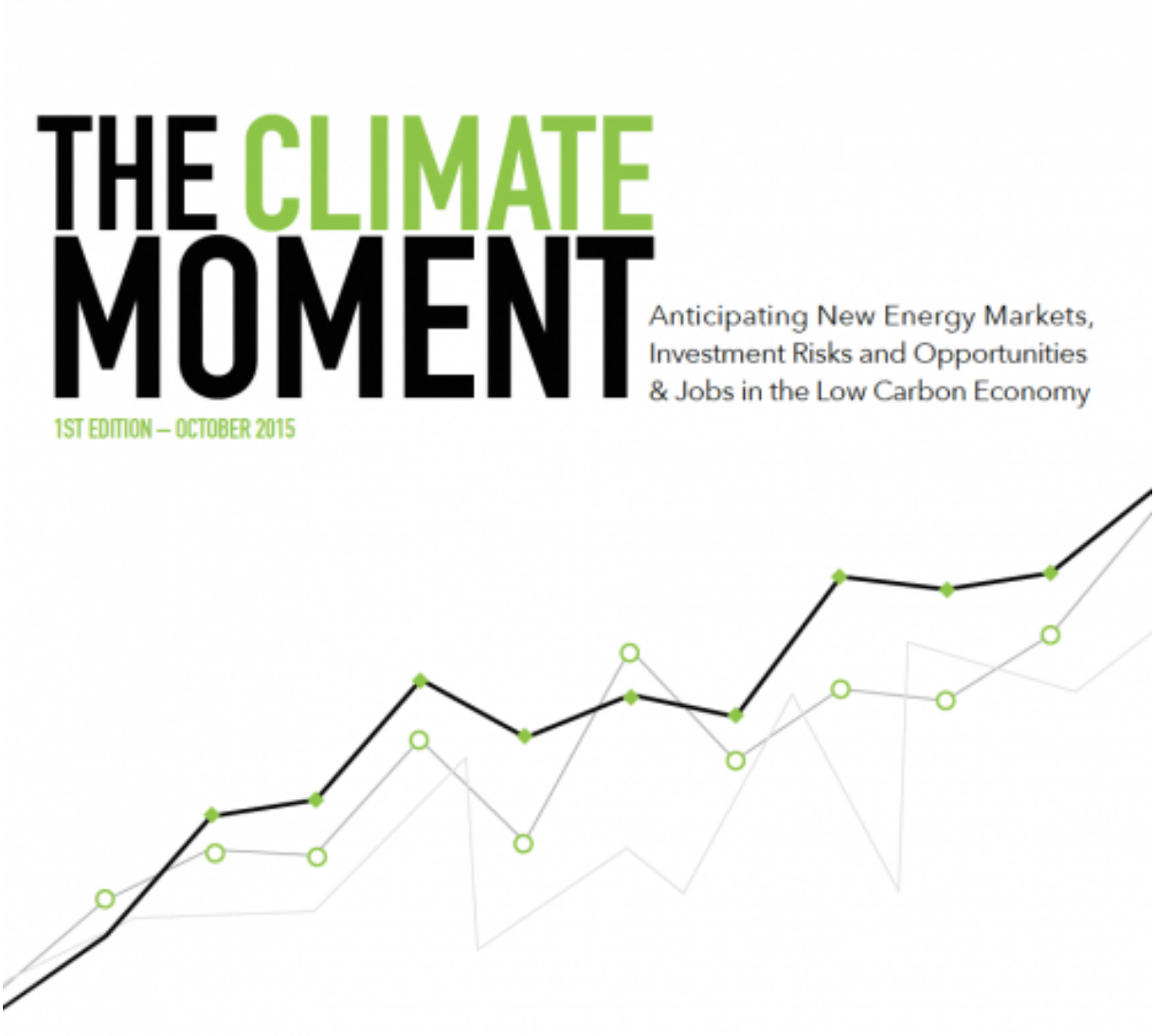

U.S. Country Summary

DUAL CITIZEN KnowlEdge Srl

ABOUT DUAL CITIZEN LLC

Dual Citizen advises clients on how to leverage data analytics and strategic communications to further their growth and development agendas. We work with government ministries, international organizations and private firms on consulting assignments and by sub-contracting with strategic partners. Dual Citizen produces the Global Green Economy Index™ (GGEI), which will publish its 5th edition in the fall of 2016. The GGEI provides a comprehensive ranking of green national reputations and actual performance over 80 countries and 50 cities. For more information, please visit www.dualcitizeninc.com and follow us on Twitter @DualCitizenInc.

