicles energy consumption[two wheel]*share of 2 wheel vehicles fuel consumption time series [gasoline power](Time))/100 Units: mtoe/Year

UNCONSCIOUSLY DETERMINED FERTILITY RATE= 4.95 Units: Dmnl

UNDER 5 : AGE 0,(AGE 1-AGE 4)

under five mortality rate= SUM(deaths[sex!,UNDER 5!]) * 1000/SUM(births[sex!]) Units: Dmnl

"UNEMPLOYMENT RATIO (total population)"= 1-employment ratio Units: Dmnl

unit correction for batteries= 1 Units: Battery/vehicle

unit correction for year= 1 Units: Ha/Year

URBAN built up area= per capita land area(Time)*URBAN population Units: Ha

urban buses emission change due to investment([(1970,0)-(2050,25)],(1970,0),(2010,0),(2011,2.42426),(2012,2.72089),(2013,3.0264),(2014,3.34082),(2015,3.6643),(2016,4.01447),(2017,4.37723),(2018,4.75275),(2019,5.14117),(2020,5.54253),(2021,5.92207),(2022,6.30981),(2023,6.70511),(2024,7.10767),(2025,7.51697),(2026,7.91079),(2027,8.30834),(2028,8.70878),(2029,9.11171),(2030,9.51676),(2031,9.91663),(2032,10.3166),(2033,10.7156

),(2034,11.1132),(2035,11.5089),(2036,12.1324),(2037,12.7723),(2038,13.4279
),(2039,14.099),(2040,14.7852),(2041,15.3341),(2042,15.8882),(2043,16.4468)
,(2044,17.0096),(2045,17.5762),(2046,18.1663),(2047,18.9319),(2048,19.7126)
,(2049,20.5079),(2050,21.128)) Units: mtoe/Year

urban buses emission change due to investment in ton= urban buses emission change due to investment(Time)*ton to mtoe Units: Ton/Year

urban car travel volume= average distance traveled cars(Time)*total private cars urban Units: Km/Year

URBAN GDP= real gross domestic product*fraction of gdp for urban areas(Time) Units: usd15/Year

urban green investment= indicated urban gdp*indicated urban green investment fraction Units: usd15/Year

urban green investment after tranportation expansion= urban green investment to tranport-total urban transport expansion cost Units: usd15/Year

urban green investment fraction([(1970,0)-
(2050,0.1)],(1970,0),(2010,0),(2011,0),(2050,0)) Units: Dmnl

urban green investment to tranport= urban green investment*urban green investment to tranport fraction Units: usd15/Year

urban green investment to tranport fraction= 0.5 Units: Dmnl

urban passenger rail co2 emission= urban passenger train energy consumption*share of passenger rail fuel consumption time series [diesel](Time)*CO2 EMISSION FACTORS[diesel] Units: mtoe/Year

urban passenger train change due to investment([(1900,0)-
(2050,10)],(1970,0),(2010,0),(2011,0.848686),(2012,0.948196),(2013
,1.04984),(2014,1.15358),(2015,1.25942),(2016,1.41347),(2017,1.57715),(2018
,1.75064),(2019,1.9341),(2020,2.12765),(2021,2.26738),(2022,2.40943),(2023,
2.55353),(2024,2.69952),(2025,2.84719),(2026,2.99832),(2027,3.151),(2028,3.30486
),(2029,3.45976),(2030,3.61554),(2031,3.77194),(2032,3.92912),(2033,4.08679
),(2034,4.24479),(2035,4.40301),(2036,4.56114),(2037,4.71941),(2038,4.87754
),(2039,5.03538),(2040,5.19278),(2041,5.34953),(2042,5.50573),(2043,5.66108
),(2044,5.81543),(2045,5.96868),(2046,5.97529),(2047,5.9738),(2048,5.96395)
,(2049,5.94569),(2050,5.919)) Units: mtoe/Year

urban passenger train change due to investment in ton= urban passenger train change due to investment(Time)*ton to mtoe Units: Ton/Year

urban passenger train energy consumption= urban public transport travel volume passenger rail*passenger rail average fuel efficiency (Time)*convert LITRE to mtoe Units: mtoe/Year

URBAN population= total population*fraction of URBAN population(Time) Units: Person

urban population density= URBAN population/URBAN built up area Units: Person/Ha

urban public transport buses= fractional public transport buses*total public transport urban Units: vehicle/Year

urban public transport by type[bus type]= urban public transport buses*fraction of bus type[bus type] Units: vehicle/Year

urban public transport energy consumption buses[bus type]= buses average fuel efficiency time series[bus type](Time)*urban public transport travel volume bus [bus type]*convert LITRE to mtoe Units: mtoe/Year

urban public transport passenger trains= (1-fractional public transport buses)*total public transport urban Units: vehicle/Year

urban public transport travel volume bus[bus type]= average distance traveled bus(Time)*urban public transport by type[bus type] Units: Km/Year

urban public transport travel volume passenger rail= urban public transport passenger trains*average distance traveled passenger rail (Time) Units: Km/Year

urban tranportation emission abatement investment= urban green investment after tranportation expansion Units: usd15/Year

urban tranportation emission abatement investment in mt= urban transport co2 abatement/1e+006 Units: Ton/Year

urban transport co2 abatement= urban tranportation emission abatement investment/transportation cost of co2 emission abatement per ton of co2 (Time) Units: Ton/Year

URBAN UNDER FIVE MORTALITY RATE= SMOOTH N(URBAN UNDER FIVE MORTALITY RATE TIME SERIES(Time), 10, URBAN UNDER FIVE MORTALITY RATE TIME SERIES (Time), 1) Units: Dmnl

URBAN UNDER FIVE MORTALITY RATE TIME SERIES([(1990,0)-(2005,60)],(1990,52.7853),(1993,48.6726),(1998,44.9808),(2000,42.7249),(2003,45.4967)) Units: Dmnl

usable discharge water= surface discharge*fraction usable of discharge water Units: Km3/Year

usable waste for LFG= Landfill*share of usable waste for LFG Units: Ton/Year

usable waste in short tons= waste to recycle/ton per short ton Units: short ton/Year

use of incinerator waste= incinerator waste/time to use incinerator waste Units: Ton/Year

use of waste for energy generation= energy recovery waste/time to use waste Units: Ton/Year

VA from aluminium= (nominal VA added per ton*total Aluminum production)/gdp deflator Units: usd15/Year

VA from chemicals= (total Chemical and plastics production*nominal va per ton of chemicals)/gdp deflator Units: usd15/Year

VA from textile= (nominal VA from textile*total Textile production)/gdp deflator Units: usd15/Year

value added= value added table(Time) Units: usd15/Ton

value added forestry([(1970,0)-(2050,80)],(1970,20.1398),(1971,20.1179),(1972,19.857),(1973,19.8755),(1974,20.4141),(1975,21.0897),(1976,20.4922),(1977,20.4118),(1978,20.4054),(1979,20.4195),(1980,20.7281),(1981,21.777),(1982,22.8858),(1983,22.1477),(1984,22.7718),(1985,23.2603),(1986,23.1006),(1987,23.0515),(1988,23.2521),(1989,23.5517),(1990,24.2628),(1991,25.118),(1992,26.2456),(1993,26.5649),(1994,26.9542),(1995,26.6348),(1996,28.1437),(1997,28.1312),(1998,29.7202),(1999,29.9354),(2000,30.3399),(2001,31.6271),(2002,31.7466),(2003,32.0598),(2004,32.7703),(2005,33.1463),(2006,34.2632),(2007,35.1236),(2008,36.917),(2009,37.8269),(2010,37.3783),(2011,37.733),(2012,38.499),(2013,38.9581),(2014,39.7676),(2015,40.9688),(2016,41.0288),(2017,41.9425),(2018,42.174),(2019,44.261),(2020,43.1349),(2021,44.9704),(2022,46.9413),(2023,49.5457),(2024,50.4502),(2050,75)) Units: usd15/m3

value added table([(1970,0)-(2010,10000)],(1970,210),(1971,206),(1972,213),(1973,207),(1974,213),(1975,214),(1976,205),(1977,205),(1978,197),(1979,201),(1980,205),(1981,205),(1982,207),(1983,209),(1984,208),(1985,211),(1986,211),(1987,217),(1988,223),(1989,218),(1990,219),(1991,221),(1992,219),(1993,219),(1994,218),(1995,217),(1996,215),(1997,217),(1998,219),(1999,222),(2000,224),(2001,222),(2002,225),(2003,224),(2004,221),(2005,227),(2006,231)) Units: usd15/Ton

value generated per unit of economic output= WITH LOOKUP (Time, ([(2000,0.2)-(2024,0.4)],(2000,0.377039),(2001,0.366226),(2002,0.366526),(2003,0.375088),(2004,0.36833),(2005,0.363085),(2006,0.358167),(2007,0.366507

