UNEP

GREEN economy
Fiscal Policy Analysis

Ghana

Citation

UNEP. (2015). Green Economy Fiscal Policy Analysis – Ghana.

Disclaimer

This publication has been produced with the assistance of Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH. The contents of this publication are the sole responsibility of UNEP and can in no way be taken to reflect the views of GIZ.

Front cover photo: Pixabay.
Back cover photos: Top, Renate Wefers; middle, Walter Callens; bottom, Gianfranco Bella.

UNEP promotes environmentally sound practices globally and in its own activities. This publication is printed on 100% recycled paper, using vegetable inks and other eco-friendly practices. Our distribution policy aims to reduce UNEP's carbon footprint.

CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF BOXES

LIST OF ACRONYMS AND ABBREVIATIONS

BOST	Bulk oil storage
CI	Cost of illness
CIF	Cost of insurance and freight
CO_2e	Carbon dioxide equivalent
COICOP	Classification of Individual Consumption According to Purpose
CPI	Consumer price index
ECOWAS	Economic Community of West African States
EPA	Environmental Protection Agency
FOB	Free on board
GDP	Gross domestic product
GHG	Greenhouse gas
GIFMIS	Ghana Integrated Financial Management Information System
GLSS	Ghana Living Standards Survey
GWh	Gigawatt-hour
HC	Human capital
IEA	International Energy Agency
IPCC	Intergovernmental Panel on Climate Change
kWh	Kilowatt-hour
LPG	Liquefied petroleum gas
MJ	Megajoule
mpg	Miles per gallon
MW	Megawatt
NO_2	Nitrogen dioxide
NOx	Mono-nitrogen oxides
NPA	National Petroleum Authority
NRGI	Natural Resource Governance Institute
OECD	Organisation for Economic Co-operation and Development
PM10	Particulate matter up to 10 micrometres in size
SO_2	Sulphur dioxide
TAPCO	Takoradi Power Company
TICO	Takoradi International Power Company
TOR	Tema Oil Refinery
TSA	Treasury Single Account
UNEP	United Nations Environment Programme
VAT	Value added tax
VIT	Vehicle income tax
WHO	World Health Organization
WTP	Willingness to pay

ACKNOWLEDGEMENTS

This study was commissioned by the United Nations Environment Programme (UNEP) under the "Fiscal Policy Reforms for Green Economy" project. The study was prepared by a team at the University of Turin led by Giorgio Brosio, with contributions from Silvana Dalmazzone, Santino Piazza, Vito Frontuto and Roberto Zanola. It was undertaken under the overall supervision of Joy Kim, Senior Economic Affairs Officer of the UNEP Economics and Trade Branch. Within UNEP, Dambudzo Muzenda and Richard Scotney provided valuable inputs to the study, and Sirini Withana provided useful comments. Philip Gass of the International Institute for Sustainable Development (IISD) and Simon Bawakyillenuo of the Institute of Statistical, Social and Economic Research (ISSER) in Ghana provided useful feedback and comments. Administrative support was provided by Rahila Somra, Fatma Pandey and Désirée Leon, and Chiara Moroni provided communications support. The report was edited by Fabienne Stassen, and the layout and design were done by Michel Favre.

UNEP would like to thank the Government of Ghana for its cooperation.

UNEP gratefully acknowledges the financial support of Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH for the preparation of this study. The study was undertaken in the context of the project "Enhancing low-carbon development by greening the economy: Policy dialogue, advisory services, tracking progress" funded by the International Climate Initiative (IKI) of the Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety (BMUB).

giz Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH

Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety

© Eunika Sopotnicka – Akosombo Hydroelectric Power Station on the Volta River in Ghana.

EXECUTIVE SUMMARY

Ghana is on the verge of becoming a relatively important oil and gas producer. This creates opportunities, but also challenges. The transformation into an oil and gas producing country will change the economic growth perspectives of Ghana, allowing the country to reach middle-income country status, which will impact on individual behaviour and spending habits and, hence, most likely, also on the use of environmental and natural resources. Another factor to consider is the already delicate state of the environment in Ghana, with the ongoing destruction of habitats and loss of biodiversity. Finally, the country is feeling the impact of climate change with particular intensity. At the same time, Ghana faces significant green growth opportunities, such as a large potential to increase the generation of energy from renewable sources and to improve land management practices. The country is also currently implementing a number of green fiscal policy measures related to taxes and electricity tariffs. While these measures aim in the right direction, they still have limited reach.

The current study focuses on the revenue component of the budget, selecting the options with the most potential to improve environmental quality and to create the preconditions for green economy investment. In view of these two goals, the study concentrates on the energy and transportation sectors, which are at once responsible for the largest contributions to both local and global pollution in Ghana and provide the best options for generating additional fiscal space for green investment.

In Ghana, recent energy policies have led to the heavy subsidization of energy products based on a system that combines subsidies granted through the use of administered fuel prices with the levying of a number of specific taxes without any definite environmental objective and of very little individual importance in terms of revenue. This combination (where the subsidy usually prevails, substantially, over taxes) has a significant impact on both the government budget and the environment.

The Government of Ghana is committed to reviewing the fuel pricing structure and subsidies to reduce the overall fiscal deficit. However, the reform process is not complete without a system of market-determined fuel prices. The current substantial fall in the international price of oil could represent an appropriate opportunity for the Government to introduce fuel pricing reform.

The core proposal advanced in this study is to reform the energy policy of Ghana through the effective removal of the system of administered pricing that creates the subsidies and the reform of energy product taxation based on the correction of the externalities they produce. For each of the policy measures suggested, the study assesses the costs and benefits of intervention and the expected environmental impact.

Aligning the total burden of excises on fuels used for transport and electricity generation to correct externalities requires a substantial increase in their tax rate. A gradual approach is therefore suggested in this study, with various options ranging from the correction of the local or the global impact, or a combination of both. The correction of congestion and of the cost of accidents can be addressed at subsequent steps of the reform process.

Compensation could be paid to the poorest households and individuals to cushion them against direct and indirect impacts of price increases. A few alternative options can be considered for households in different expenditure brackets that could benefit from the compensation.

The proposed reforms would contribute substantially to the creation of much-needed fiscal space for green economy investments. A tax correcting for global and local damages produced by fossil fuels in the generation of electricity and in transportation would provide almost one additional percentage point of revenue collections on GDP (between 0.89 per cent and approximately 1 per cent, depending on the elasticity scenario), representing an increase of about 7 per cent over the revenue collections of 2013 (equivalent to 15.3 per cent of GDP).

Complementing taxes on transport fuels with distance related taxes – such as congestion charges levied at the metropolitan/municipal level – would introduce an intergovernmental dimension to the energy/environmental taxation framework, since these instruments can conveniently be applied at the subnational government level. This strategy would also increase the environmental impact of taxation without the need to rely exclusively on politically sensitive transport fuel taxes.

This study also considers the current structure of vehicle taxation in Ghana in order to exploit synergies between fiscal instruments applied to energy and transport and lay out some suggestions for reform. Consideration is given to vehicle taxation in view of its strong complementarity with fuel taxation. One suggestion made in the study is the introduction of a *feebate* system aimed at stimulating higher fuel efficiency with no cost to taxpayers as a whole, but with a redistribution of the burden between owners of high fuel-efficient vehicles and owners of low fuel-efficient vehicles.

Reforms of fiscal policies in the energy and transport sectors, such as those outlined in this study, are a crucial first step within any general green economy strategy. Removing inefficient and environmentally-harmful subsidies is a necessary precondition. In addition, internalizing social damages in the price of fossil fuels is one of the most effective ways to promote technological change and generate fiscal space for the green investment that Ghana has identified as a priority.

© Paul Smith – The Kejetia market in Kumasi is the largest market in Western Africa with over 10,000 stalls.

1 INTRODUCTION

Addressing the challenges of sustainable green growth requires adjustments in taxes and public sector pricing policies aimed at influencing behaviour and contributing to the creation of the fiscal space needed for green economy investment. It then involves redirecting public spending to promote green infrastructure and low-carbon production methods. Consequently, the fiscal agenda for green growth requires an assessment of the overall resource envelope relative to spending needs. It must also include a determination of public spending, pricing and tax policies, together with an evaluation of the role of regulations, information flows and institutions.

General tax reforms can increase the effectiveness of green policies. Additional fiscal space is created through the reform of taxation, including revising tax bases, assessing tax incentives with a view to closing loopholes, reducing incentives to cheat, strengthening tax administration with the expanded use of information, and the like. These actions can be strengthened by introducing environmentally-targeted taxes in the general tax reform strategy, some of which, such as energy and fuel taxes, have a considerable direct impact on revenues and on greenhouse gas (GHG) emissions.

The expenditure component of the budget also forms part of the fiscal space. In evaluating the space for green economy investments, it is necessary, first, to take into account other high priority expenditure policies and commitments, which may not be susceptible to spending cuts or may simultaneously require additional investments, such as those in the social sector. Second, it is necessary to analyse the potential for rationalizing existing inefficient expenditures. Here, a crucial role may be played by subsidies to fossil fuel-based energy sources that absorb substantial fiscal resources, largely benefit the rich and generally have a negative impact on the environment.

This report takes as a reference point the current economic context of Ghana, whose main component is the transformation into an oil and gas producing country. This will change the country's economic growth prospects and probably raise the Ghanaian people's expectations about the sharing of rents. A second element to consider is the middle-income country status that could be acquired by Ghana, which will impact on individual behaviour and spending habits and, therefore, most likely, also on the use of environmental and natural resources. A third factor is the already delicate state of the environment in Ghana, with the ongoing destruction of habitats and loss of biodiversity. Finally, the country is feeling the impact of climate change with particular intensity. At the same time, Ghana faces significant green growth opportunities, such as a large potential to increase the generation of energy from renewable sources and to improve land management practices (Government of Ghana, Ministry of Environment, Science and Technology, 2010).

This study will focus on the revenue component of the budget, selecting the options with the most potential to improve environmental quality and create the preconditions for green economy investments. In view of these two goals, the study focuses on the energy sector, which makes the largest contribution to both local (SO_2, NO_x) and global (CO_2) pollution in Ghana and is also the best option for generating additional fiscal space for green investment.

In Ghana, recent energy policies have led to the heavy subsidization of energy products based on a rather opaque system that mixes subsidies granted through the use of administered fuel prices with the levying of a number of specific taxes without any specific environmental objective and of very little individual importance in terms of revenue. This combination (where the subsidy usually prevails, substantially, over taxes) has a significant impact on both the government budget and the environment.