ABOUT KNOWLEDGE SRL

KnowlEdge Srl (KE) is a consulting company with international presence, supporting its clients in exploring socio-economic and environmental complexity to inform decision making for sustainability. KE is a leader in developing customized methodologies and tools for the elaboration of integrated strategies, action plans and investment programs, including for green economy and green growth. This includes work in the context of risk assessment, with emphasis on reducing vulnerability and enhancing resilience. Dr. Bassi, the CEO of KE, recently published "Tackling Complexity", a book presenting a step-by-step approach to using systems thinking to solve complex problems in both the socio-political and business environments. For more information, please visit www.ke-srl.com.

The U.S. Climate Moment: A Systems Approach to Green Investment

Introduction

In the months after the historic climate agreement reached in Paris in December 2015, climate-related investments have been top of mind. Consensus estimates are that around $1 trillion annually will be required to have a chance at keeping global emissions within the 2 degree Celsius budget framework that has structured recent climate negotiations.

Despite the primacy of government goal-setting in reaching the recent climate accord, these investments will have to originate primarily from the private sector. While governments have made a dent in this effort – most notably through a commitment to pledge additional support to help developing countries adapt to the adverse impacts of global climate change – these public efforts will still fall well short of what is required.

Encouragingly, large investors are already evolving to a more multi-dimensional approach to green investments. Environment, social & governance (ESG) criteria have infiltrated investment evaluation in some of the largest banks in the world, including Goldman Sachs and J.P. Morgan. So-called "green bonds" are increasingly popular. Many of the world's largest companies – propelled by pledges at the COP21 in Paris – are making ambitious commitments to renewable energy investments to support power requirements and reduce ecological footprints.

But in facing this enormous task and responsibility, market actors will require new and different analytical approaches to link these global goals with the investments that will help reach them. We believe that an integrated "systems" approach offers a new way to begin to evaluate investments in the context of broader, global goals related to climate change and sustainable development. A traditional evaluation method might assess a green investment opportunity according to the cost of capital, the time period of the project and the cash flow generated over a given period. However, in the context of climate-related investments, a systems approach offers an integrated viewpoint for policymakers, investors and businesses. It can help to unify the demands for returns required by investors with the increasing urgency of allocating capital to projects that further global climate and sustainable development goals.

This brief country summary will explain how and why a systems approach to green investments is valuable in the context of the U.S. economy, in addition to sharing some of the results from our analysis of the economy-wide impacts of the U.S. achieving its climate goals.

Systems Analysis and Climate Change

This U.S. country summary is an excerpt from *The Climate Moment: Anticipating New Energy Markets, Investment Risks & Opportunities and Jobs in the Low Carbon Economy*, a study that provides an in-depth analysis of 11 of the largest carbon markets in the world. For each market, we use emission reduction pledges to the Paris Climate Conference (called INDCs in UN-speak) to calculate the INDC-related investment required, payback periods, avoided costs, energy sector winners and losers and employment impacts. In addition to summarizing these data in a user-friendly presentation, the study includes original research insights revealing tangible policy, investment and business trends in each country for readers to be aware of.

Our modeling forecasts economy-wide outcomes over time with direct links to the stakeholders most impacted by them – policy makers, investors and businesses – so they can utilize a more multi-dimensional set of results to inform their decision making. In the most simple terms, our model takes inputs from each country – including policy interventions and certain assumptions like population trends, GDP growth and energy prices – and generates outputs related to investment required, policy-induced avoided costs and added benefits in areas like employment and performance against secondary targets related to energy consumption and emissions.