),(2008,0.354963),(2009,0.320284),(2010,0.347642),(2011,0.351641),(2012,0.346048
),(2013,0.349106),(2014,0.351024),(2015,0.346537),(2016,0.342064),(2017,0.342051
),(2018,0.334727),(2019,0.327547),(2020,0.307744),(2021,0.277761),(2022,0.263256
),(2023,0.262424),(2024,0.247135))) Units: Dmnl

value generated per unit of economic output for buildings= WITH LOOKUP (Time,
([(2000,0)-(2050,0.2)],(2000,0.0630867),(2001,0.0591946),(2002,0.0575681)
,(2003,0.0597042),(2004,0.05683),(2005,0.0564474),(2006,0.0577857),(2007,0.0609081
),(2008,0.0611079),(2009,0.0589223),(2010,0.0596115),(2011,0.0624016),(2012
,0.0608733),(2013,0.0627468),(2014,0.0636212),(2015,0.0640943),(2016,0.0573727
),(2017,0.0509699),(2018,0.0528087),(2019,0.0550099),(2020,0.0547888),(2021
,0.052325),(2022,0.0905696),(2023,0.0908705),(2024,0.0909664),(2049.85,0.0912281)
)) Units: Dmnl

value generated per unit of economic output for plastic= WITH LOOKUP (Time,
([(2000,0.4)-(2024,0.6)],(2000,0.511778),(2001,0.517196),(2002,0.516927),
(2003,0.537279),(2004,0.540573),(2005,0.540404),(2006,0.538118),(2007,0.539853
),(2008,0.537133),(2009,0.548244),(2010,0.543468),(2011,0.556901),(2012,0.560557
),(2013,0.530208),(2014,0.51954),(2015,0.492613),(2016,0.51483),(2017,0.521942
),(2018,0.533814),(2019,0.539774),(2020,0.565002),(2021,0.495973),(2022,0.491185
),(2023,0.507397),(2024,0.506824))) Units: Dmnl

value generated per unit of economic output of clothing= WITH LOOKUP (Time,
([(2000,0.1)-(2020,0.2)],(2000,0.172998),(2001,0.16241),(2002,0.154202),(
2003,0.159834),(2004,0.158173),(2005,0.152222),(2006,0.142465),(2007,0.143834
),(2008,0.144782),(2009,0.138947),(2010,0.141875),(2011,0.144349),(2012,0.136554
),(2013,0.144354),(2014,0.144344),(2015,0.139097),(2016,0.12848),(2017,0.133978
),(2018,0.13654),(2019,0.138857),(2020,0.134876))) Units: Dmnl

variable cost of fishing= fish catch*per unit variable cost of fishing Units: usd15/Year

variance of per capita income= std dev of per capita income^2 Units: Dmnl

vehicle demand per population= WITH LOOKUP (Time, ([(1970,0.2)-
(2024,0.3)],(1970,0.257037),(1971,0.254004),(1972,0.250605),
(1973,0.247205),(1974,0.244043),(1975,0.241188),(1976,0.23863),(1977,0.236213
),(1978,0.23401),(1979,0.231984),(1980,0.230113),(1981,0.228466),(1982,0.22695
),(1983,0.225517),(1984,0.224214),(1985,0.223006),(1986,0.221904),(1987,0.220898
),(1988,0.220009),(1989,0.219239),(1990,0.218552),(1991,0.217995),(1992,0.217486
),(1993,0.217083),(1994,0.216705),(1995,0.216408),(1996,0.21616),(1997,0.215981
),(1998,0.215899),(1999,0.215863),(2000,0.21584),(2001,0.216171),(2002,0.216467
),(2003,0.216574),(2004,0.216811),(2005,0.217),(2006,0.217486),(2007,0.217805
),(2008,0.218363),(2009,0.218612),(2010,0.21886),(2011,0.219524),(2012,0.220151
),(2013,0.220625),(2014,0.221004),(2015,0.221312),(2016,0.221667),(2017,0.222047

),(2018,0.222662),(2019,0.223977),(2020,0.222212),(2021,0.22265),(2022,0.221987),(2023,0.221253),(2024,0.220518))) Units: vehicle/Person/Year

vehicle disposal["2or3 wheel type"]= vehicle stock["2or3 wheel type"]/AVRAGE LIFE VEHICLE["2or3 wheel type"] Units: vehicle/Year

vehicle employment factor= 0.075 Units: Person/vehicle/Year

vehicle material waste to landfills[Materials]= MAX(0,Material waste collected from vehicles[Materials]*share of material waste from vehicles to be landfilled [Materials]) Units: Ton/Year

Vehicle materials to be reused[Materials]= DELAY FIXED (Vehicle waste from manufacturing[Materials]+vehicle waste to be reused in vehicle manufacturing [Materials],1,0) Units: Ton/Year

vehicle ownership per population accounting for increased income= vehicle demand per population*(GDP 2024 relativzed^elasticity of GDP to demand for vehicles)*(1-decrease in vehicle ownership from public transport-decrease in vehicle ownership from ride sharing) Units: vehicle/(Year*Person)

vehicle production and maintenance employment= (car direct employment factor+car operations employment factor)*total vehicles Units: Person

vehicle sales["2or3 wheel type"]= share of vehicle by type["2or3 wheel type"](Time)*total vehicle sales["2or3 wheel type"]/vehicle sales adjustment time Units: vehicle/Year

vehicle sales adjustment time= 1 Units: Year

vehicle stock["2or3 wheel type"]= INTEG (vehicle sales["2or3 wheel type"]-vehicle disposal["2or3 wheel type"], initial vehicle stock["2or3 wheel type"]) Units: vehicle

vehicle tech type: reg gasoline, hybrid gasoline, reg diesel, hybrid diesel, V CNG, V fuel cell

Vehicle waste from manufacturing[Materials]= Material Consumption for vehicle production[Materials]*material waste generated per material [Materials] Units: Ton/Year

vehicle waste in landfills to be incinerated[Materials]= Material waste from vehicles landfilled[Materials]/Average time for waste to be incinerated Units: Ton/Year

Vehicle waste shares check[Materials]= materials from vehicles to be reused share[Materials] +share of material waste from vehicles to be landfilled[Materials] +materials from vehicles to be recycled share[Materials] Units: Dmnl/Year

vehicle waste to be reused in vehicle manufacturing[Materials]= Material waste to be reused[Materials]+Materials recovered[Materials] Units: Ton/Year

vehicles average fuel efficiency time series[two wheel]([(1970,0)-(2050,0.1)],(1970,0.00614),(2000,0.0162281),(2008,0.0179825),(2018,0.0171053),(2024,0.0184211),(2036,0.0201754),(2042,0.0197368),(2050,0.0219298)) vehicles average fuel efficiency time series[three wheel]([(1970,0)-(2050,0.1)],(1970,0.0934211),(1980,0.0802632),(1992,0.0605263),(2002,0.047807),(2010,0.0421053),(2019,0.0421053),(2029,0.0350877),(2040,0.0276316),(2050,0.0245614)) Units: litre/Km

vehicles CO2 emissions[two wheel]= ((two wheel vehicle energy consumption by energy type[ethanol]*CO2 EMISSION FACTORS [ethanol]))+((two wheel vehicle energy consumption by energy type[gasoline power]*CO2 EMISSION FACTORS[gasoline power])) vehicles CO2 emissions[three wheel]= ((three wheel vehicle energy consumption by energy type[ethanol]*CO2 EMISSION FACTORS [ethanol]))+((three wheel vehicle energy consumption by energy type[gasoline power]*CO2 EMISSION FACTORS[gasoline power])) Units: mtoe/Year