The core proposal advanced in this study is to reform Ghana's energy policy through: (1) the effective removal of the system of administered pricing that creates the subsidies; and (2) the introduction of a system of energy product taxation based on the correction of the externalities they produce. For each of the policy measures suggested, the study assesses the costs and benefits of intervention and the expected environmental impact. In addition, the study considers the main options for the use of the additional revenue that will be generated, with a view also to foster political support for the reform. Options for the use of additional revenues include, in various combinations, the financing of green investments, the reduction of the tax burden, in particular on labour (also aimed at reducing incentives to informality), and compensatory measures to the most affected households.

The study also considers the current structure of vehicle taxation in Ghana in order to exploit synergies between fiscal instruments applied to energy and transport, and lays out some suggestions for reform.

The structure of the rest of the study is the following: section 2 presents the fiscal framework within which reform options for green growth are proposed. Section 3 introduces the main environmental indicators and outlines the most urgent environmental issues. Sections 4 and 5 are devoted to the energy sector and the main options for environmentally-oriented energy taxation. Section 6 presents reform options for vehicle taxation, and section 7 concludes.

© UNEP

2 THE FISCAL FRAMEWORK

The economy of Ghana is characterized by large and persistent fiscal and external imbalances. The fiscal deficit amounted to 10.8 per cent of gross domestic product (GDP) in 2013 (Table 1).

TABLE 1. GROSS DOMESTIC PRODUCT, 2010-2014

	2010	2011	2012	2013*	2014*
Population (million)	*24.66*	*25.24*	*25.82*	*26.43*	*27.04*
Exchange rate (cedis/US$)	*1.43*	*1.51*	*1.81*	*1.92*	*2.94*
GDP current prices (million cedis)	46 042	59 816	75 315	94 939	113 436
Non-oil GDP current prices (million cedis)	45 865	56 070	69 666	87 604	106 902
GDP current prices (million US$)	32 186	39 517	41 656	49 447	38 584
Per capita GDP (cedis)	1 867	2 370	2 916	3 592	4 195
Per capita GDP (US$)	1 305	1 566	1 613	1 871	1 427
Rates of change in %					
GDP current prices	25.8	29.9	25.9	26.1	19.5
GDP at constant (2006) prices	3.4	14.0	9.3	7.3	4.2
Non-oil GDP at constant (2006) prices	7.6	8.2	8.6	6.7	4.1

* Revised.
Source: Ghana Statistical Service, 2015, p. 3.

The reduction of this extremely high fiscal deficit is difficult given, among other factors, the existence of large arrears to be paid that have an impact on future budgets (Table 2).

TABLE 2. CENTRAL GOVERNMENT BUDGET SCENARIO, 2013-2016 (% OF GDP)

	2013 projected	2014 budget	2015 budget	2016 budget
Total revenue and grants	18.1	21.2	21.2	21.2
Revenue	19.5	17.6	20.1	19.9
of which tax revenue	15.3	17.8	17.7	18.1
of which VAT*	3.6	4.1	4.1	3.9
oil revenue	1.9	1.6	1.4	1.4
Total expenditure	26.5	26.6	26.2	26.0
of which wages	9.6	8.5	7.5	7.0
interest costs	5.0	5.9	5.2	4.6
subsidies	1.3	0.1	0.1	0.1
capital expenditure	6.4	8.3	9.6	9.9
Arrears clearance and VAT refunds	-2.5	-3.1	-2.5	-1.2
Overall balance	**-10.8**	**-8.5**	**-7.5**	**-6.0**

* VAT = value added tax.
Source: IMF, 2014a.

The fiscal expansion that occurred in recent years was accompanied by a growing deficit in the current account in the balance of payments. As a result, public debt increased significantly, up to 49 per cent of GDP and US$641.69 per capita in 2014 (The Economist, 2015), and the international reserve position weakened alongside a depreciating currency.

Shrinking the deficit will require either a huge reduction in expenditure, which could be politically problematic, especially after the cut in public salaries enacted in 2013, or a further substantial increase in taxation, or a combination of the two. The commitment to the substantial elimination of subsidies shown in Table 2 has to be part of the fiscal strategy. International Monetary Fund and Government of Ghana projections reported in Table 2 indicate a larger commitment on the revenue side, bringing tax collection from 15.3 per cent of GDP in 2013 to 18.1 per cent in 2016, although implementation is a clear challenge. One has to consider, in this respect, that the share of tax revenue to GDP is inflated by the relevance of value added tax (VAT) refunds, meaning that the revenue shown is gross rather than net. Moreover, the persistence over the years of VAT refunds indicates that the administration of VAT is still not working adequately and that the extent of cheating inferred from the payment of refunds is very large. This will require strengthening the administration, starting by cross-checking information. In fact, VAT remains weak in Ghana with very low specific productivity. Projections for 2014 show collection as a share of GDP of 4.1 per cent with a tax rate of 17.5 per cent, implying productivity of 0.23 per cent.

According to the Ministry of Finance's 2014 mid-year budget review, actions aimed at increasing the collection of taxes are expected to meet substantial difficulties:

Provisional end-year fiscal data for 2013 indicate that both revenue and expenditure were below their respective targets for the year. However, the shortfall in revenue far exceeded the shortfall in expenditure, resulting in a cash fiscal deficit equivalent to 10.1 percent of GDP against the original budget target of 9.0 percent and the revised target of 10.2 percent. (Government of Ghana, Ministry of Finance, 2014).

The existence of a potentially large space to expand tax revenues is also shown by comparative analysis between Ghana and other countries in sub-Saharan Africa. While the level of public expenditure in Ghana is not very high comparatively and is balanced between current and capital expenditure, the ratio of total taxes to GDP is still quite low compared to that of other African countries, as shown in Table 3. The gap with reference to sub-Saharan African countries' average amounts to more than 10 percentage points, when all taxes are compared, and it remains high when resource taxes are excluded from the comparison.

TABLE 3. TOTAL TAXES TO GDP, COMPARISON BETWEEN GHANA AND SUB-SAHARAN AFRICA, 2000-2010 (% OF GDP)*

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Ghana	11.0	12.3	11.4	13.7	13.2	14.0	14.0	13.6	13.2	12.5	13.8
Sub-Saharan Africa	22.4					22.3					24.4

* Most recent data set available.
Source: Mansour, 2014.

Despite an increase in recent years, direct taxes still contribute modestly to total tax collection (Table 4). This is attributed to the structure of the economy of Ghana, particularly to the importance of the informal sector. According to recent estimates (Osei-Boateng and Ampratwum, 2011), 80 per cent of the Ghanaian workforce is employed in the informal sector, which is characterized by very low wages.

The largest contributors to tax collection are indirect levies, particularly VAT (although not performing well) and tariff duties. The performance of oil revenues was quite strong in 2013 as a result of higher-than-expected oil prices and production, but it could suffer in the future from protracted falls in the oil price. Total petroleum receipts were 1,358 million cedis for the first three quarters of 2013 (Government of

Ghana, Ministry of Finance, 2013). Oil revenues can only partially reduce the overall imbalance, given the country's commitment to set aside most of the revenues for future generations.

TABLE 4. STRUCTURE OF THE TAX SYSTEM IN GHANA, 2000-2010 (% OF GDP)

2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Corporate income tax										
1.7	1.8	1.5	1.7	1.8	2.0	1.6	1.7	1.8	1.8	2.1
Personal income tax										
1.4	1.5	1.5	1.8	1.7	1.5	1.7	1.7	1.7	2.1	2.2
Indirect taxes										
5.0	5.4	5.0	6.3	5.9	6.7	6.4	6.4	6.0	5.3	5.3
Trade taxes										
2.2	1.9	2.2	2.2	2.2	3.0	2.9	2.7	2.7	2.8	2.6
Other taxes*										
0.7	1.7	1.2	1.7	1.6	0.8	1.4	1.1	1.0	0.5	1.6
All taxes										
11.0	12.3	11.4	13.7	13.2	14.0	14.0	13.6	13.2	12.5	13.8

* Minor taxes varying from country to country.
Source: Mansour, 2014.

The taxation of labour, which applies to the formal sector, is not exceedingly high in Ghana. It derives from combining a moderately progressive personal income tax with more substantial social security contributions (Ghana Revenue Authority, 2014). The highest marginal rate for income tax is 27.5 per cent, applied to yearly incomes above 31,680 cedis (the equivalent of approximately US$9,800). This is a relatively low marginal rate, whose incidence is further reduced by the application of a number of personal allowances. Social security contributions are levied at a combined (employers plus employees) flat rate of 18.5 per cent (Table 5). In comparative terms, the personal income tax of Ghana is nominally lower than that of Kenya, and is aligned on average with that of Mauritius (which has a higher initial rate and a smaller marginal rate). Social security contributions are a little higher in Ghana than in Kenya and Mauritius.[1]

Even if moderate, the burden of combined taxation on labour may still be an obstacle that could hinder the growth of the formal sector, particularly if there is no correspondence between what wage earners receive in terms of service benefits and what they pay in taxes.

TABLE 5. TAX RATES (%) LEVIED ON THE PERSONAL INCOME TAX AND SOCIAL SECURITY CONTRIBUTIONS IN GHANA, MAURITIUS AND KENYA

	Ghana	Mauritius	Kenya
Lowest tax rate on personal income tax	5.0 on annual income up to US$736	15.0	10.0 on annual income up to US$1,342
Highest (marginal) tax rate on personal income tax	27.5 on annual income above US$9,800	15.0	30.0 on annual income above US$5.134
Social security contributions on employees	5.5	4.0	variable
Social security contributions on employers	13.0	10.0	10.0

Sources: Mauritius: KPMG, 2012; Kenya: Kenya Revenue Authority, 2014; Ghana: Ghana Revenue Authority, 2014.

Information on subnational government finances is scanty and does not allow a full assessment of whether they contribute positively or negatively to the public sector imbalance. Specifically targeted analysis would be needed.

In general, the present fiscal framework of Ghana offers very little space to finance additional green economy expenditure, unless this expenditure comes at the cost of cuts in other outlays that are difficult to single out. While some rerouting of expenses towards the green economy is certainly possible, the other main alternative is to generate sufficient additional revenue through strengthening the tax administration and creating new fiscal space by removing adverse subsidies and applying environment-related taxes and other fiscal measures. The UNEP *Green Economy Fiscal Policy Scoping Study – Ghana* (UNEP, 2014) provides a detailed overview of the fiscal, social and environmental profile of Ghana, including an analysis of environmental fiscal reforms in key sectors of importance to the country's green economy transformation.

3 THE ENVIRONMENT

Ghana is facing serious environmental challenges. According to the *Green Economy Fiscal Policy Scoping Study – Ghana* (UNEP, 2014), the cost of environmental degradation in Ghana amounts to 10 per cent of GDP. As is well illustrated in this study, worrying environmental trends include the depletion of natural-resource stocks, habitat destruction and the loss of biodiversity through poorly managed natural-resource use.