The model developed for this study includes several variables across sectors and thematic domains. This can be achieved by ensuring data consistency (within and across sectors), which allows for the creation of a more comprehensive analysis that in our case includes energy demand, supply and emissions, as well as estimations of the investment required to reach desired emission reduction targets, resulting energy savings and employment creation. In practical terms, we have performed "knowledge integration" in a single framework of analysis for low carbon interventions.

Systems Analysis and Green Investment

The results presented in the next sections of this paper are one example of how our model can be applied to assessing linkages between emission reduction pledges and economy-wide impacts in a large market like the United States. As the results make clear, this integrated viewpoint helps stakeholders understand the relationship between policy interventions (or targets in the case of the INDCs) and the economy-wide impacts: how will the energy sector be transformed? How much investment is required and what is the payback period? What are the avoid costs from these investments? And what are impacts on tangible social variables like employment?

As becomes clear, a systems approach ultimately provides insights on some of the same values that a traditional investment evaluation or one with an ESG overlay may consider. For example, our model considers the payback period of investments in renewable energy or energy efficiency. But in parallel, it offers a projection on the avoided costs to consumers from these investments, as defined by lower energy bills or avoiding social impacts related to pollution. In terms of labor, our model offers projections on the employment impacts of these investments. Will they lead to employment gains or losses and for what type of workers? What is the timing of these impacts?

Given the dynamic nature of energy markets and policy making related to climate change, some will seek simulations for the U.S. with variations on these assumptions. Related to the country-level model for the United States, we offer the opportunity to change both assumptions (e.g. GDP growth, energy prices) and policies (e.g. target emissions reduction, energy efficiency improvement). Further details on these customized modeling packages can be accessed at http://dualcitizeninc.com/digital-documents/customized-climate-moment-study?n=custom. Based on the existing modeling for the U.S., different energy prices and technology costs, as well the projected baseline rate of energy efficiency improvement would be useful to explore in these customized scenarios.

Applying the Model to Market and Investment Decisions

One finding from our work in this space is that in reality, a model like ours must be adaptable to the wide-range of opportunities under consideration by market actors. While central banks, national policy makers and environmental/green economy NGOs are interested in a high-level view of the country-level interdependencies between emissions reduction pledges (INDCs) and these economy-wide impacts, most market actors face a more narrow question: how can this model help to evaluate the worthiness – from a financial and more integrated point of view – of investments under consideration?

There are two main ways in which our model can be adapted in the U.S. market:

- *State-level and regional assessments.* In a large market like the United States, investments are often made in more local contexts, subjecting decision-makers to vastly different economic and policy realities. For example, states may have more or less ambitious emission reduction targets compared to the national level, and different incentives and policies to support renewable energy and energy efficiency. Our national model for the U.S. can be adapted to these more local contexts.
- *Transaction-level assessments.* Many investors are focused on transactions within distinct geographic contexts. While state-level policies and incentives may influence their decision to invest, these investors also require an integrated viewpoint on the ESG impacts of their investment. Our model can also be adapted to supply insight on a transaction-level as well, and incorporate additional third party datasets related to additional ESG variables.

U.S. Climate Commitments

On March 31st, 2015, the United States submitted its Intended Nationally Determined Contribution (INDC), proposing an economy-wide target to reduce GHG emissions to 26-28% below 2005 levels by 2025. U.S. President Barack Obama announced an earlier target to increase the share of non-hydro renewables to 20% by 2030. For the purpose of our analysis of the U.S. market, we modeled two main scenarios: a business-as-usual (BAU) case that assumes the continuation of historic trends and a Low Carbon (LC) scenario that simulates additional interventions that reduce energy intensity across sectors and increases the use of renewable energy for electricity generation in line with the U.S. INDC.

A top contributor to global carbon emissions and one of the most sophisticated financial markets in the world, the United States is a vital target for climate-related business innovation and investment. After a prolonged period of inaction in the post-Kyoto period, the United States under President Obama has seized upon the levers of federal power to produce a relatively ambitious pledge to the COP21 in Paris. Congress does not share the federal government's commitment due to a combination of lobbying pressure from fossil fuel industries and a lack of recognition in human-induced climate change by some members of Congress.