Vehicles currently in use= INTEG (reusing of used vehicles+Sale of vehicle-Discard of Vehicle, initial vehicles in use) Units: vehicle

vehicles energy consumption[two wheel]= (vehicles travel volume[two wheel]*vehicles average fuel efficiency time series [two wheel](Time))*convert LITRE to mtoe*(1-efficiency ratio transport from green investment) vehicles energy consumption[three wheel]= (vehicles travel volume[three wheel]*vehicles average fuel efficiency time series [three wheel] (Time))*convert LITRE to mtoe*(1-efficiency ratio transport from green investment) Units: mtoe/Year

vehicles material recycled BAU[Materials]= share of material waste from vehicles to be recycled[Materials](Time) Units: Dmnl/Year

vehicles material recycled CA[Materials]= S9 CE share of material waste from vehicles to be recycled CA[Materials](Time) Units: Dmnl/Year

vehicles material recycled HA[Materials]= S9 CE share of material waste from vehicles to be recycled HA[Materials](Time) Units: Dmnl/Year

vehicles material recycled LA[Materials]= S9 CE share of material waste from vehicles to be recycled LA[Materials](Time) Units: Dmnl/Year

vehicles material resued CA[Materials]= S9 S10 CE share of material from vehicles waste to be reused CA[Materials] (Time) Units: Dmnl/Year

vehicles material reused BAU[Materials]= share of material from vehicles waste to be reused[Materials](Time) Units: Dmnl/Year

vehicles material reused HA[Materials]= S9 S10 CE share of material from vehicles waste to be reused HA[Materials] (Time) Units: Dmnl/Year

vehicles material reused LA[Materials]= S9 S10 CE share of material from vehicles waste to be reused LA[Materials] (Time) Units: Dmnl/Year

vehicles travel volume[two wheel]= INDICATED vehicles travel volume[two wheel]
vehicles travel volume[three wheel]= INDICATED vehicles travel volume[three wheel]
Units: Km/Year

vessel acquisition time= 1 Units: Year

vessel buyback expected expenditure([(1970,0)-(2050,2e+010)],(1970,0),(2010,0),(2011,7.5e+009),(2012,1.13e+010),(2013,1.5e+010),(2014,1.13e+010),(2015,7.5e+009),(2016,6e+009),(2017,5.25e+009),(2018,4.5e+009),(2019,3.75e+009),(2020,3e+009),(2021,0)) Units: usd15/Year

vessel buyback investment= vessel buyback expected expenditure(Time)*fishery switch
Units: usd15/Year

vessel capacity= INTEG (new vessel-vessel discard, initial vessel capacity) Units: vessel

vessel discard= (vessel capacity/life span of vessel)+vessels to redraw due to buyback program Units: vessel/Year

vessel investment([(1900,0)-(2100,4e+010)],(1970,1.2e+010),(1988,1.98e+010),(2001,2.12e+010),(2010,2.26e+010),(2031,1.491e+010),(2050,2.49e+010)) Units: USD/Year

vessel maintenance cost= vessel capacity*vessel maintenance cost per unit Units: USD

vessel maintenance cost per unit= 2000 Units: USD/vessel

vessels to redraw due to buyback program= vessel buyback investment/average cost of vessel buyback Units: vessel/Year

walking and cycling population= indicated transport model share[wcycling]*URBAN population Units: Person/Year

waste capital life time= 30 Units: Year

waste collection fraction increase= DELAY N(INDICATED waste collection fraction increase, 1, 0, 3) Units: Dmnl

waste collection increase from green investment= residual investment from waste/total upstream cost Units: Ton/Year

waste electricity generation in QDBTU table([(1971,0)-(2010,10)],(1971,0.03612),(1972,0.0431164),(1973,0.0404346),(1974,0.0630944),(1975,0.0746772),(1976,0.0752371),(1977,0.08032),(1978,0.0919425

),(1979,0.0952443),(1980,0.120156),(1981,0.122749),(1982,0.133432),(1983,0.141163
),(1984,0.154504),(1985,0.173003),(1986,0.193137),(1987,0.193491),(1988,0.215604
),(1989,0.234967),(1990,0.498353),(1991,0.595968),(1992,0.731466),(1993,0.717837
),(1994,0.768081),(1995,0.83711),(1996,0.825895),(1997,0.864268),(1998,0.888081
),(1999,0.989404),(2000,1.10249),(2001,1.09391),(2002,1.13947),(2003,1.1478
),(2004,1.18777),(2005,1.16043),(2006,1.25143),(2007,1.32227)) Units: qdbtu/Year

waste energy capacity= INTEG (waste energy construction-waste energy discard, 0) Units: MW

waste energy capital life time= 30 Units: Year

waste energy construction= if then else(Time<2010, waste energy investment(Time)/waste energy cost per mw (Time)/waste energy construction time, (future waste energy investment /waste energy cost per mw(Time)/waste energy construction time))*if then else (IEA NET ZERO SWITCH=1,"Increase in waste capacity IEA.NZ",1) Units: MW/Year

waste energy construction employment= waste energy construction*(waste energy construction employment factor(Time)+waste energy manufacturing employment factor(Time)) Units: Person/Year

waste energy construction employment factor([(2010,0)-(2030,10)],(2010,8.2668),(2011,8.0818),(2012,7.8997),(2013,7.7205
),(2014,7.544),(2015,7.3703),(2016,7.1993),(2017,7.031),(2018,6.8653),(2019
,6.7023),(2020,6.5418),(2021,6.4161),(2022,6.2915),(2023,6.168),(2024,6.0455
),(2025,5.9242),(2026,5.8039),(2027,5.6846),(2028,5.5664),(2029,5.4492),(2030
,5.3331)) Units: Person/MW

waste energy construction time= 1 Units: Year

waste energy cost per mw([(2015,0)-(2030,2e+007)],(2015,5.74e+006),(2030,5.38e+006)) Units: usd15/MW

waste energy discard= waste energy capacity/waste energy capital life time Units: MW/Year

waste energy electricity generation= min((TOTAL electricity demand accounting for distribution losses-hydro electricity generation -wind electricity generation-solar electricity generation-geothermal electricity generation -tidal energy electricity generation-wave energy electricity generation-landfill gas electricity generation -nuclear energy electricity generation), waste energy power capacity use/mwh to gwh) Units: GWh/Year

waste energy investment([(1970,0)-(2000,2e+010)],(1970,5.58e+009),(1984,1e+010),(2000,1.76e+010)) Units: usd15

waste energy load factor([(2010,0.4)-(2050,0.6)],(2010,0.474453),(2022,0.431433),(2023,0.42853),(2030,0.501968),(2035,0.486196),(2040,0.483805),(2050,0.492808)) Units: Dmnl

waste energy maintenance cost= waste energy capacity*waste energy maintenance cost per mw Units: usd15/Year

waste energy maintenance cost per mw= 205875 Units: usd15/MW/Year

waste energy manufacturing employment factor([(2010,0)-(2030,10)],(2010,0.8479),(2011,0.8289),(2012,0.8102),(2013,0.7918),(2014,0.7737),(2015,0.7559),(2016,0.7384),(2017,0.7211),(2018,0.7041),(2019,0.6874),(2020,0.671),(2021,0.6581),(2022,0.6453),(2023,0.6326),(2024,0.6201),(2025,0.6076),(2026,0.5953),(2027,0.583),(2028,0.5709),(2029,0.5589),(2030 ,0.547)) Units: Person/MW

waste energy operation and maintenance employment= waste energy capacity*waste energy operation and maintenance employment factor (Time) Units: Person/Year

waste energy operation and maintenance employment factor([(2010,0)-(2030,10)],(2010,3.2907),(2011,3.217),(2012,3.1446),(2013,3.0732),(2014,3.003),(2015,2.9338),(2016,2.8657),(2017,2.7987),(2018,2.7328),(2019,2.6679),(2020,2.604),(2021,2.554),(2022,2.5044),(2023,2.4552),(2024,2.4065),(2025,2.3582),(2026,2.3103),(2027,2.2628),(2028,2.2158),(2029,2.1691),(2030,2.1229)) Units: Person/MW

waste energy power capacity use= waste energy load factor(Time)*potential electricity generation waste energy Units: MWh/Year

waste for compost= municipal waste compost[mcompost] Units: Ton/Year

waste for energy recovery= biomass waste energy recovery and composting+"c&d waste energy recovery"+industrial waste for energy recovery +municipal waste for energy recovery[menergy recovery] Units: Ton/Year

waste for incinerator= industrial waste for incineration Units: Ton/Year

waste generated from discarding buildings= Demolition of old buildings*(ton of waste generated per discarded building /KG PER TON) Units: Ton/Year

waste generated from discarding clothing= Scrapping of clothing*(ton of waste generated per discarded clothing) Units: Ton/Year