Natural resources constitute an essential component of the national economy and a source of livelihood for local communities, especially in the poorest areas of the country. Uncontrolled deforestation and the unsustainable management of forest resources have led to the rapid degradation of forest ecosystems, the progressive reduction of forest cover and a sharp decline in the density of several wild plant species (particularly those used in the woodcarving industry).

According to the Environmental Protection Agency (EPA) of Ghana, over 90 per cent of the country's high forests have been logged since the late 1940s. The rate of deforestation is 5 per cent in off-reserves and 2 per cent in on-reserves. In turn, the loss of forest stocks has accelerated desertification.

Water and fishery resources are being progressively depleted due to unsustainable management. Mining activities and chemical inputs in agricultural production are causing degraded water quality in rivers and lakes. Air, soil and water pollution from mining activities (particularly gold) are associated with an increase in the incidence of respiratory diseases and reduced agricultural productivity

© Courtesy www.carboafrica.net – Ankasa Forest canopy.

(Aragon and Rud, 2012). Pollution, coupled with insufficient investment, results in a lack of accessible potable water for a large part of the rural population. Fishing activities in internal waters and the gulf are seriously compromised. The country is also particularly exposed to the impacts of climate change, such as the increased frequency of floods and droughts, due to its geographical features and to the structure of its economy. The impact of improper strategies in the development of the energy sector, discussed in detail in section 4, is also of major concern.

Table 6 provides some indicators of environmental and economic performance, enabling the identification of certain critical issues. Ghana has a relatively high ratio of energy use to GDP, in particular in comparison with Kenya, despite the latter's lower GDP per capita. The total CO_2 emissions level is rather low, also in per capita terms, confirming that Ghana is not, in general, a major contributor to global GHG emissions. On the contrary, local pollution seems to be a more urgent environmental issue. Systematic and reliable data on ambient concentrations are very scarce, pointing to a serious monitoring gap in air quality and key indicator pollutants, shared with most other sub-Saharan countries.

The limited data available indicate biomass fuels, traffic congestion and unpaved roads are a source of heavy concentrations of particulate matter, whose levels in urban, commercial and roadside areas are consistently above both the EPA guideline level of 70 μg/m³ and the World Health Organization (WHO) guideline level of 50 μg/m³. PM10 concentration monitored in Accra neighbourhoods in 2008 showed levels ranging from 57.9 to 93.6 μg/m³, with a weighted average of 71.8 μg/m³. These levels are lower than the annual averages observed in large cities in Asia and also in the Middle East, but substantially higher than EPA guidelines and WHO health standards, and higher than ambient levels in Latin America and in industrial countries (Arku et al., 2008). NO_2 concentration measured at roadside locations often appears to be above the annual WHO guideline of 0.02 parts per million (Fiahagbe, 2012), whereas both SO_2 and NO_2 showed relatively low concentrations in residential areas (Arku et al., 2008).

TABLE 6. ENVIRONMENTAL INDICATORS FOR GHANA, KENYA AND MAURITIUS

	Energy intensity*	Energy consumption per capita**	CO_2 emissions***		GDP (US$) current	Population density	Population	PM10**** (micrograms per cubic metre)	Threatened species	Forested area (% of land area)
	2011	2010	2010 total	2010 per capita	2012 per capita	2011	2011	2011	2013	2011
Ghana	3 377	129	8 999	0.37	1 646	109	24 820 706	82	215	21.2
Kenya	2 673	95	12 427	0.30	933	74	42 027 891	66	419	6.1
Mauritius	2 427	967	4 118	3.21	8 862	634	1 286 051	11	237	17.3

* Total energy consumption in British thermal units per million dollars of GDP (in constant 2005 prices).
** Energy consumption in kilogram of oil equivalent per capita.
*** Carbon dioxide (CO2) emissions in metric tons.
**** PM10 = particulate matter up to 10 micrometres in size.
Sources: World Bank: http://data.worldbank.org/indicator/; UNdata: http://data.un.org/Search.aspx?q=mauritius.

Exposure to indoor air pollution deriving from inefficient cooking-stoves and polluting fuels (mainly unprocessed wood and charcoal) causes the loss of more than 16,600 lives annually in Ghana (Armah, Odoi and Luginaah, 2013; WHO, 2009), highlighting universal access to modern energy for cooking and productive use of energy as a priority for a greener Ghanaian economy.

4 THE ENERGY SECTOR

Ghana's energy sector is characterized by the prevalence of biofuels in the supply of energy products, followed by oil and electricity (Table 7). Households are the main consumers of biofuels (wood and charcoal used for cooking and heating), while the transport sector, particularly road transport, is mainly responsible for the consumption of oil products, followed by industry.

Household use of wood and charcoal has a heavy impact on the environment, starting with its production, which contributes to deforestation, and ending with combustion, which is responsible for noxious emissions. Reducing the production and consumption of wood and charcoal requires regulation and investment to make other less polluting energy products available to households. The main alternatives are electricity, with an extension of the grid to rural and remote areas, and compressed natural gas. Expanding access to compressed natural gas by developing its distribution system in rural areas is part of the charcoal replacement strategy currently being pursued in Ghana, and it appears to be a practical alternative to taxation.

TABLE 7. ENERGY USE IN GHANA BY SECTOR, 2011 (KILOTONS OF OIL EQUIVALENT)

	Oil products	Biofuels and waste	Electricity	Total
Industry	467	577	335	1 379
Transport	1 898			1 898
of which: roads	1 684			-
Residential	233	2 300	237	2 770
Commerce and public services	28	72	113	213
Agriculture	53	2		55
Other	66			66
Total	**2 745**	**2 951**	**685**	**6 381**

Note: Blank cells indicate that the contribution of a particular fuel to that sector is negligible.
Source: International Energy Agency, 2013.

The taxation of the consumption of wood and charcoal could potentially provide a large tax base in Ghana, but its feasibility is problematic because these products are produced and sold in the clandestine and informal sector. This is the main reason the taxation of wood and charcoal is not included in the strategy proposed in this study.[2]

The existence of sizeable informal, unregistered timber harvesting undermines the revenue earning potential of existing taxes and fees (most of which are collected as stumpage fees), which constitute only some 6 per cent of the stumpage value (Lund, Carlsen, Hansen and Treue, 2012). Making the levying of fees on logging effective might, as a side effect, help curb the household use of wood and charcoal, since charcoal is merely a by-product of deforestation and agricultural expansion. The effective monitoring and implementation of existing rules, however, would require broad-based legal reforms of forest governance, including changes in tree tenure and in the allocation of timber rights aimed at creating incentives to cultivate timber trees on agricultural lands and in woodlot plantations. Also, initiatives aimed at improving technologies used to produce charcoal could help maximize the quantity of charcoal produced per logged tree.

A key, rather recent development for the energy sector is the start of commercial oil production in December 2010, which which has helped Ghana to become an oil exporting country. Production has been the result of the 2007 offshore discovery in the Jubilee Field, which represents a huge opportunity for the country to increase revenues from exports and to enhance domestic energy supply – a crucial resource that could drive national economic development. Estimates of total oil reserves range from 800 million to 1.8 billion barrels. In 2013, the Jubilee Field produced on average 99,000 barrels per day, and production is expected to continue for the next twenty years, with a peak of 122,000 barrels per day. This would generate on average US$1 billion per year in export revenues (Natural Resource Governance Institute, 2014). Moreover, Ghana intends to start commercializing the natural gas springing from oil wells.

The contribution of oil production to the budget now exceeds by far that derived from minerals (Mathrani et al., 2013). Government revenue generated when the oil price exceeds a given level – the benchmark – will be channelled to the Ghana Stabilization Fund[3], to the Ghana Heritage Fund[4] and to the central government budget.

Realistically, the oil sector's growth will directly generate relatively few jobs in Ghana. However, via the expansion of aggregate demand, the boom in oil production will generate additional employment especially in the country's non-tradable sectors, such as construction, transportation and wholesale/retail services. Oil export growth will exert pressure towards the re-evaluation of the cedi against the US dollar – the so-called Dutch Disease – imperilling the growth of tradable sectors. This implies the Government's need to pursue policies that will increase the competitiveness of firms both on the international and domestic (as imports will become cheaper) markets.

Also, as is happening frequently around the world, the large availability of hydrocarbons may induce the Government to pursue strategies that conflict with environmental protection and the efficient use of natural resources. Making efficient use of oil and gas revenues so as to sustain economic development and welfare in an inter-temporal perspective is fraught with problems that, if not solved adequately, may give rise to the "resource curse".[5]

Resources can be wasted by corrupt practices, impacting on the revenues from government sales of hydrocarbons and minerals. Box 1 highlights the example of Nigeria, where a special task force uncovered significant fraud in the accounting of oil and gas revenues. Ghana, however, shows favourable signs of good natural-resource management. It is a member of the Extractive Industries Transparency Initiative, ranks relatively well on corruption indices calculated by Transparency International[6] and has shown further improvement in recent years. Ghana also fares relatively well on other governance indices, such as those calculated by the World Bank, with steady improvements in recent years.[7] Clearly, creating an interface between the Ghana Integrated Financial Management Information System (GIFMIS), the Treasury Single Account (TSA) and oil companies' information systems could increase transparency and reduce leakages of oil resources.[8] Even with good governance institutions, resources from oil and gas could be invested in the development of sectors that, without strict and effective regulation, may have a heavy polluting impact and turn out not to be environmentally sustainable. In Ghana, decommissioning and clean-up costs for mine lands, as well as the environmental legacy of oil extraction, have been key concerns.

There is also a tendency in oil producing countries, as is already the case in Ghana, to heavily subsidize energy consumption, both for final and intermediate use. With very few exceptions – notably, Norway, the United Kingdom and, to a smaller extent, Peru – oil producing countries tend to subsidize the consumption of oil products with various instruments, such as administered prices and taxes on exports. A political rationale lies behind this choice, as it allows citizens to benefit immediately from part of the oil rents. However this choice is also fraught with a number of negative consequences, such as: (1) the excessive consumption of energy, leading to pollution and congestion; (2) the allocation of resources that benefit the richest segments of the population, which are the largest consumers of energy products; and (3) lost opportunities to use the resources for a green development strategy. As a matter of fact, even when coupled with regulatory measures, energy subsidization policies result in levels of energy consumption that tend to be unsustainable in the long term.