Having federal action as the centerpiece to U.S. progress on emissions reductions contributes to market uncertainty, as there is no assurance the new president in January 2017 will continue President Obama's actions on climate through executive order. Yet our study of the U.S. market illuminates diverse and compelling opportunities, often in states not associated with strong public support for addressing climate change. Furthermore, our study reveals growth in new financing

mechanisms and business innovation. These investment opportunities arise in tandem with a much different energy mix in our LC scenario, with sharp declines in the use of petroleum and natural gas as inputs to energy production.

Assumptions

- GDP growth: 2.81% average annual growth between 2015 and 2018, constant at 2.36% after 2018

2015	2016	2017	2018
3.14%	3.06%	2.66%	2.36%

Table 1. Assumed GDP growth under all scenarios (IMF, World Economic Outlook, July 2015)

- Population growth: 0.60% annual growth from 2020 to 2040

2020	2025	2030	2035	2040
0.72%	0.68%	0.61%	0.53%	0.46%

Table 1. Assumed population growth under all scenarios (UN, World Population Prospects: The 2015 Revision)

- Energy Prices: 2% annual growth rate as of 2014 for coal prices and 4% annual growth rate as of 2014 for petroleum and natural gas prices.
- Energy efficiency improvement: 1.5% from 2000 to 2040 under the BAU scenario; 2.5% from 2016 to 2024, and 3.25% from 2025 until 2040 estimated under the Low Carbon (LC) scenario, based on INDC target. The improvement would be performed equally across key sectors, including residential, industrial, transport and others.

Selected Takeaways from Modeling of U.S. National Market

- **Declining petroleum and natural gas.** Under the Low Carbon (LC) scenario, the future U.S. energy mix changes considerably, particularly for the use of natural gas and petroleum which, compared to 2012, will decline by 10.9% and by 11.2% respectively in 2025, 22% and by 21% respectively in 2030. Specifically, natural gas consumption will decline from 20.2 million TJ/year in 2014 to 16.22 and 14.2 million TJ/year in 2025 and 2030 respectively.
- **Emissions per capita decline, but not by enough.** Under the LC scenario, emissions per capita from energy consumption will decline to 15.3 ton/person/year in 2020, to 12.9 ton/person/year in 2025, and to 11 ton/person/year in 2030. Given the large U.S. contribution to global emissions, this decrease is not adequate to reach the widely embraced global target of keeping warming under 2°C.
- **Majority of emissions reductions reached through improvements in energy efficiency.** The average contribution of renewable energy investments to the reduction of electricity emissions amounts to 34% in the period 2015-2030. The annual investment required to reach the energy efficiency targets for electricity assumed for the LC scenario amounts to $15.1 billion per year on average in the period 2015-2025, or $166.4 billion in total by 2025.
- **Short payback period to INDC-related investment.** These investments are fully repaid (when considering policy-induced avoided costs) within 2 to 3 years depending on the cost assumption utilized in the LC scenario. This short payback time is primarily due to the

stronger emphasis that the INDC puts on energy efficiency investments, rather than on renewable energy.

- **Strong renewable energy job growth.** The share of renewable energy jobs in the power sector will reach 38.9% in 2020, 49.7% in 2025, and 34% in 2030, including hydro and other renewables, compared to 28% in 2015. Of the total jobs in the renewable energy sector the share of jobs in construction amount to 77% in 2020, but it decreases to 50% in 2030 and then it remains constant until 2040.