waste generated from discarding plastic= Scrapping of plastic*(ton of waste generated per discarded plastic) Units: Ton/Year

waste generated from discarding vehicles= Scrapping of Vehicles*(ton of waste generated per discarded vehicle/KG PER TON) Units: Ton/Year

waste green investment= green economy investment*waste green investment fraction(Time) Units: usd15/Year

waste green investment fraction([(2011,0)-(2050,0.3)],(2011,0),(2050,0)) Units: Dmnl

waste inceniration= waste energy electricity generation*waste inceniration factor Units: ton/year

waste inceniration factor= 1818.18 Units: dmnl

waste landfilled from green investment= industrial waste*fraction of industrial waste to uses increase[ilandfill] Units: Ton/Year

waste not used because of electricity from LFG capacity= (LFG for Electricity-electricity from LFG/LFG to electricity)/cubic feet of LFG per ton of waste Units: Ton/Year

waste not used because of natural gas from LFG capacity= (residual LFG-natural gas from LFG)/cubic feet of LFG per ton of waste Units: Ton/Year

waste per unit of industrial production= waste per unit of industrial production time series(Time) Units: Ton/usd15

waste per unit of industrial production time series([(1970,0)-(2010,1e-005)],(1970,3.2e-006),(2010,4.8e-006)) Units: Ton/usd15

waste share of power generation= waste energy electricity generation/total electricity generation Units: Dmnl

waste to Landfill= biomass waste for landfill+"c&d waste to landfill"+"e-waste to landfill"+industrial waste landfill +municipal waste landfill[mlandfill] Units: Ton/Year

waste to recycle= "e-waste recycled"+industrial waste recycled+municipal waste recyled[mrecycle] Units: Ton/Year

waster use for building construction= WITH LOOKUP (Time, ([(2000,10)-(2050,20)],(2000,14.6488),(2001,15.8722),(2002,16.5252),(2003,15.2568),(2004,14.6501),(2005,15.6573),(2006,14.1334),(2007,12.518),(2008,11.5048),(2009,13.2521),(2010,12.2924),(2011,12.6004),(2012,11.2095),(2013,10.7664),(2014,10.6478),(2015,11.6802),(2016,13.2245),(2017,15.4709),(2018,14.9108),(2019,14.7559),(2020,15.3337),(2021,13.032),(2022,13.0873),(2023,12.9251),(2024,12.5147),(2049.69,11.3596))) Units: m3/sqm

wastewater produced= desired wastewater produced per capita*total population Units: Km3/Year

water consumption per unit= 193.8*1000 Units: liter/Ton

water coverage from MDGs investment= total annual MDGs investment water/MDGs investment water cost per m3 Units: m3/Year

water demand management fraction([(1970,0)-(2050,0.5)],(1970,0),(2010,0),(2011,0.01),(2050,0.2)) Units: Dmnl

water demand reduction= INDICATED water demand reduction from management Units: Km3/Year

water demand reduction fraction= water demand management fraction(Time) Units: Dmnl

water demand reduction from management= indicated water demand reduction fraction*total water demand Units: Km3/Year

WATER EFFICIENCY FROM INVESTMENT= water demand reduction/INDICATED total water demand Units: 1

water employment= water employment factor(Time)*TOTAL WATER consumption Units: Person

water employment factor([(1996,0)-(2010,10000)],(1996,5851.68),(1997,5559.71),(1998,6907.07),(1999,6757.66),(2000,6234.89),(2001,5729.19),(2002,5593.73),(2003,5538.24),(2004,5011.43),(2005,4778.38),(2006,4685.09),(2007,4820.12),(2008,6451.38)) Units: Person/Km3

water green investment= green economy investment*water green investment fraction(Time) Units: usd15/Year

water green investment after MDG investment= MAX(0,water green investment-total annual MDGs investment water) Units: usd15/Year

water green investment fraction([(2011,0)-(2050,0.3)],(2011,0),(2050,0)) Units: Dmnl

water in reservoirs= INTEG (reservoirs recharge+water supply from investment-reservoirs evaporation-reservoirs use , initial reservoirs water) Units: Km3

water stress= total water dia/total renewable water resources Units: 1

water supply from DESALINATION= DESALINATION WATER SUPPLY INVESTMENT/(cost of water supply BY DESALINATION per m3 *m3 to km3) Units: Km3/Year

water supply from investment= water supply from DESALINATION Units: Km3/Year

water supply management investment= MAX(0,water green investment after MDG investment-cost of water demand management) Units: usd15/Year

water travel CO2 emissions by energy type[diesel]= ((international water travel energy consumption*SHARE OF INTERNATIONAL WATER TRAVEL [diesel]*CO2 EMISSION FACTORS[diesel])+(national water travel energy consumption[diesel]*CO2 EMISSION FACTORS[diesel])) water travel CO2 emissions by energy type[residual fuel]= ((international water travel energy consumption*SHARE OF INTERNATIONAL WATER TRAVEL [residual fuel]*CO2 EMISSION FACTORS [residual fuel])+(national water travel energy consumption[residual fuel] *CO2 EMISSION FACTORS[residual fuel])) Units: mtoe/Year

water travel employment= total water transport energy consumption*water travel employment factor Units: Person/Year

water travel employment factor= 20000 Units: Person/mtoe

water use for clothing production= WITH LOOKUP (Time, ([(2000,800)-(2022,2000)],(2000,886.555),(2001,969.857),(2002,1042.65),(2003,996.862),(2004,1010.06),(2005,1014.23),(2006,976.806),(2007,886.241),(2008,860.718),(2009,994.168),(2010,924.625),(2011,802.854),(2012,824.554),(2013,875.116),(2014,907.952),(2015,989.126),(2016,1004.6),(2017,1067.51),(2018,1033.04),(2019,1074.76),(2020,1130.27),(2021,979.424),(2022,884.287))) Units: m3/Ton

water use for plastic production= WITH LOOKUP (Time, ([(2000,2)-(2024,4)],(2000,2.71338),(2001,2.41002),(2002,2.63413),(2003,2.28896),(2004,2.92155),(2005,2.96377),(2006,2.76598),(2007,2.48878),(2008,3.33503),(2009,3.42924),(2010,3.49114),(2011,2.82006),(2012,2.74271),(2013,2.7591),(2014,2.68725),(2015,2.56549),(2016,2.3423),(2017,2.52082),(2018,2.68866),(2019,2.462),(2020,2.42457),(2021,2.69121),(2022,2.63671),(2023,2.59964),(2024,2.55846))) Units: m3/Ton

water use for vehicle production= WITH LOOKUP (Time, ([(2000,0)-(2050,200)],(2000,56.3891),(2001,57.2121),(2002,59.9115),(2003,60.155),(2004,66.6198),(2005,74.0245),(2006,74.7818),(2007,74.5867),(2008,78.3551),(2009,85.6146),(2010,86.1591),(2011,80.2273),(2012,82.5251),(2013,84.892),(2014,89.162),(2015,93.9927),(2016,90.7238),(2017,93.1152),(2018,95.0603),(2019,97.4337),(2020,115.543),(2021,101.577),(2022,109.966),(2023,113.195),(2024,113.352),(2050.61,191.228))) Units: m3/vehicle

water use from building construction= Sale of buildings*waster use for building construction Units: m3/Year

water use from clothing production= Sale of clothing*water use for clothing production Units: m3/Year

water use from plastic production= Sale of plastic*water use for plastic production Units: m3/Year

water use from vehicle production= Sale of vehicle*water use for vehicle production Units: m3/Year

water use rate([(1970,0)-(2010,10)],(1970,0.7),(1990,0.8),(2010,0.85)) Units: Dmnl

water used for biogasoline and biodiesel production= total bushel production*water used per bushel Units: gallon/Year

water used per bushel= 4000 Units: gallon/Bushel

"Water. Collection, purification and distribution of water employment"= total employment*sectoral distribution of employment[wcd] Units: Person

wave capacity from green investment= wave green investment/wave energy cost per mw(Time)/wave energy construction time Units: MW

wave energy capacity= INTEG (wave energy construction-wave energy discard, 0) Units: MW

wave energy construction= if then else(Time<2010, wave energy investment/wave energy cost per mw(Time)/wave energy construction time, (future wave energy investment /wave energy cost per mw(Time)/wave energy construction time)+wave capacity from green investment) Units: MW/Year

wave energy construction employment= wave energy construction*(wave energy construction employment factor(Time) +wave energy manufacturing employment factor(Time)) Units: Person/Year