Box 1.
Mismanagement of natural-resource revenues: the case of Nigeria

Nigeria is the top oil producing country in Africa and a major global exporter of natural gas. However, the potential contributions of the oil and gas sectors to the nation's development have so far been undermined by corruption and the mismanagement of revenues, as the Petroleum Revenue Special Task Force discovered in 2012. The task force was set up by the Ministry of Petroleum Resources and was headed by Nuru Ribadu, the former head of the Economic and Financial Crimes Commission, the nation's leading anti-corruption agency. The task force was mandated to review revenues from the oil and gas industries, and to make recommendations to the Government to improve revenue collection and management from the country's oil and gas operations. The task force's report, which covered a ten-year period from 2002 to 2012, highlighted a number of practices and trends that were systematically leading to lost revenues. Some of these practices include:

- Discretionary processes in awarding oil blocks, leading to significant revenue losses
- Crude sold to private commodity traders without formal contracts rather than directly to refineries, which is an unusual practice among oil producing countries
- Gas sold below market rates by Nigeria Liquefied Natural Gas, a State company jointly owned by foreign energy companies Shell, Eni and Total; the under-priced gas sales led to a deficit of an estimated US$29 billion
- Unpaid signature bonuses for oil block licences amounting to US$183 million since 2008 and unpaid royalties of about US$3.02 billion
- Discrepancies in the Nigerian National Petroleum Corporation's currency conversion practices from US dollars to nairas, the local currency

The findings of the Petroleum Revenue Special Task Force's report were contested by the Government and the report was never officially published, making it challenging to verify its findings. However, Central Bank Governor Lamido Sanusi subsequently reported that US$20 billion in oil revenues had not been submitted to the Government, out of US$67 billion of oil sold between January 2012 and July 2013. The alleged corruption in Nigeria's oil industry not only limits the fiscal space for financing national development, but deters potential investors from doing business in the country. Ghana could draw some lessons from Nigeria's experience and put in place safeguards to avoid patronage, fraud and other illegal activities that could undermine the potential revenues gained from its burgeoning oil industry.

Sources: *Financial Times*, "Ribadu report: Inquiry shines light on murky mechanics of the oil industry", 27 November 2012, and "Nigeria gas deals found to have cost $29bn", 24 October 2012.

4.1 PETROLEUM PRODUCTS: PRODUCTION AND CONSUMPTION

With the discovery of the Jubilee Field in 2007 and the start of extraction in 2010, oil production in Ghana increased from 8.9 kilotons in 2002 to 5,266.5 kilotons in 2013 (Table 8).

The increased oil production resulted in an increase in oil exports, which rose from 62,474 barrels in 2002 to 36,048,290 barrels in 2013. However, the increase in oil exports was not accompanied by a reduction in imports, which also increased to meet increasing demand for oil products for the production of electricity and for gasoline and diesel.

4.2 PRICING AND SUBSIDY POLICIES

As for downstream activities, since 2004 a deregulation process allowed oil companies to enter the market to import and distribute oil and petroleum products. The National Petroleum Authority is the technical adviser to the Government and elaborates pricing policies on behalf of the latter. However, the Government determines prices. When price increases are made necessary by a widening gap between the international reference price and the administered price but are not implemented, the cost of subsidies is assumed by the budget with transfers to producers and importers. However, large delays in effective disbursements make it difficult to precisely assess the importance of subsidies, among other things.

TABLE 8. PETROLEUM PRODUCTION, 2002-2013 (KILOTONS)

	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Saltpond Field	8.9	10.3	22.9	11.8	22.9	27.1	30.5	24.8	13.9	10.8	15.1	15.0
Jubilee Field	*	*	*	*	*	*	*	*	181.1	3 394.0	4 118.7	5 251.5
Total	**8.9**	**10.3**	**22.9**	**11.8**	**22.9**	**27.1**	**30.5**	**24.8**	**195.0**	**3 404.8**	**4 133.8**	**5 266.5**

* Non-existent
Source: Energy Commission of Ghana, 2014a.

Fuel prices in Ghana are determined administratively by the Government, which fixes the wholesale price, the so-called administered current price of distinct fuels, to which a number of taxes and margins are applied to determine the retail (ex-pump) price. When the administered current price is lower than the reference (ex-refinery) price – the so-called FOB Mediterranean price – a subsidy is paid to the importer/refiner. The unitary – per barrel – subsidy is equal to the difference between the administered price and the reference price. The total subsidy is equal to the unitary subsidy times the quantity consumed. The mechanism is illustrated in Table 9 with gasoline and diesel, the main fuels (with reference price of May 2014) and Table 29 in Annex 2 (with reference price of May 2013) as well as in Figures 1 and 2. The presentation of two distinct but similar tables is warranted because of the strong fluctuations in subsidies derived, in turn, from the changes in oil prices and exchange rates, and from Government updates of the administered price.

TABLE 9. PETROLEUM PRODUCT PRICING FORMULA (REFERENCE PRICE OF MAY 2014)*

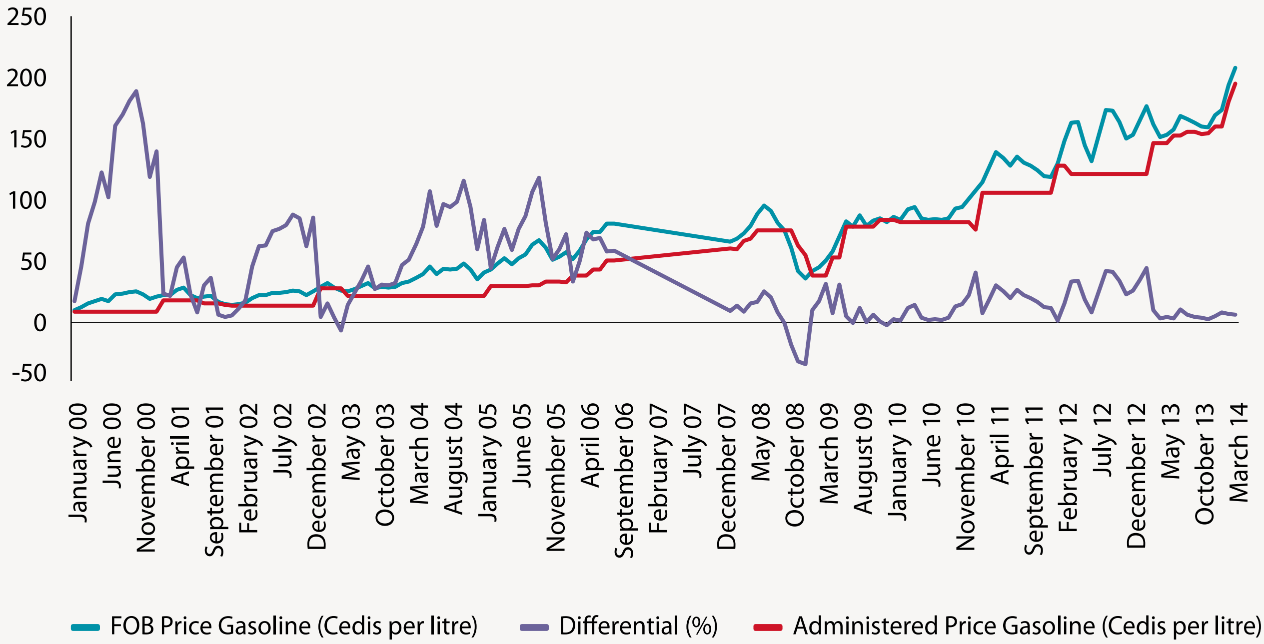
Variable name	Description	Source	Gasoline	Diesel
Reference price	FOB Mediterranean price (average of previous three months). The respective prices are: Premium 0.15 g/l and diesel 0.2%**		1 005.44	1 078.87
+Suppliers' commission (US$ per metric ton)	Tendering process		12.87	11.45
+Insurance (US$ per metric ton)	Suppliers' insurance cost		0.36	0.30
CIF (US$ per metric ton)	Total cost of insurance and freight	Sum of 1+2+3	1 018.66	1 090.62

Variable name	Description	Source	Gasoline	Diesel
Related charges (% of CIF)	Include: off-loading, losses, inspection, letter of credit costs, purchasers' commission, demurrage, financial costs, storage, rack loading cost, operation margin		13.85	13.85
+Related charges (US$ per metric ton)		Product of 4x5	141.08	151.05
=Total cost (US$ per metric ton)		Sum of 6+4	1 159.74	1 241.68
Conversion factor	From metric tons to litres		1 379.70	1 187.60
Ex-refinery full-cost price (US$ per litre)		Division of 7 over 8	0.8405	1.045
Cedis per US$ exchange rate	Average exchange rate of previous three months	Bank of Ghana	2.3397	2.3397
Ex-refinery full-cost recovery price (cedis per litre)		Product of 9x10	1.958	2.436
Administered current price (cedis per litre)		NPA (April 2014)	2.084	2.231
+Excise duty			0.0278	0.018
+TOR debt recovery levy			0.08	0.08
+Road Fund levy			0.0732	0.0732
+Energy Fund levy			0.0005	0.0005
+Exploration			0.001	0.001
+Cross-Sub. levy			0.05	-0.0269
+Primary distribution margin			0.065	0.065
+BOST margin			0.03	0.03
+Fuel marking margin			0.01	0.01
=ex-deposit price (cedis per litre)			2.422	2.482
Unified Petroleum Price Fund			0.09	0.09
Marketers' margin			0.1282	0.1282
Dealers' (retailers/operators) margin			0.0894	0.0894
Indicative maximum price (ex-pump)			2.7299	2.79
Trigger mechanism				
Volume sales in previous month (litres)			119 687 500	133 056 450
Actual refinery sales in previous month			249 524 500	296 928 774
Refinery sales at full-cost recovery			234 415 341	324 139 415
Per cent difference (relative subsidy)			6.06	-9.16
Triggered if actual and full-cost recovery total sales differ by more than 2.5 per cent.				

* Calculations based on February-April 2014.
** The lead content is expressed in terms of grams per litre of petroleum product.
Sources: International Energy Agency, 2014; National Petroleum Authority of Ghana, 2014; Platts, 2014; Unione Petrolifera Italiana, 2014.