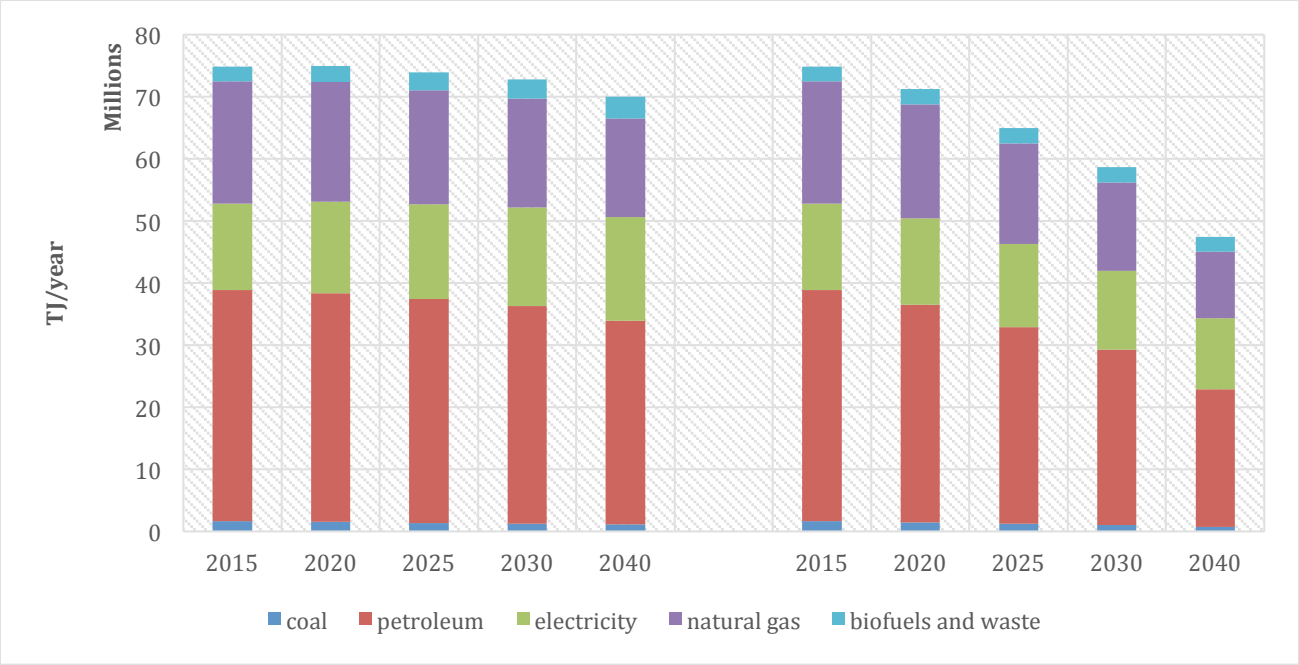

Figure 1: Energy demand by energy source (TJ/year). BAU (left) and LC (right).

Selected Research Insights

Our approach incorporates both quantitative outputs from our systems model with research insights to empower clients with a more complete viewpoint on different markets. Below are some of these insights we are monitoring in the U.S. market:

State-level Climate Compliance in Flux
The Clean Power Plan (CPP) requires state-level compliance with an overall emissions reduction goal from U.S. power plants of 32% by 2030. State utilities are already moving towards decarbonizing sources of electricity generation, even in states party to a lawsuit against the EPA rule (e.g. First Energy Corp. (FE) and American Electric (AEP) have started retiring coal plants in West Virginia). As the legal and political battles continue, often along partisan lines fueled by media coverage, a closer monitoring of actions by state-level utilities will give market observers a clearer picture of the future energy mix to expect. States must submit their finalized SIPs by the fall of 2016.

Wind is Becoming Increasingly Cost Competitive.
A recent study from the U.S. Department of Energy reports that in 2014, wind prices fell to 2.35 cents per kWh for Power Purchase Agreements (PPAs), a 66% decline since 2009, when prices

topped out at nearly 7 cents per kWh. As states and their utilities formulate plans to comply with the Clean Power Plan, wind is likely to play an increasingly central role, particularly in interior states like Texas, Oklahoma, Iowa, Michigan and Nebraska. These states installed the most wind capacity in 2014 and have adopted new turbine design enhancements that can boost project capacity factors.