wave energy construction employment factor([(2010,0)-(2030,20)],(2010,14.4),(2011,13.1108),(2012,11.9352),(2013,10.8632),(2014,9.8858),(2015,8.9947),(2016,8.1826),(2017,7.4424),(2018,6.7679),(2019,6.1533),(2020,5.5934),(2021,5.0835),(2022,4.619),(2023,4.1961),(2024,3.8111),(2025,3.4606),(2026,3.1416),(2027,2.8513),(2028,2.5871),(2029,2.3469),(2030,2.1283)) Units: Person/MW

wave energy construction time= 1 Units: Year

wave energy cost per mw([(2015,0)-(4000,8e+006)],(2015,3.52e+006),(2930,2.69e+006)) Units: usd15/MW

wave energy discard= wave energy capacity/waste capital life time Units: MW/Year

wave energy electricity generation= min((TOTAL electricity demand accounting for distribution losses-hydro electricity generation -wind electricity generation-solar electricity generation-geothermal electricity generation -tidal energy electricity generation), wave energy power capacity use/mwh to gwh) Units: GWh/Year

wave energy investment Units: usd15

wave energy load factor= 0.2 Units: Dmnl

wave energy maintenance cost= wave energy capacity*wave energy maintenance cost per mw Units: usd15/Year

wave energy maintenance cost 3= "Co-generation energy capacity"*wave energy maintenance cost per mw 3 Units: usd15/Year

wave energy maintenance cost per mw= 200000 Units: usd15/MW/Year

wave energy maintenance cost per mw 3= 500000 Units: usd15/MW/Year

wave energy manufacturing employment factor([(2010,0)-(2030,10)],(2010,1.6),(2011,1.4568),(2012,1.3261),(2013,1.207),(2014,1.0984),(2015,0.9994),(2016,0.9092),(2017,0.8269),(2018,0.752),(2019,0.6837),(2020,0.6215),(2021,0.5648),(2022,0.5132),(2023,0.4662),(2024,0.4235),(2025,0.3845),(2026,0.3491),(2027,0.3168),(2028,0.2875),(2029,0.2608),(2030,0.2365)) Units: Person/MW

wave energy operation and maintenance employment= wave energy capacity*wave energy operation and maintenance employment factor (Time) Units: Person/Year

wave energy operation and maintenance employment factor([(2010,0)-(2030,1)],(2010,0.512),(2011,0.4662),(2012,0.4244),(2013,0.3862),(2014,0.3515),(2015,0.3198),(2016,0.2909),(2017,0.2646),(2018,0.2406),(2019,0.2188),(2020,0.1989),(2021,0.1807),(2022,0.1642),(2023,0.1492),(2024,0.1355),(2025,0.123),(2026,0.1117),(2027,0.1014),(2028,0.092),(2029,0.0834),(2030 ,0.0757)) Units: Person/MW

wave energy power capacity use= wave energy load factor*potential electricity generation wave energy Units: MWh/Year

wave green investment= wave green investment fraction(Time)*power generation investment Units: usd15/Year

wave green investment fraction([(2011,0)-(2050,0.3)],(2011,0.01),(2050,0.01)) Units: Dmnl

wave share of power generation= wave energy electricity generation/total electricity generation Units: Dmnl

Weighted Average Energy Price= Coal Energy Market Share*real coal price per MBTU+Natural Gas Energy Market Share *real natural gas price per MBTU +Oil Energy Market Share*real oil price per Mbtu+Renewable Resources Energy Market Share *Renewable Resources price Units: usd15/Mbtu

"weighted personal consumption (WPC)"= PC DISPOSABLE INCOME/(1+gini coefficient(Time)) Units: Dmnl

weighted us gas price per mbtu= real natural gas price per MBTU Units: usd15/Mbtu

well being index= (medium term average real pc gdp/reference saturation income)*income weight + (pc health expenditure/reference saturation pc health expenditure)*access to health care weight Units: Dmnl

WHO STANDARD CALORIES= 2600 Units: Kal/(Person*day)

WHO STANDARD MICRONUTRIENTS =5 Units: gr/(Person*day)

WHO STANDARD PROTEINS = 50 Units: gr/(Person*day)

WIND: WIND ONSHORE, WIND OFFSHORE

wind capacity= INTEG (wind construction-wind discard, 20) Units: MW

wind capacity from green investment= wind green investment/wind cost per mw(Time)/wind construction time Units: MW

wind capital life time= 20 Units: Year

wind construction= if then else(Time<2010, wind investment(Time)/wind cost per mw(Time)/wind construction time , (future wind investment/wind cost per mw (Time) /wind construction time)+wind capacity from green investment)*(if then else (IEA NET ZERO SWITCH=1,"Increase in wind capacity IEA.NZ",1)) Units: MW/Year

wind construction employment= wind construction*(wind construction employment factor(Time)+wind manufacturing employment factor (Time)) Units: Person/Year

wind construction employment factor([(2010,0)-(2030,4)],(2010,3.8118),(2011,3.664),(2012,3.522),(2013,3.3855),(2014,3.2543),(2015,3.1282),(2016,3.0068),(2017,2.8902),(2018,2.778),(2019,2.6701),(2020,2.5662),(2021,2.4931),(2022,2.4214),(2023,2.3514),(2024,2.2828),(2025,2.2158),(2026,2.1502),(2027,2.086),(2028,2.0233),(2029,1.9619),(2030 ,1.9019)) Units: Person/MW

wind construction time= 1 Units: Year

wind cost per mw([(2015,0)-(2030,6e+006)],(2015,1.43e+006),(2030,1.32e+006)) Units: usd15/MW

wind discard= wind capacity/wind capital life time Units: MW/Year

wind electricity generation= min((TOTAL electricity demand accounting for distribution losses-hydro electricity generation), windpower capacity use/mwh to gwh) Units: GWh/Year

wind energy production in QDBTU= wind energy production in QDBTU table(Time) Units: qdbtu/Year

wind energy production in QDBTU table([(1971,0)-(2010,1)],(1971,0),(1972,0),(1973,0),(1974,0),(1975,0),(1976,0), (1977,0),(1978,9.54042e-006),(1979,1.90808e-005),(1980,3.49815e-005),(1981, 3.49815e-005),(1982,6.04227e-005),(1983,9.54042e-005),(1984,0.000120845),(1985,0.000184448),(1986,0.000435679),(1987,0.000620127),(1988,0.00107171),(1989,0.00865634),(1990,0.0123389),(1991,0.0133471),(1992,0.0147559),(1993,0.0177992),(1994,0.0232214),(1995,0.0252789),(1996,0.0300332),(1997,0.0383875),(1998,0.0511017),(1999,0.0684748),(2000,0.0996147),(2001,0.122136),(2002,0.16801),(2003,0.204467),(2004,0.267513),(2005,0.33063),(2006,0.41905),(2007,0.551172)) Units: qdbtu/Year

wind green investment= wind green investment fraction(Time)*power generation investment Units: usd15/Year

wind green investment fraction([(2011,0)-(2050,1)],(2011,0.35),(2050,0.15)) Units: Dmnl

wind investment([(1970,0)-(2010,6e+010)],(1970,5.26e+008),(1984,7.89e+008),(1990,7.89e+008),(1994,1.58e+009),(1999,2.63e+009),(2010,5.34e+010)) Units: usd15

wind load factor([(2010,0.2)-(2050,0.4)],(2010,0.215698),(2022,0.269084),(2023,0.262627),(2030,0.275906),(2035,0.30056),(2040,0.316908),(2050,0.336461)) Units: Dmnl

wind maintenance cost= wind capacity*wind maintenance cost per mw Units: usd15/Year

wind maintenance cost per mw= 39187.5 Units: usd15/MW/Year

wind manufacturing employment factor([(2010,0)-(2030,20)],(2010,17.7542),(2011,17.0498),(2012,16.3735),(2013,15.7239),(2014,15.1001),(2015,14.5009),(2016,13.9253),(2017,13.3723),(2018,12.841),(2019,12.3304),(2020,11.8397),(2021,11.5016),(2022,11.1709),(2023,10.8473)