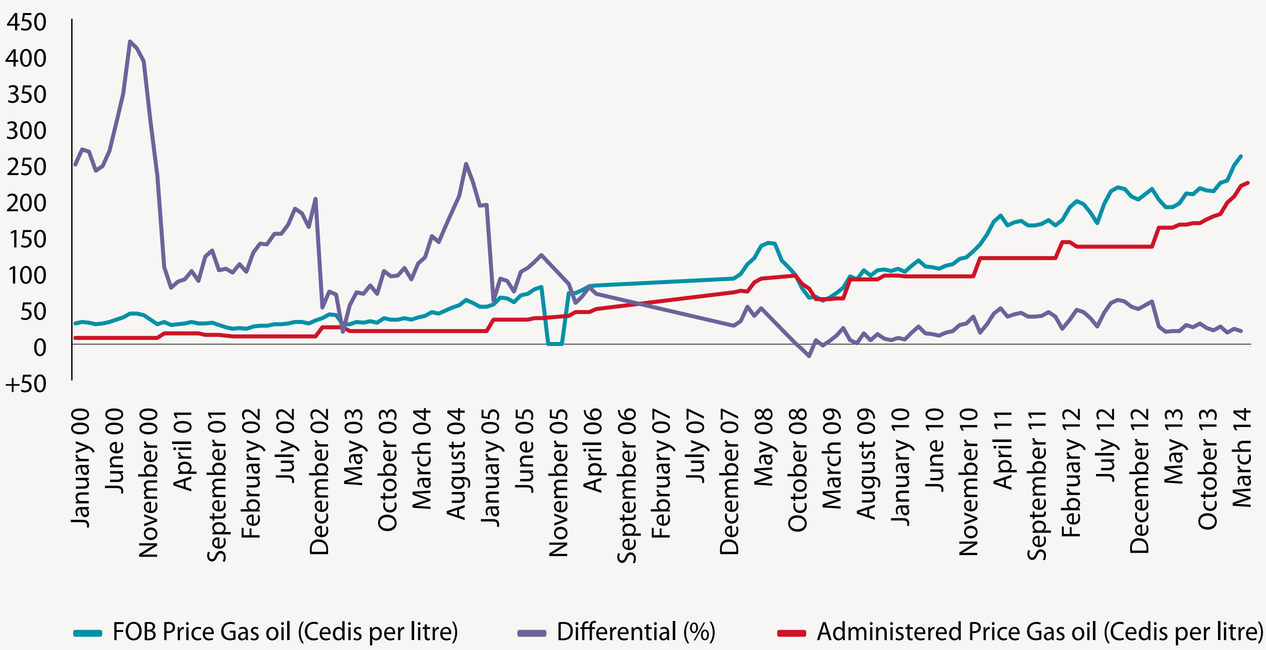
Table 9 starts with the reference ex-refinery price which is increased by different items and margins to determine the ex-refinery full-cost price (in particular the supplier commission's tendering process and the supplier's insurance cost). The sum of the three components determines the total cost of insurance and freight (CIF) to which a number of related charges are applied. Then the US dollar price is

FIGURE 1. GASOLINE EX-REFINERY ADMINISTERED AND FOB* MEDITERRANEAN PRICE, 2000-2014



* Free on board.
Sources: International Energy Agency, 2014; Unione Petrolifera Italiana, 2014; Platts, 2014; National Petroleum Authority of Ghana, 2014.

FIGURE 2. DIESEL EX-REFINERY ADMINISTERED AND FOB* MEDITERRANEAN PRICE, 2000-2014



* Free on board.
NB: "Gas oil" in the graph refers to diesel.
Sources: International Energy Agency, 2014; Unione Petrolifera Italiana, 2014; Platts, 2014; National Petroleum Authority of Ghana, 2014.

converted into cedis. When the administered current price is lower than the ex-refinery full-cost price, the first is taken for the application of a number of taxes and fees, plus the retail margins. The resulting sum is the price consumers pay at the pump. Taxes and levies are addressed in subsection 4.3.

Three important remarks can be made with reference to Table 9. The first is that, despite taxes and fees added on the administered price, fuels can still be subsidized if the taxes and fees are lower than the subsidy. The second is that there is a small cross-subsidization process by which a levy applied to gasoline is used to reduce the price of other fuels. The third is that, as of April 2014, i.e. the last available date to which Table 9 refers, a small subsidy exists for diesel only, whereas gasoline is not subsidized. This is due to the fact that the administered price has not been re-evaluated recently, notwithstanding the substantial recent devaluation of the cedi against the US dollar. The present situation, where the administered price for gasoline is lower than the ex-refinery price, could provide a good opportunity for reconsidering – indeed, discontinuing – the subsidization policy and putting the whole fuel price and tax policy on a sound footing from an environmental point of view.

Figures 1 and 2 above show the trend from 2000 to 2014 of the reference and the administered prices for gasoline and diesel and, by the differential, the subsidy. As already mentioned, large fluctuations occur over time. Since the increase in the administered price in 2013, the gap between the two prices has narrowed, implying a substantial reduction of the unitary subsidy.

4.3 TAXES AND LEVIES ON FUELS

Distinct levies and cross-subsidization mechanisms are applied to the ex-refinery price to determine the ex-deposit price (Table 9).

Excise duty: This tax is applied to all fuels except premix, a mix between gasoline and lubricant used by fishermen, which is heavily subsidized.

TOR debt recovery levy: The Tema Oil Refinery (TOR) is the national refinery, which in the recent past accumulated an unsustainable deficit because of the delays accumulated in the disbursement of the subsidy (the difference between the market and the administered price). The Government of Ghana introduced a special levy on gasoline to reduce this deficit.

Energy Fund levy: Under Act 685 of 2005, the Government introduced a levy of 0.07 cedis on every litre of petroleum product, other than liquefied petroleum gas (LPG). The energy levy constitutes part of the Energy Fund established under the Energy Commission Act, 1997 (Act 541).

Hydrocarbon exploration: By Act 685 of 2005, the Government imposed a levy of 0.001 cedi on every litre of petroleum product (other than LPG). The levy aims to provide resources to promote the exploration of hydrocarbon sites and create a data set containing geological information on Ghana.

Road Fund levy: Act 685 of 2005 introduced a levy of 0.07 cedis on every litre of petroleum product (other than LPG). The Road Fund levy constitutes part of the Road Fund established under the Road Fund Act, 1997 (Act 536).

Cross-subsidy levy: The aim of this levy – 0.05 cedis per litre of gasoline – is to generate resources to allocate to sustainable fuels (LPG) and motivate substitution among different fuels. The cross-subsidization should be in balance over the year, meaning no cost for the budget, or public purse.

Moreover, petroleum products are VAT exempt under the VAT law (S.15/Schedule 1) and the National Health Insurance levy, a special levy of 2.5 per cent, does not apply to petroleum products. Revenue implications apart, the VAT exemption on petroleum products creates an interruption in the flow of information on users.

Despite their relatively high number, the burden of taxes and fees on fuels is very low. In 2014, it amounted to 0.23 cedis per litre of gasoline, representing about 11 per cent of the retail price. This is, in comparative terms, an extremely low tax burden, as shown in more detail below.

Since several taxes are applied to fuels, the net cost of the subsidy for the public purse is equal to the difference between the gross subsidy and the collection of taxes on fuels. As of April 2014, the estimated[9] collection of taxes for gasoline, as shown in Table 10, was larger than the estimated total subsidy. Diesel tax collection was much lower than the gross subsidy, implying a net and substantial burden for the public purse. However, the administered price was not re-evaluated in the months leading to April 2014 despite the massive depreciation of the cedi. The closeness of the administered to the ex-refinery price eliminates the net subsidy for gasoline and reduces it for diesel (as reported in Table 10), thus providing an opportunity for the reform of energy taxation, as analysed in section 5.

TABLE 10. SUBSIDIES ON GASOLINE AND DIESEL, APRIL 2014 (CEDIS)

	Gasoline		Diesel	
Volume (litres) sales (March 2014)	119 687 500		133 056 450	
Tax collections				
Excise duty	2.78	332 731 250	1.80	239 501 610
TOR debt recovery levy	8.00	957 500 000	8.00	1 064 451 600
Road Fund levy	7.32	876 112 500	7.32	973 973 214
Energy Fund levy	0.05	5 984 375	0.05	6 652 823
Hydrocarbon exploration	0.10	11 968 750	0.10	13 305 645
Cross-subsidy levy	5.00	598 437 500	-2.69	-357 921 851
Subtotal of taxes collected	2 782 734 375		1 939 963 041	
Gross subsidy	-361 623 813		2 856 469 977	
Net subsidy (+ = subsidy)	-3 144 358 188		916 506 936	
Total (gasoline + diesel)	**-2 227 851 252**			

Sources: Energy Commission of Ghana, 2014a; 2014b.

4.4 ELECTRICITY

The Energy Commission, established by the Energy Commission Act, 1997 (Act 541), is the body responsible for the regulation of electricity, natural gas and the renewable energy sector in Ghana. The Energy Commission serves as the Government's energy policy adviser and deals with the collection and provision of statistical information.

4.4.1 Generation

Hydroelectricity generation is the primary source of electricity in Ghana, with an installed capacity of 1,580 megawatts (MW). It is followed by thermal (a mix of gas and oil) power plants. These two sources represent almost the country's entire installed capacity (Table 11). The share of electricity produced by the hydroelectric sector decreased from 91.5 per cent in 2000 to 63.9 per cent in 2013, substituted by the thermal sector, which increased from 8.5 per cent to 36 per cent due to increased production at the two main power plants – TAPCO and TICO (Energy Commission of Ghana, 2014b).

4.4.2 Consumption

Industry represents 47 per cent of total electricity consumption, the largest of any sector. However, its share has decreased from 68 per cent in 2000. Industry's progressive reduction in electricity demand is partially driven by the decrease in aluminium production. The Volta