Subnational and Business Indicators of Opportunity

Non-state climate initiatives are important to monitor as a different way to identify trends and opportunities for business and investment. Cities are emerging as vital laboratories for innovation and green business growth, and tracking the municipalities with the most ambition could reveal otherwise unknown opportunities. Similarly, companies with aggressive commitments to renewable energy can act to transform energy markets around them, a trend already observed as large U.S. corporations like Google, Apple, and Walmart invest in new renewable energy capacity to support their business operations.

Talent and STEM Skills

The U.S. has the third highest number of renewable energy jobs globally, with 625,000 employed in the sector based on recent estimates. Our modeling suggests continued growth in renewable energy jobs. Yet a recent Solar Jobs Census reported the employers in the solar industry were finding it increasingly difficult to find qualified workers, a notable increase over previous years.

As observed in other countries, policy and firm-based uncertainty is part of the challenge. Renewable energy sectors face greater policy uncertainty than traditional ones. Furthermore, as a newer area, there is greater volatility with start-ups rising and falling, as is the case in any nascent growth sector.

Working Together

There are a few ways to leverage our existing modeling and expertise in this area, for policy makers, investors and other market actors. We already have completed two product offerings that can be accessed through our website:

- The first is the full study of the 11 largest carbon emitters, providing model outputs and research insights for each market. The study can be purchased directly online for $499 or by contacting us directly at the emails below.
- The second is the customization option discussed earlier, allowing clients to modify assumptions in our study and receive the resulting simulations. This customization option can be requested directly online for $2,999 or by contacting us directly.
- The third is to engage with us to structure a tailored consulting arrangement to apply our existing modeling framework to support decision makers.

For more information, please contact Dr. Andrea Bassi (andrea.bassi@ke-srl.com) or Jeremy Tamanini (jeremy@dualcitizeninc.com).

Summary Data Table

The table below provides readers with a sample of the outputs from our national systems model for the U.S. market:

Time (Year)	2015	2020	2025	2030	2040
CO_2 EMISSIONS					
Total CO_2 emissions (million ton/year)					
LC	5484.72	5099.23	4462.72	3929.62	3033.37
BAU	5481.18	5537.55	5518.75	5483.80	5347.55
CO_2 reduction relative to 2005 (%)					
LC	-9%	-15%	-26%	-34%	-49%
BAU	-9%	-8%	-8%	-9%	-11%
Emissions per capita (ton/person)					
LC	17.08	15.32	12.94	11.04	8.08
BAU	17.07	16.63	16.01	15.40	14.24
Emissions intensity (kg/US$)					
LC	0.38	0.31	0.24	0.19	0.11
BAU	0.38	0.33	0.29	0.26	0.20
ENERGY DEMAND					
Total country energy demand (TJ/year)					
LC vs BAU	0%	-5%	-12%	-19%	-32%
Energy demand per capita (TJ/person)					
LC	0.23	0.21	0.19	0.16	0.13
BAU	0.23	0.23	0.21	0.20	0.19
Energy demand per unit of GDP (TJ/US$)					
LC	5,126	4,271	3,465	2,778	1,774
BAU	5,126	4,496	3,940	3,447	2,619
ELECTRICITY GENERATION					
Share of RE electricity generation (%)					
LC	14%	18%	24%	27%	30%
BAU	14%	14%	14%	13%	13%
INVESTMENT AND SAVINGS					
Total cumulative investment (billion US$)					
LC vs BAU	0	-16	-5	17	256
Total annual investment RE+EE (billion US$/year)					
LC vs BAU	0	-6	10	14	31
Total avoided costs cumulative (billion US$)					
LC vs BAU	0.23	125	639	1,775	6,621
Total avoided costs annual (billion US$/year)					
LC vs BAU	0.23	49	145	286	674
EMPLOYMENT					
Energy efficiency employment fuels (person)					
LC vs BAU	3,631	474,086	1,094,193	1,711,669	2,630,536
Energy efficiency employment electricity (person)					
LC vs BAU	-58	122,140	304,221	504,950	886,943
Electricity supply employment (person)					
LC vs BAU	13,742	118,488	74,116	-417,510	-666,295