,(2024,10.5307),(2025,10.221),(2026,9.9181),(2027,9.6218),(2028,9.332),(2029
,9.0486),(2030,8.7714)) Units: Person/MW

wind operation and maintenance employment= wind capacity*wind operation and maintenance employment factor(Time) Units: Person/Year

wind operation and maintenance employment factor([(2010,0)-
(2030,1)],(2010,0.63),(2011,0.6058),(2012,0.5826),(2013,0.5602),
(2014,0.5387),(2015,0.518),(2016,0.4981),(2017,0.479),(2018,0.4605),(2019,0.4428
),(2020,0.4257),(2021,0.4136),(2022,0.4017),(2023,0.3901),(2024,0.3788),(2025
,0.3676),(2026,0.3568),(2027,0.3461),(2028,0.3357),(2029,0.3255),(2030,0.3156)) Units: Person/MW

wind share of power generation= wind electricity generation/total electricity generation Units: Dmnl

windpower capacity use= wind load factor(Time)*potential electricity generation wind Units: MWh/Year

working age: (AGE 15 - AGE 65)

world biofuel demand= world biofuel production in qdbtu Units: qdbtu/Year

world biofuel production in qdbtu= total biofuel production IN MB/QDBTU to MB(Time) Units: qdbtu/Year

world BIOFUELS DEMAND IN qdbtu= world biofuel demand Units: qdbtu/Year

World Coal Actual Reserves Production Ratio= World Coal Recoverable Reserves/World Coal Production Rate Units: Year

World Coal Capacity Utilisation in Production= World Coal Capacity Utilisation in Production table(World Coal Capacity Utilisation in Production function) Units: Dmnl

World Coal Capacity Utilisation in Production function= indicated world Coal demand/World Coal Potential Production Units: Dmnl

World Coal Capacity Utilisation in Production table([(0,0)-
(1.6,1)],(0,0),(0.2,0.2),(0.4,0.4),(0.6,0.6),(0.8,0.8),(1,1),(1.2,1),(1.4,1),(1.6,1)) Units: Dmnl

World Coal Cumulative Production= INTEG (World Coal Production Rate, World Coal Initial Cumulative Production) Units: MST

world Coal demand= coal demand Units: MST/Year

world Coal demand in qdbtu= world Coal demand/QDBTU to MST Units: qdbtu/Year

World Coal Demand Supply Balance= world Coal demand/world coal production Units: Dmnl

World Coal Desired Discovery Rate= World Coal Initial Discovery Rate*World Coal Effect of Energy Utilisation on Exploration *World Coal Price Effect on Exploration Units: MST/Year

World Coal development rate= World Coal Initial Development Rate*World Coal Relative Effect of Depletion on Productivity of Investment in Development function IR *World Coal Relative Effect of Technology and Depletion on Productivity of Investment in Development function *World Coal Price Effect on Exploration Units: MST/Year

World Coal Discovered Reserves= INTEG (World Coal development rate+World Coal Discovery Rate-World Coal Production Rate , World Coal initial discovered resources) Units: MST

World Coal Discovery Rate= min(World Coal Desired Discovery Rate,World Coal Potential Discoverable Resource) Units: MST/Year

World Coal Effect of Depletion on Productivity of Investment in Development function IR = identified World Coal reserve developable remaining/World Coal Total Resource Units: Dmnl

World Coal Effect of Energy Utilisation on Exploration= World Coal Effect of Energy Utilisation on Exploration Table(World Coal fraction UR remaining) Units: Dmnl

World Coal Effect of Energy Utilisation on Exploration Table([(0,0)-(1,1.3)],(0,0),(0.2,0.25),(0.330275,0.507456),(0.486239,0.866667),(0.626911,1.09474),(0.746177,1.19167),(0.868502,1.22018),(1,1.22018)) Units: Dmnl

World Coal Effect of Technology and Depletion on Productivity of Investment in Development function = World Coal Undiscovered Resources/World Coal Total Resource Units: Dmnl

world coal final consumption in mb= (agriculture coal demand+commercial coal demand+Fishing coal demand+industrial coal demand +"non-energy use coal demand"+Others coal demand+residential coal demand+transportation coal demand)*convertor to MB Units: MB/Year

World Coal Fraction Total Resources Remaining= (World Coal Undiscovered Resources+World Coal Discovered Reserves)/(World Coal Undiscovered Resources +World Coal Discovered Reserves+World Coal Cumulative Production) Units: Dmnl

World Coal fraction UR remaining= World Coal Undiscovered Resources/World Coal initial NR resources Units: Dmnl

World Coal Identified Reserve non recoverable= World Coal Discovered Reserves-World Coal Recoverable Reserves Units: MST

World Coal Initial Cumulative Production= 200000 Units: MST

World Coal Initial Development Rate= 1000 Units: MST/Year

World Coal initial discovered resources= 1.32e+006 Units: MST

World Coal Initial Discovery Rate= 600 Units: MST/Year

World Coal Initial Effect of Depletion on Productivity of Investment in Development function IR = INITIAL(World Coal Effect of Depletion on Productivity of Investment in Development function IR) Units: Dmnl

World Coal Initial Effect of Technology and Depletion on Productivity of Investment in Development function = INITIAL(World Coal Effect of Technology and Depletion on Productivity of Investment in Development function) Units: Dmnl

World Coal initial NR resources= (World Coal Cumulative Production+World Coal Discovered Reserves+World Coal Undiscovered Resources) Units: MST

World Coal Maximum Production Rate= World Coal Discovered Reserves/Minimum Extraction Time Units: MST/Year

World Coal Potential Discoverable Resource= Coal fraction discoverable(Time)*World Coal Undiscovered Resources/Minimum Extraction Time Units: MST/Year

World Coal Potential Production= min(WORLD Coal PRODUCTION CAPACITY,World Coal Potential Production from Reserves) Units: MST/Year

World Coal Potential Production from Reserves= World Coal Recoverable Reserves/World Coal Reference Reserve Production Ratio Units: MST/Year

World Coal Price Effect on Exploration= Coal Price per MBTU/Coal production cost per MBTU Units: Dmnl

world coal production= World Coal Production Rate Units: MST/Year

WORLD Coal PRODUCTION CAPACITY= 120000 Units: MST/Year

World Coal Production in qdbtu= World Coal Production Rate/QDBTU to MST Units: qdbtu/Year

World Coal Production Rate= min(World Coal Capacity Utilisation in Production*World Coal Potential Production ,World Coal Maximum Production Rate) Units: MST/Year

World Coal Recoverable Reserves= (World Coal Discovered Reserves+World Coal Cumulative Production)*Coal Fraction Recoverable (Time)-World Coal Cumulative Production Units: MST

World Coal Reference Reserve Production Ratio= 20 Units: Year

World Coal Relative Effect of Depletion on Productivity of Investment in Development function IR = World Coal Effect of Depletion on Productivity of Investment in Development function IR /World Coal Initial Effect of Depletion on Productivity of Investment in Development function IR Units: Dmnl

World Coal Relative Effect of Technology and Depletion on Productivity of Investment in Development function = World Coal Effect of Technology and Depletion on Productivity of Investment in Development function /World Coal Initial Effect of Technology and Depletion on Productivity of Investment in Development function Units: Dmnl

World Coal Total Resource= World Coal Cumulative Production+World Coal Discovered Reserves+World Coal Undiscovered Resources Units: MST

World Coal Undiscovered Resources= INTEG (-World Coal Discovery Rate-World Coal development rate, initial World Coal undiscovered resources) Units: MST

World Desired Recoverable Coal= world Coal demand+Coal World Adjustment of Total Recoverable Resources Remaining +Coal World Adjustment for Expected Growth in Demand Units: MST/Year

World Desired Recoverable Gas= natural gas demand+Gas World Adjustment of Total Recoverable Resources Remaining +Gas World Adjustment for Expected Growth in Demand Units: BCF/Year

world elasticity of oil price to supply demand balance= if then else (Time<2003, 1, 1.5) Units: Dmnl

world electricity final consumption in in qdbtu= world electricity final consumption in mb/QDBTU to MB(Time) Units: qdbtu/Year

world electricity final consumption in mb= car stock oil demand reduction in mb+total electrification from transport+ (agriculture electricity demand+commercial electricity demand+Fishing electricity demand +industrial electricity demand+ "non-energy use electricity demand" +Others electricity demand+Others electricity demand+residential electricity demand +transportation electricity demand)* convertor to MB Units: MB/Year

world energy demand supply balance= total energy demand/total energy supply Units: Dmnl

World Natual Gas initial discovered resources= 9.75e+006 Units: BCF

World Natural Gas Actual Reserves Production Ratio= World Natural Gas Potential Production from Reserves/World Natural Gas Production Rate Units: Dmnl