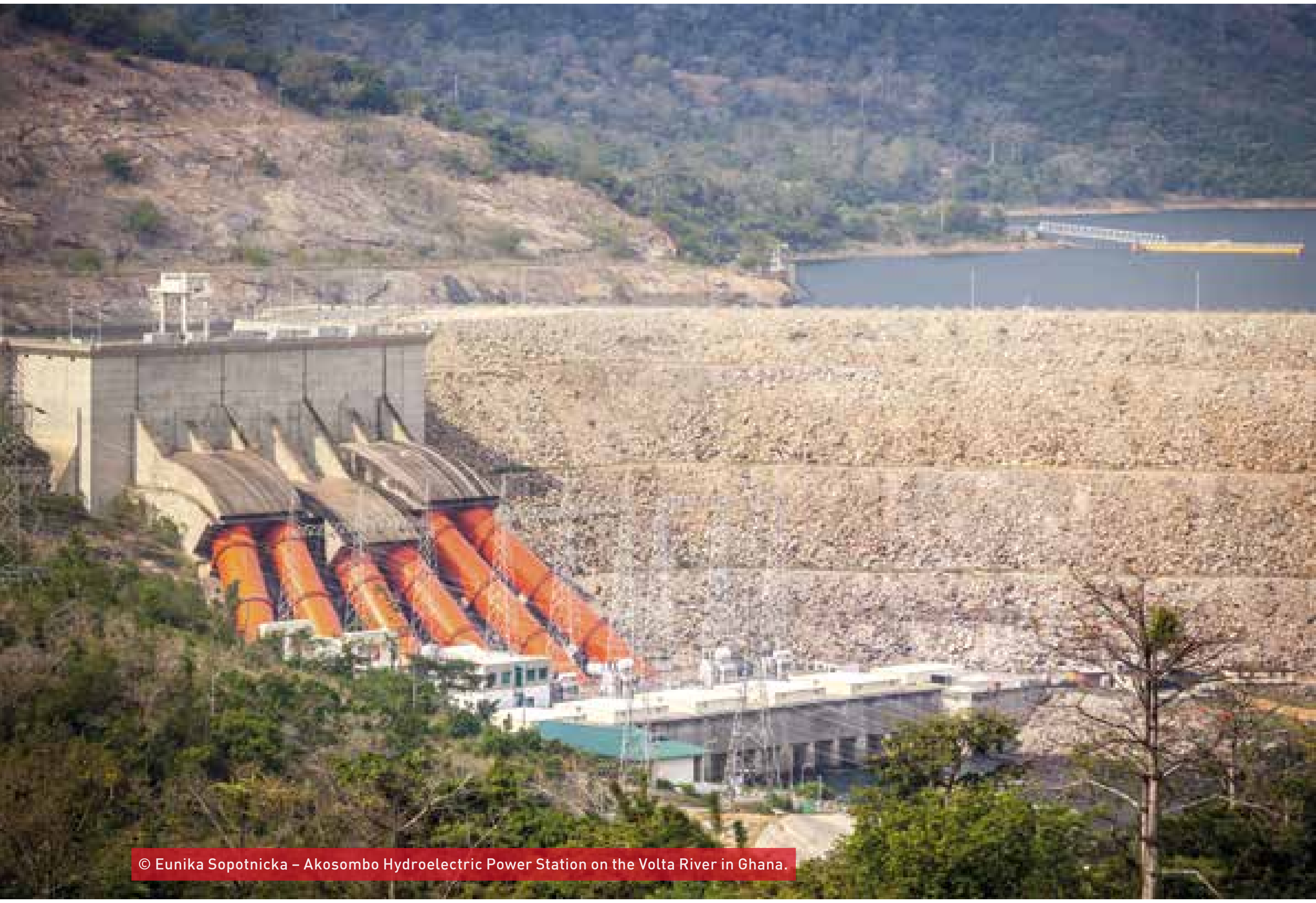
TABLE 11. INSTALLED CAPACITY AND ELECTRICITY PRODUCTION, 2013

Type of generation plant	Fuel type	Installed capacity (MW)**	Production (MW)**
Hydro	Water	1 580 (53.8)	8 233 (63.9)
Thermal power plants*	Oil and gas	1 380(45.9)	4 635 (36)
Renewables		2.5 (0.1)	3 (0.02)
Embedded generation		5 (0.2)	
Total		**2 967.5**	**12 870**

* Fuels used are mainly diesel, natural gas and light crude oil.
** Shares in parentheses (%).
Source: Energy Commission of Ghana, 2014b.

Aluminium Company, the primary consumer of electricity, reduced its electricity consumption from 2,500 gigawatt-hours (GWh) (58 per cent of the industry electricity demand) to 590 GWh (13 per cent). This reduction in electricity demand was partially offset by increased demand in the mining sector.

Thanks to better living conditions and the electrification of rural areas, the residential sector moved from 23.5 per cent in 2000 to 36 per cent of electricity demand in 2013. The non-residential sector in 2013 had three times the electricity demand of 2000 and increased its share of total demand to 17 per cent (Table 12).



© Eunika Sopotnicka – Akosombo Hydroelectric Power Station on the Volta River in Ghana.

TABLE 12. ELECTRICITY DEMAND BY SECTOR, 2000-2013

	Industry		Non-residential		Residential		Total
	1 000 GWh	Share(%)	1 000 GWh	Share (%)	1 000 GWh	Share (%)	1 000 GWh
2000	4.31	68.0	0.55	8.7	1.49	23.5	6.34
2001	4.33	66.4	0.58	8.7	1.61	24.7	6.53
2002	3.90	63.2	0.60	9.8	1.67	27.1	6.17
2003	2.21	48.6	0.62	13.6	1.73	38.0	4.55
2004	2.03	44.8	0.66	14.6	1.78	39.3	4.53
2005	2.54	49.2	0.70	13.6	1.92	37.2	5.16
2006	3.59	55.1	0.79	12.1	2.13	32.7	6.51
2007	2.70	48.3	0.80	14.3	2.10	37.6	5.59
2008	2.97	48.2	0.93	15.1	2.27	36.9	6.16
2009	2.94	47.2	0.88	14.1	2.41	38.7	6.23
2010	3.16	46.1	0.97	14.1	2.74	39.9	6.86
2011	3.90	48.9	1.31	16.4	2.76	34.6	7.98
2012	4.15	51.2	1.115	14.2	2.80	34.6	8.25
2013	4.22	47.1	1.53	17.0	3.23	36.0	9.00

Source: Energy Commission of Ghana, 2014a.

4.4.3 Pricing

The Public Utilities Regulatory Commission determines electricity tariffs. The tariff scheme is based on increasing blocks and differentiates residential and non-residential customers (Table 13).

In October 2013, a substantial increase in electricity tariffs of between 65 per cent and 78.6 per cent was implemented in response to a request for an average increase of 166 per cent by electricity utilities operating in Ghana.

TABLE 13. ELECTRICITY TARIFFS FOR RESIDENTIAL AND NON-RESIDENTIAL CUSTOMERS (CEDIS PER KWH)

	Residential					
Units (kWh)	Energy charge	Street lights	Special levy	Service charge	Subsidy	Net charge
0	0					
1	0.16	0	0	1	0.63	0.53
…	…	…	…	…	…	…
150	47.18	0.02	0.03	2.96	6.20	43.99
160	50.32	0.02	0.03	2.96	…	53.33
	Non-residential					
Units (kWh)	Energy charge	Street lights	Special levy	Service charge	VAT	Total
0	0			4.93	0.74	5.67
1	0.45			4.93	0.81	6.19
…	…	…	…	…	…	…
150	67.82	0.02	0.03	4.93	10.91	83.71
160	72.34	0.02	0.03	4.93	11.59	88.91

Source: Energy Commission of Ghana, 2014a.

© UNEP – Ghanaian electricians.

The net charge is composed of:

- Energy charge: This is a per kilowatt-hour (kWh) increase that covers the cost of the actual power (electricity) consumed.
- Street lights: This component aims to cover the cost of street lighting.
- Special levy: This increasing levy aims to generate resources for cross-subsidization among consumers differentiated by volume of consumption and is an additional charge towards the cost of rural electrification.
- Service charge: This fixed rate for access to electricity supply does not depend on the electricity consumed.
- Subsidy: The subsidy decreases with increasing volume and falls to zero for customers that consume more than 150 kWh.

For residential consumers, no VAT is levied. Non-residential consumers do not benefit from subsidies and their tariffs differ from residential consumers due to VAT and the unitary energy charge. In the residential sector, the charge is 0.16 cedis per kWh while for non-residential customers it is 0.45 cedis per kWh, as reported in Table 13.

The end-user tariffs established in 2013 are among the most expensive in Africa for the non-residential sector. The Energy Commission has identified this situation as a possible cause of loss of competitiveness with respect to neighbouring countries and countries exporting finished products to Ghana (in particular China, India and the Republic of Korea).

The high differential between residential and non-residential end-user tariffs points to a potential need to review the tariff scheme to reduce the cross-subsidization between the productive and non-productive (such as residential and public lightning) sectors.

© demerzel21 – Tropical forest of Kakum National Park, a 375 square km national park located in the Central Region of Ghana.

5 ENVIRONMENTALLY-ORIENTED ENERGY TAXATION

5.1 MAIN OPTIONS

The main fiscal strategy proposed in this study is a reform of energy taxation based on the removal of subsidies and the introduction of tax instruments to correct, with gradual intensity and coverage, the environmental impact and other externalities generated by the energy sector. As illustrated above, this strategy is suggested, among other considerations, to avoid the temptation to use oil and gas rents to subsidize energy products to the detriment of other more growth-efficient and environmentally-friendly alternatives.

Different options are available to Ghana, ranging from pure energy taxes to explicitly targeted environmental tax instruments.

Pure excises on selected fuels and other energy sources. This is the traditional solution applied in virtually all countries. However, revenues, rather than environmental concerns, tend to be the primary goal of excises.

Pure excises are modulated according to socio-economic considerations. The environmental impact of different fuels is generally neglected and no link exists between the burden of the excises and the social damages connected to their use. For example, diesel is traditionally taxed less than gasoline because it is used for transporting goods and by the agricultural and fishing sectors, even though diesel has adverse impacts on the environment in terms of nitrogen oxide emissions and particulate matter.

The environmental impact of pure excises derives from their price effect. The impact is not trivial, as illustrated in Box 2, which shows the price elasticity of fuel consumption in the short and long term. A sufficiently large excise on petroleum and other products can constrain demand as well as foster environmentally-friendly industrial restructuring. For example, data in Box 2 show that a 10 per cent increase in the price of gasoline leads in the short term to a 3 per cent reduction in its consumption, while in the long term it leads to a 7 per cent reduction in its consumption, which is substantial.

Some additional environmental targeting can, however, also be introduced in these excises. An example is the typical differentiation of the excise between leaded and unleaded gasoline to the advantage of the latter. There has also been a general repositioning of the taxation of diesel in Europe, in the sense that the traditionally lower excise on diesel has come closer to that on gasoline. The application of VAT over the combination of price plus excises amplifies the incidence of taxation and provides ample revenues. From the standpoint of environmental impact, last generation diesel and gasoline engines can be considered more or less equivalent: diesel produces less CO_2 per km driven, but more particulate matter. Emissions of CO, NO_x, hydrocarbon and other pollutants per km are more or less equivalent. Even though reported emissions per fuel type vary across sources,[10] on the whole diesel appears to contribute less than gasoline to global pollution, but possibly more than gasoline to local pollution. There do not appear to be strong environmental reasons to differentiate the taxation of these two fuels. Gas has real potential to lower the local and global impacts of vehicle use. If investments in the distribution network of currently imported LPG or of natural gas were a feasible option in Ghana, a differentiated tax regime could be designed to provide incentives to promote hybrid vehicles.

Pure measured emission taxes. These taxes involve payments directly related to metered or measured quantities of polluting effluents. They can be targeted to emissions with both local and global impacts. Specific examples of measured local emission taxes are the Swedish tax on nitrogen oxide emissions and the emission charges on water pollution levied in the Netherlands. In these cases, the sources of emissions are charged an amount based on the measured total emissions from each particular source.

Box 2.
The environmental impact of excises

A large number of studies estimate the price elasticity of the demand for vehicle fuels. The results depend on the countries selected, the period and the methodology (time series versus cross section). The average values of the price elasticity of diesel from a large number of studies have been calculated by Graham and Glaister (2002) and are shown below.

	Short-term elasticity	
Time series analysis	- 0.27	- 0.71
Cross-section analysis	- 0.28	- 0.84

The results show that in the short term, when vehicles are not yet replaced, the price elasticity is rather low – the variation in demand is between one fourth and one third of the variation in price.