World Natural Gas Capacity Utilisation in Production= World Natural Gas Capacity Utilisation in Production table(World Natural Gas Capacity Utilisation in Production function) Units: Dmnl

World Natural Gas Capacity Utilisation in Production function= indicated world natural gas demand/World Natural Gas Potential Production Units: Dmnl

World Natural Gas Capacity Utilisation in Production table([(0,0)-(1.6,1)],(0,0),(0.2,0.2),(0.4,0.4),(0.6,0.6),(0.8,0.8),(1,0.98),(1.2 ,1),(1.4,1),(1.6,1)) Units: Dmnl

World Natural Gas Cumulative Production= INTEG (+World Natural Gas Production Rate, World Natural Gas Initial Cumulative Production) Units: BCF

world natural gas demand in qdbtu= natural gas demand/QDBTU to BCF Units: qdbtu/Year

world natural gas demand supply balance= natural gas demand/world natural gas production Units: Dmnl

World Natural Gas Desired Discovery Rate= World Natural Gas Initial Discovery Rate*World Natural Gas Effect of Energy Utilisation on Exploration *World Natural Gas Price Effect on Exploration Units: BCF/Year

World Natural Gas development rate= World Natural Gas Initial Development Rate*World Natural Gas Relative Effect of Depletion on Productivity of Investment in Development function IR *World Natural Gas Relative Effect of Technology and Depletion on Productivity of Investment in Development function *World Natural Gas Price Effect on Exploration Units: BCF/Year

World Natural Gas Discovered Reserves= INTEG (-World Natural Gas Production Rate+World Natural Gas Discovery Rate+World Natural Gas development rate , World Natual Gas initial discovered resources) Units: BCF

World Natural Gas Discovery Rate= min(World Natural Gas Desired Discovery Rate,World Natural Gas Potential Discoverable Resource) Units: BCF/Year

World Natural Gas Effect of Depletion on Productivity of Investment in Development function IR = identified World Natural Gas reserve developable remaining/World Natural Gas Total Resource Units: Dmnl

World Natural Gas Effect of Energy Utilisation on Exploration= World Natural Gas Effect of Energy Utilisation on Exploration Table(World Natural Gas fraction UR remaining) Units: Dmnl

World Natural Gas Effect of Energy Utilisation on Exploration Table([(0,0)-(1,1.3)],(0,0),(0.2,0.25),(0.330275,0.507456),(0.486239,0.866667),(0.626911,1.09474),(0.746177,1.19167),(0.868502,1.22018),(1,1.22018)) Units: Dmnl

World Natural Gas Effect of Technology and Depletion on Productivity of Investment in Development function = World Natural Gas Undiscovered Resources/World Natural Gas Total Resource Units: Dmnl

world natural gas final consumption in mb= (agriculture natural gas demand+commercial natural gas demand+Fishing natural gas demand +industrial natural gas demand+"non-energy use natural gas demand"+Others natural gas demand +residential natural gas demand+transportation natural gas demand)*convertor to MB Units: MB/Year

World Natural Gas Fraction Total Resources Remaining= (World Natural Gas Undiscovered Resources+World Natural Gas Discovered Reserves)/(World Natural Gas Undiscovered Resources+World Natural Gas Discovered Reserves +World Natural Gas Cumulative Production) Units: Dmnl

World Natural Gas fraction UR remaining= World Natural Gas Undiscovered Resources/World Natural Gas initial NR resources Units: Dmnl

World Natural Gas Identified Reserve non recoverable= World Natural Gas Discovered Reserves-World Natural Gas Recoverable Reserves Units: BCF

World Natural Gas Initial Cumulative Production= 1.5946e+006-Natural Gas Initial Cumulative Production Units: BCF

World Natural Gas Initial Development Rate= 30000 Units: BCF/Year

World Natural Gas Initial Discovery Rate= 100000 Units: BCF/Year

World Natural Gas Initial Effect of Depletion on Productivity of Investment in Development function IR = INITIAL(World Natural Gas Effect of Depletion on Productivity of Investment in Development function IR) Units: Dmnl

World Natural Gas Initial Effect of Technology and Depletion on Productivity of Investment in Development function = INITIAL(World Natural Gas Effect of Technology and Depletion on Productivity of Investment in Development function) Units: Dmnl

World Natural Gas initial NR resources= (World Natural Gas Cumulative Production+World Natural Gas Discovered Reserves +World Natural Gas Undiscovered Resources) Units: BCF

World Natural Gas Maximum Production Rate= World Natural Gas Discovered Reserves/Minimum Extraction Time Units: BCF/Year

World Natural Gas Potential Discoverable Resource= Natural Gas fraction discoverable(Time)*World Natural Gas Undiscovered Resources /Minimum Extraction Time Units: BCF/Year

World Natural Gas Potential Production= min(WORLD NATURAL GAS PRODUCTION CAPACITY,World Natural Gas Potential Production from Reserves) Units: BCF/Year

World Natural Gas Potential Production from Reserves= World Natural Gas Recoverable Reserves/World Natural Gas Reference Reserve Production Ratio Units: BCF/Year

World Natural Gas Price Effect on Exploration= Natural Gas Price per MBTU/natural gas production cost per MBTU Units: Dmnl

world natural gas production= World Natural Gas Production Rate Units: BCF/Year

WORLD NATURAL GAS PRODUCTION CAPACITY= 400000 Units: BCF/Year

World Natural Gas Production in qdbtu= World Natural Gas Production Rate/QDBTU to BCF Units: qdbtu/Year

World Natural Gas Production Rate= min(World Natural Gas Capacity Utilisation in Production*World Natural Gas Potential Production ,World Natural Gas Maximum Production Rate) Units: BCF/Year

World Natural Gas Recoverable Reserves= (World Natural Gas Discovered Reserves+World Natural Gas Cumulative Production)*Natural Gas Fraction Recoverable(Time)*World Natural Gas Technology Enhancement -World Natural Gas Cumulative Production Units: BCF

World Natural Gas Reference Reserve Production Ratio= 15 Units: Year

World Natural Gas Relative Effect of Depletion on Productivity of Investment in Development function IR = World Natural Gas Effect of Depletion on Productivity of Investment in Development function IR /World Natural Gas Initial Effect of Depletion on Productivity of Investment in Development function IR Units: Dmnl

World Natural Gas Relative Effect of Technology and Depletion on Productivity of Investment in Development function = World Natural Gas Effect of Technology and Depletion on Productivity of Investment in Development function /World Natural Gas

Initial Effect of Technology and Depletion on Productivity of Investment in Development function Units: Dmnl

World Natural Gas Technology Enhancement= DELAY N(technology enhancement table(row Gas demand supply balance),1,1,1) Units: Dmnl

World Natural Gas Total Resource= World Natural Gas Cumulative Production+World Natural Gas Discovered Reserves +World Natural Gas Undiscovered Resources Units: BCF

World Natural Gas Undiscovered Resources= INTEG (-World Natural Gas Discovery Rate-World Natural Gas development rate, initial World Natural Gas undiscovered resources) Units: BCF

World Oil Capacity Utilisation in Production= World Oil Capacity Utilisation in Production table(World Oil Capacity Utilisation in Production function) Units: Dmnl

World Oil Capacity Utilisation in Production function= Effective ROW oil demand/World Oil Potential Production Units: Dmnl

World Oil Capacity Utilisation in Production table([(0,0)-(1.6,1)],(0,0),(0.2,0.2),(0.4,0.4),(0.6,0.6),(0.8,0.8),(0.9,0.9),(1 ,0.98),(1.2,1),(1.4,1),(1.6,1)) Units: Dmnl

World Oil Cumulative Production= INTEG (+World Oil Production rate, World Oil Initial Cumulative Production) Units: MB

world oil demand= oil inventory and losses(Time)+world oil final consumption in mb Units: MB/Year

world oil demand in qdbtu= world oil demand/QDBTU to MB(Time) Units: qdbtu/Year

world oil demand supply balance= (world oil demand*(1+ROW Trend)^5)/(World Oil Potential Production*(1+ROW Potential Production Trend)^5) Units: Dmnl

World Oil Desired Discovery Rate= World Oil Initial Discovery Rate*World Oil Effect of Energy Utilisation on Exploration *World Oil Price Effect on Exploration Units: MB/Year

World Oil Discovered Reserves= INTEG (-World Oil Production rate+World Oil Discovery from Exploration+World Oil Discovery from development +addition to world oil discovered reserves, World Oil initial discovered resources) Units: MB