The short-term elasticity is used to estimate the budget impact of a price and/or tax change, because the immediate impact is relevant. For Ghana, Dahl (2012) reports a short-term elasticity of -0.26 for gasoline and -0.13 for diesel.

The long-term elasticity – which is more relevant for estimating the environmental impact – is much larger:an increase in price of 10 per cent leads to an estimated decrease in consumption of between -0.71 per cent and -0.84 per cent. Clearly, the price effect can be compensated by the income effect. As the country gets richer, consumers are able to keep their consumption levels unchanged even in the presence of price increases. Another study, Sterner (2007), analyses the pattern of fuel consumption in a sample of countries (which does not include Ghana) with both low and high fuel prices. The results show a significant price effect in the long term, supporting the idea that excises can be an effective instrument for environmental policy.

© demerzel21 – Ghanaian open pit gold mine.

In contrast, carbon taxes are not usually based on actual physical metering of CO_2 emissions from smoke stacks, although technically feasible and implemented in some large power plants. Rather, they are generally levied on the carbon content of fuels. The emissions are therefore measured by calculating how much CO_2 is produced by a given source. The Intergovernmental Panel on Climate Change has published a set of guidelines that all countries now use, as part of the United Nations Framework Convention on Climate Change, to estimate GHG emissions, so as to produce uniformity across countries and minimize the margin of error (IPCC, 2006).

The most common approach to emission taxes is to start by charging "big polluters" – such as power plants, refineries and industrial firms – a specific tax per unit of emissions such as tons of CO_2 or other pollutants. In principle, emission taxes on large point sources enjoy wide popularity, but as they are concentrated on a small number of large taxpayers, these targets groups may launch strong, coordinated resistance, especially as small groups are easier to organize than large ones. These taxes can be very precisely targeted to align with environmental objectives and are recommended in the literature, along with tradable permits, as the main instruments in climate change mitigation policies.

To contain administrative costs and counter political resistance, emission-based taxes should be gradually introduced, and their coverage progressively increased. Ideally, a tax on emissions of a given pollutant should be levied on all sources – firms and individuals. In most cases, this is technically and/or politically unfeasible in a single step.

Gradual introduction and revenue neutrality have been recognized as key ingredients to design a successful carbon tax in the Canadian province of British Columbia. Introduced in July 2008, British Columbia's carbon tax is levied on most fuels and emissions. It was initially set at 10 Canadian dollars (C$) per ton of carbon dioxide and gradually rose, by C$5 per year, to reach its maximum at C$30 in 2014. Revenue neutrality was ensured by cutting C$760 million on corporate and income taxes. British Columbia's carbon tax has proven to be effective in reducing the consumption of fossil fuels without depressing the economy: official statistics confirm that the province's GDP per capita performed well with respect to other Canadian provinces since the introduction of the carbon tax.

The recently acquired status of Ghana as an oil producing country and the sound dynamics of the country's economic growth would make the adoption of a circumscribed carbon emission tax a strategic future and outward-oriented fiscal policy. At the same time, one has to consider that, in the national context, the local impact of energy consumption is larger than the global impact, especially for fuels used for transport. Caring for the population's immediate welfare would then suggest giving higher priority to the internalization of local externalities. In addition, revenue considerations add argument to the correction of local impact.

Excises re-modulated according to emission intensity. With this alternative, re-modulated excises are used to approximate a tax on emissions. This instrument has a less precise environmental focus than pure emission taxes, but entails lower administrative costs and has a much higher potential to create fiscal space.

Goods and services generating environmental damages in their production or consumption may be subject to differentiated tax rates according to their environmental impact, such as GHG emissions, while comparatively greener goods can be taxed less heavily than their substitutes.

Re-modulated excises represent an improvement against pure excises with very little increase in administrative and compliance costs because


© UNEP

these taxes use existing assessment and collection procedures.

All environmental taxes are based on a fiscal incentive mechanism, but they exert their impact in different ways:

- Simple excises generate an incentive to reduce consumption due to price increases.
- Re-modulated excises produce a stronger environmental incentive, as the tax burden is based on the relationship between the tax base (e.g. a given fuel) and its emissions. The induced modification in relative prices reflects pollution externalities more closely.
- Pure emission taxes determine the tax burden directly on the grounds of polluting emissions.

The choice between the different types of environmental taxes will depend on considerations pertaining to costs, economic and political factors, and targeting. Targeting (linking taxes to environmental impact) is more direct and efficient with pure emission taxes. This is especially true when multiple emissions are targeted. The efficiency gap becomes less substantial when only a single emission is targeted, as in the case of a carbon tax.

However, relevant administrative gains can be achieved from modulating excises according to emissions instead of using pure emission taxes. The modulation of existing tax rates according to pollution content does not require metering emissions directly, which can be complex and costly, requiring new equipment as well as new production and monitoring procedures. Only metering of the product is needed – a much easier task.

Political costs and benefits of the different alternatives also need to be taken into account. The introduction of a carbon tax has been relatively easy politically in Scandinavian countries and is increasingly popular with the general public in countries with a political climate that welcomes environmental reform. Resistance by the most affected sectors, however, is still considerable, and the process has been troubled in several jurisdictions, including Australia and Canada. This explains the gradual approach to carbon taxes that is generally followed in most countries. A large coordinated reform strategy could work better, as suggested by the Mexican case.[11]

5.2 MAIN COMPONENTS OF THE REFORM STRATEGY

The possibility of environmental targeting, the potential of revenues deriving from a large tax base, and the containment of administration costs (in Ghana only one refinery exists currently and a large quantity of fuel is imported) suggest using re-modulated excises to reform energy taxation.

The range of products subject to the first stage of reform is limited, but their economic importance is very large. Increasing taxes on partly renewable cooking fuels, such as wood and charcoal, is problematic due to administration and compliance costs, while taxing LPG could prove unproductive from an environmental point of view because it would retard the shift from environmentally-damaging fuels, such as wood and charcoal, to LPG which is less harmful. Action should be taken after the shift is completed.

The main characteristics of the reform strategy are the following: the first step should be to abandon the system of administered pricing and to replace it by a system of market pricing. As yet no effective step has been taken on this front. The elimination of the administered price system is required, as opposed to the introduction of increases, however large, in administered prices. Similarly, the fact that international fuel prices occasionally fall below the administered price, mostly because of the retarded re-evaluation of the latter, cannot be interpreted as a removal of the subsidy scheme.

The intention of the Government of Ghana is to “review the fuel pricing structure and the method of assessing foreign exchange losses and subsidies to reduce the overall fiscal deficit”. The Government is also committed to “a gradual and automatic adjustment to ex-pump fuel price within tolerable price bands and the establishment of an effective over/under recovery mechanism that will avoid wide swings in prices” (Government of Ghana, Ministry of Finance, 2014). This important step must be acknowledged. However, the reform process is not complete without a system of market-determined fuel prices. The current substantial (and possibly sustained) fall in the international price of oil could represent an appropriate opportunity for the Government to introduce the reform. At the same time, the Government's critical role would be preserved as it would monitor the price determination process of firms, to prevent the exploitation of market power.

Aligning the total burden of excises on fuels used for transport and electricity production to correct externalities requires a substantial increase in their tax rate. A gradual approach is therefore suggested in this study, with various options ranging from the correction of the local or the global impact, or a combination of both. The correction of congestion and of the cost of accidents is left to subsequent steps of the reform process.

The removal of cross-subsidization between fuels would also be part of the reform. The removal is especially justified by the fact that part of the tax burden on gasoline is currently used to subsidize diesel, another polluting fuel.

Complementing taxes on transport fuels with distance related taxes – such as congestion charges levied at the metropolitan/municipal level – would introduce an intergovernmental dimension to the energy/environmental taxation framework, since these instruments can conveniently be applied at the subnational government level. This strategy would also increase the environmental impact of taxation without the need to rely exclusively on politically sensitive transport fuel taxes.

Compensation could be paid to the poorest households/individuals to absorb the direct and indirect impacts of price increases.[12] A few alternative options relate to the compensation amount and to households in different expenditure brackets that would benefit from the compensation.

Options related to the use of revenues are realistically limited by the need to reduce the current large imbalance in the government budget. This applies particularly to the reduction of the tax burden on labour, especially of social security contributions.

Promoting green investments with the collection of environmental taxes should attenuate political opposition to the reform, which nevertheless should be accompanied by a timely and well-designed information campaign that highlights the crucial gains of the transition to the green economy combined with green fiscal reforms, while announcing the payment of compensation to the most affected households.

Finally, even if a decision to contribute to climate change mitigation by introducing a moderate carbon tax was desirable in the short term for Ghana, emissions trading should not be ignored in the design of a long-term climate change mitigation strategy. Implementing a carbon emission trading system at the level of upstream fossil-fuel producers on the grounds of the carbon content of fuels, or on downstream emitters to capture emissions from large sources, is not much more complex administratively than implementing a carbon tax. Many oil-producing, high-income countries – such as Canada (in Alberta) and Norway – have implemented similar schemes. The European Union Emissions Trading System provides adequate experience on the system's set-up, management and most typical obstacles. One reason to prefer a carbon tax is that in the present international context of economic and climate change politics, it could be preferable to fix a well-defined, predictable price for emissions, leaving quantities free to adjust. The experiences of the price volatility and crash in the EU Emissions Trading System in recent years are a lesson in that direction. In the medium and long run, however, as countries converge


© UNEP

on a common target for stabilizing atmospheric GHG concentrations, and developing countries commit to binding emission reductions, fixed emission targets will become increasingly advantageous.[13]

Sections 5.3 to 5.6 and 6 present reform proposals for transport fuels, fuels used in the generation of electricity, and vehicle taxation. Fiscal instruments targeted also at the consumption of wood and charcoal as domestic fuels could potentially provide significant environmental benefits, but, as discussed in section 4, a feasible proposal would entail the broader reform of timber governance in Ghana, which does not fall within the scope of this study.

5.3 TAXING TRANSPORT FUELS: THE INTERNALIZATION OF PETROLEUM PRODUCTS' EXTERNAL COSTS

The tax burden on fuels should accurately reflect the quantity of externalities derived from their production and consumption, making the taxes efficient (Pigouvian). Following the classification proposed by the IMF (2014b), five main categories of externalities are considered: (1) global damages linked to GHG emissions; (2) damages from local air pollution derived from emissions of other gases, such as nitrogen oxide, volatile organic compounds and particulate matter, impacting on human mortality and morbidity; (3) traffic congestion causing delays; (4) traffic accidents; and (5) road damages. Two separate steps are required: assessing the economic burden of these external costs and translating their price into an efficient tax.