World Oil Discovery from development= World Oil Initial Development Rate*World Oil Relative Effect of Depletion on Productivity of Investment in Development function IR *World Oil Relative Effect of Technology and Depletion on Productivity of Investment in Development function *World Oil Price Effect on Exploration Units: MB/Year

World Oil Discovery from Exploration= min(World Oil Desired Discovery Rate,World Oil Potential Discoverable Resource) Units: MB/Year

World Oil Effect of Depletion on Productivity of Investment in Development function IR = identified World Oil reserve developable remaining/World Oil Total Resource Units: Dmnl

World Oil Effect of Energy Utilisation on Exploration= World Oil Effect of Energy Utilisation on Exploration Table(World Oil fraction UR remaining) Units: Dmnl

World Oil Effect of Energy Utilisation on Exploration Table([(0,0)-(1,1.3)],(0,0),(0.2,0.25),(0.330275,0.507456),(0.486239,0.866667),(0.626911,1.09474),(0.746177,1.19167),(0.868502,1.22018),(1,1.22018)) Units: Dmnl

World Oil Effect of Technology and Depletion on Productivity of Investment in Development function = World Oil Undiscovered Resources/World Oil Total Resource Units: Dmnl

world oil final consumption in mb= (normalized agriculture petroleum demand+normalized commercial petroleum demand +normalized Fishing petroleum demand+normalized industrial petroleum demand +"normalized non-energy use petroleum demand" +normalized Others petroleum demand+normalized residential petroleum demand +total transport oil consumption in qdbtu)*convertor to MB+oil demand for power generation in mb Units: MB/Year

World Oil Fraction Recoverable= 0.22+Oil Fraction Recoverable(Time) Units: Dmnl

World Oil Fraction Total Resources Remaining= (World Oil Undiscovered Resources+World Oil Discovered Reserves)/(World Oil Undiscovered Resources +World Oil Discovered Reserves+World Oil Cumulative Production) Units: Dmnl

World Oil fraction UR remaining= World Oil Undiscovered Resources/World Oil initial NR resources Units: Dmnl

World Oil Identified Reserve non recoverable= World Oil Discovered Reserves-World Oil Recoverable Reserves Units: MB

World Oil Initial Cumulative Production= 885505-Initial Oil Cumulative Production Units: MB

World Oil Initial Development Rate= 10000 Units: MB/Year

World Oil initial discovered resources= 2.47e+006 Units: MB

World Oil Initial Discovery Rate= 3000 Units: MB/Year

World Oil Initial Effect of Depletion on Productivity of Investment in Development function IR = INITIAL(World Oil Effect of Depletion on Productivity of Investment in Development function IR) Units: Dmnl

World Oil Initial Effect of Technology and Depletion on Productivity of Investment in Development function = INITIAL(World Oil Effect of Technology and Depletion on Productivity of Investment in Development function) Units: Dmnl

World Oil initial NR resources= (World Oil Cumulative Production+World Oil Discovered Reserves+World Oil Undiscovered Resources) Units: MB

World Oil Potential Discoverable Resource= Oil Fraction Discoverable(Time)*World Oil Undiscovered Resources/Minimum Extraction Time Units: MB/Year

World Oil Potential Production= effect of investment on potential production*Effective world oil potential production from reserves Units: MB/Year

World Oil Price Effect on Exploration= (Oil Price per MBtu/World Oil production cost)^1.5 Units: Dmnl

world oil production= World Oil Production rate Units: MB/Year

World Oil Production Capacity= 50000 Units: MB/Year

World Oil production cost= World real Oil production cost*gdp deflator Units: USD/Mbtu

World Oil production historical([(1990,300)-(2015,30000)],(1990,22108.1),(1991,21976.7),(1992,21976.7),(1993,21987.6),(1994,22261.3),(1995,22750.4),(1996,23254.2),(1997,23976.8),(1998,24425.8),(1999,24035.3),(2000,24944.1),(2001,24798.1),(2002,24396.6),(2003,25367.5),(2015,24940)) Units: MB/Year

World Oil Production in qdbtu= World Oil Production rate/QDBTU to MB(Time) Units: qdbtu/Year

World Oil Production rate= World Oil Capacity Utilisation in Production*World Oil Potential Production Units: MB/Year

World Oil Recoverable Reserves= (World Oil Discovered Reserves+World Oil Cumulative Production)*Oil Fraction Recoverable (Time)-World Oil Cumulative Production Units: MB

world oil reference reserve production ratio= world oil reference reserve production ratio function((World Oil Discovered Reserves +World Oil Cumulative Production)/World Oil Total Resource) Units: Year

world oil reference reserve production ratio function([(0,0)-(1,40)],(0,1),(0.143731,1.57895),(0.272171,2.45614),(0.391437,2.80702

),(0.501529,3.68421),(0.577982,4.5614),(0.681957,6.31579),(0.776758,10),(0.834862,16.3),(0.892966,21),(0.941896,23.5),(1,25)) Units: Year

World Oil Relative Effect of Depletion on Productivity of Investment in Development function IR = World Oil Effect of Depletion on Productivity of Investment in Development function IR /World Oil Initial Effect of Depletion on Productivity of Investment in Development function IR Units: Dmnl

World Oil Relative Effect of Technology and Depletion on Productivity of Investment in Development function = World Oil Effect of Technology and Depletion on Productivity of Investment in Development function /World Oil Initial Effect of Technology and Depletion on Productivity of Investment in Development function Units: Dmnl

World Oil technology enhancement= DELAY N(technology enhancement table(row demand supply balance), 1,1,1) Units: Dmnl

World Oil Total Resource= World Oil Cumulative Production+World Oil Discovered Reserves+World Oil Undiscovered Resources Units: MB

world oil ultimate recovery= World Oil Cumulative Production+World Oil Recoverable Reserves Units: MB

World Oil Undiscovered Resources= INTEG (-World Oil Discovery from Exploration-World Oil Discovery from development +addition to world oil undiscovered resources, initial World Oil undiscovered resources) Units: MB

World pressure to produce= DELAY N(world pressure to produce function(world oil demand supply balance),1,1,1) Units: Dmnl

world pressure to produce function([(0,0)-(2,2)],(0.5,0.8),(0.8,0.9),(1,1),(1.25,1.1),(1.5,1.2)) Units: Dmnl

World real Oil production cost= World real Oil production cost data*effect of world oil demand and supply balance Units: Dmnl

World real Oil production cost data= 6.5 Units: Dmnl

world remewables demand in qdbtu= WORLD RENEWABLES DEMAND IN QDBTU Units: qdbtu/Year

world renewable resources final consumption in mb= (agriculture renewable resources demand+commercial renewable resources demand +Fishing renewable resources demand+Industrial renewable resources demand+"non-energy use renewable resources demand" +Others renewable resources demand+residential renewable resources demand+transportation renewable resources demand)*convertor to MB Units: MB/Year

world renewable resources final consumption inqdbtu= world renewable resources final consumption in mb/QDBTU to MB(Time) Units: qdbtu/Year

WORLD RENEWABLES DEMAND IN QDBTU= total electricity demand from renewable sources*GWH TO QDBTU Units: qdbtu/Year

WORLD TOTAL ELECTRICITY DEMAND IN QDBTU= TOTAL electricity demand accounting for distribution losses*GWH TO QDBTU Units: qdbtu/Year

PAGE PARTNERSHIP FOR ACTION ON GREEN ECONOMY

PAGE brings together the expertise convening power and networks of five UN agencies – UN Environment, International Labour Organization, UN Development Programme, UN Industrial Development Organization, and UN Institute for Training and Research – to support countries in addressing one of the most pressing challenges of the 21st century: transforming their economies and financial systems into drivers of sustainability and social equity. Since its inception in 2013, PAGE is supported by the generous contributions of its funding partners including European Union, German Federal Ministry for the Environment, Climate Action, Nature Conservation and Nuclear safety, Ministry of Foreign Affairs of Finland, Norwegian Ministry of Climate and Environment, Ministry of Climate, Energy and Environment of the Republic of Korea, Swedish International Development Agency (SIDA), and the State Secretariat for Economic Affairs of Switzerland (SECO).

The Partnership supports nations and regions in reframing economic policies and practices around sustainability to foster economic growth, create income and jobs, reduce poverty and inequality , strengthen the ecological foundations of their economies and achieve Sustainable Development Goals.

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