© UNEP

Global damages linked to GHG emissions

Worldwide damages derive from a large variety of impacts from GHG emissions, such as negative effects on agricultural production, water availability, marine ecosystems, energy production and consumption, social well-being and geopolitics; sea level rise; increased frequency and gravity of natural disasters; the spread of tropical diseases; and biodiversity loss. The estimates of these damages reflect divergent views about the appropriate discount rate, the valuation of ecosystem damages and the probability of extreme outcomes. The location of countries is an important determinant of damages, as is the structure of their economic system. Developed countries in temperate zones may even benefit from global warming, although only in the near future, while small island states located in tropical zones are likely to be the most severely affected.

Monetary valuations depend on different methods: prevention (abatement) costs, replacement or restoration costs, protection and adaptation costs, the cost of lost production, and the value of statistical lives lost, to cite a few. For example, the costs of sea level rise can be expressed as the capital costs of protecting coastal areas plus the value of land and infrastructure at risk, plus expected fatalities evaluated using the statistical value of life. The discount rate exerts a critical influence and, in general, differences in basic assumptions generate widely divergent values. However, the consensus at the beginning of this century was that the central price of damages to developed countries was around US$20-US$22 per ton of CO_2e emissions. This corresponds to a cost of about US$0.06 per gallon of fuel. This amount has since been revised as a result of growth in GDP, inflation and a clearer appreciation of the dynamics and environmental impact of climate change. IMF (2014b) suggests using a value of US$35 per ton of CO_2e emissions.

Local environmental externalities

The first step in the valuation of local environmental externalities is to assign the emissions of pollutants to the use of each fossil fuel. This requires disaggregated information on fuel consumption. The second step is to estimate the extent to which emissions contribute to the deterioration of air quality. The deterioration of air quality, in turn, produces various damages, the most important of which are consequences for human health, determined by exposure levels.

The usual methodology for evaluating these damages consists of linking variations in the concentration of pollutants in the air to probable impacts on health, such as premature mortality and respiratory illnesses.

Converting health impacts to economic values requires the use of unit economic values for mortality and morbidity. For the former, the Value of a Statistical Life can be measured using the Human Capital (HC) approach (present value of earnings lost as a result of premature death) or alternatively by the Willingness to Pay (WTP) of a population to reduce certain types of risk to which it is exposed, based on contingent valuation or hedonic pricing. For morbidity, this valuation can also be based on WTP to avoid symptoms caused by pollution-related illnesses, or alternatively, on the Cost of Illness (CI), which basically includes health care costs and productivity losses until recovery (or death). (Navajas, Panadeiros and Natale, 2012:12-13).

The evaluations based on the value of a statistical life give lower bound estimates, based on foregone future incomes. These estimates do not include the subjective value people assign to life (in terms of consumption, leisure, etc.)

Traffic congestion

Congestion costs derive from delays, concentrated in urban areas, and the value of time. Damages caused by congestion in terms of higher emissions due to increased fuel consumption are taken into account in the estimation of local environmental externalities. Nonetheless, the costs of congestion are substantial.

Traffic accidents

The cost of accidents depends mainly on accident rates, injuries and the value of life. Medical costs and damages to property must also be added. To estimate the cost for Ghana, road fatalities and GDP per capita were used as regressors of the cost determined for the countries sampled, and the coefficients associated to these variables were applied to their value for Ghana, obtaining a cost of accidents equal to US$0.014 per mile. This cost is substantially lower than the average cost determined for the reference sample. The difference to a large extent reflects the lower per capita GDP of Ghana.

Road damages

Road damages depend on the use of roads, especially by heavy vehicles such as lorries. These vehicles mostly use diesel. Road damage estimates therefore refer only to the use of diesel.

5.4 A CORRECTIVE TAX ON TRANSPORT FUELS: THE METHODOLOGY

Parry and Small (2005) provide an analytical approach to translate damages into corrective taxes. This approach can be simplified (see Parry, 2005) by the following expression:

Efficient/Pigouvian tax ($ per gallon) =

{fuel-related externalities ($ per gallon): carbon and other global emissions}

+

{mileage-related externalities ($ per mile): local pollution, congestion and accidents}

×

{miles per gallon}

×

{a = percentage share of reduction of gasoline consumption due to reduced mileage}

The first factor (global damages) is linked directly to the consumption of fuels, while the remaining factors are directly proportional to the number of miles driven rather than to the fuel consumed. There are two reasons for the link with miles driven instead of fuel used. First, there is the impact of emission standards, which are defined in terms of grams per mile, not grams per gallon. This means that a vehicle with low mileage per gallon will not pollute more per mile since it has to comply with emission standards. Second, miles per gallon also rise with higher fuel prices since people respond by purchasing smaller or more energy-efficient vehicles.

The formula scales back the mile-related cost of externalities by applying a factor α reflecting the reduction at the margin in fuel consumption due to the decrease in miles driven because of the increased taxation. The factor α represents an impact that is added to the reduction in fuel consumption derived from improvements in the average fuel economy of vehicles.[14] For this parameter a value of 40, as in Parry (2005), is adopted.

Table 14 shows the estimates for Ghana of global and local damages (including congestion, accidents and road damages) for gasoline and diesel. It also shows the calculated efficient tax (which amounts to the sum of all damages), the actual tax and the retail price.

TABLE 14. COMPARISON OF ESTIMATES OF DAMAGES AND EFFICIENT TAX WITH CURRENT TAX, MAY 2014 (US$ PER LITRE)

	Estimate of damages						Actual tax	Price
	Global (carbon)	Local air pollution	Traffic congestion	Traffic accidents	Road damages	Efficient tax		
Gasoline	0.08	0.003	0.020	0.172	-	0.275	0.082	0.97
Diesel	0.09	0.008	0.017	0.088	0.027	0.230	0.053	0.99

Sources: For estimates of damages: IMF, 2014b; for tax: Table 9 of this study.

The main message emerging from Table 14 is the extremely low level of the burden of taxation in Ghana – even in the case where no subsidy is paid. The tax on gasoline represents less than 10 per cent of the retail price. An efficient tax, correcting for the externalities, should be approximately four times higher. For diesel, the gap between the efficient tax level and the actual level is even bigger.

5.5 A CORRECTIVE TAX ON TRANSPORT FUELS: THE MACROECONOMIC IMPACT

A sudden, all-in-one price increase to correct all the externalities would not be feasible, economically or politically. Instead, the Government of Ghana could carefully elaborate a medium- to long-term strategy over several years, to realize the full impact of the reform. Importantly, the Government could also exploit the current decline in international oil prices to gradually start implementing the reform.

Simulations of two options are presented here, which show the impact on revenue, and the reduction of environmental damages and other externalities.

The first consists in the internalization of all local damages, including local pollution, traffic congestion and accidents, and (for diesel) road damages. It would require an increase in the excise duty to 0.38 cedis per litre of gasoline and 0.27 cedis per litre of diesel (respectively +5 and +4 per cent) (see Table 15).

The second option introduces corrective taxes to address both global and local damages, and would involve an increase in the excise duty to 0.54 cedis for gasoline and 0.46 cedis for diesel, equivalent to an 11 per cent increase in the retail price (see Table 16).

Table 15 reports the impact on consumption and tax collection of the reform aimed at correcting all local damages, showing two sets of values for elasticity. The first set is drawn from the literature (see Box 2), the second derives from this study's estimates based on the 2005/06 Ghana Living Standards Survey (GLSS) (the most recent household microdata available) and updates.[15] The elasticity of the second set is considerably higher than the first but is calculated only on households that actually spend on fuels.

The short-term impact of the correction for all local damages on consumption and polluting emissions would vary, according to the elasticity, from -0.6 per cent in the case of diesel with the elasticity

TABLE 15. ENVIRONMENTALLY-EFFICIENT FUEL TAXES: BASIC RESULTS OF THE SIMULATION OF REFORM INTERNALIZING ALL LOCAL DAMAGES

	Gasoline a)	Diesel a)	Gasoline b)	Diesel b)
Present tax and levies (cedis per litre)	0.23	0.15	0.23	0.15
Price (cedis per litre)	2.73	2.79	2.73	2.79
Adjustment for all local damages (cedis per litre)	0.38	0.27	0.38	0.27
New price (cedis per litre)	2.88	2.91	2.88	2.91
% increase in price	5.5	4.3	5.5	4.3
Short-term elasticity	0.26	0.13	0.56	0.56
2013 consumption (litres per year)**	1 044 058	1 664 348	1 044 058	1 664 348
Consumption after new tax (litres per year)**	1 029 038	1 654 801	1 011 707	1 623 220
Short-term % change in consumption and damages	-1.4	-0.6	-3.1	-2.5
Long-term elasticity	0.8	0.8	0.8	0.8
Long-term % change in consumption and damages	-4.4	-3.5	-4.4	-3.5
Estimated tax collections before tax reform (cedis)**	240 133	249 652	240 133	249 652
Estimated tax collections after first step of reform (cedis)**	392 124	451 951	385 519	443 325
Additional collections (cedis)**	151 991	202 299	145 386	193 673
Additional collections (% of GDP)	0.2	0.2	0.2	0.2
% increase in tax collections	63	81	61	78

Note: a) Low elasticity; b) High elasticity.
** Consumption and collection data in 000.
Source: Authors' calculations based on Tables 9 and 14.

taken from the literature, to -2.5 per cent with this study's own estimates of elasticity. For gasoline, the corresponding values would be -1.4 per cent and -3.1 per cent. With an estimated long-term[16] elasticity of 0.8, the reduction in consumption and in polluting emissions would be much more substantial, ranging from -4.4 per cent for gasoline, to -3.5 per cent for diesel.

The impact on tax collection would be substantial, amounting to an increase of between 61 per cent and 63 per cent for gasoline and of between 78 per cent and 81 per cent for diesel, depending on elasticity (Table 15). The projected change derives from a tax increase that is substantial in percentage terms due to the extremely low level of current taxation.

Table 16 shows the estimates pertaining to the introduction of an excise duty that corrects for both global and local impacts. The tax change would be higher than in the previous case, resulting in a greater reduction of pollution and damages and a higher increase in revenues.

5.6 A CORRECTIVE TAX ON TRANSPORT FUELS: THE DISTRIBUTIVE IMPACT OF REFORM AND ITS COMPENSATION

The payment of compensation to the most affected segments of the population requires, first, determining how much households with different income and expenditure levels spend on fuels, directly and indirectly, and then calculating how much more they will have to spend because of the tax increase to maintain their level of consumption.

More precisely, two distinct effects can be distinguished: first, the direct impact of a fuel price increase on household budgets and second, the indirect impact due to an increase in the prices of all other goods and services as producers pass on higher fuel prices. The total impact is the sum of the direct and indirect effects. While the direct impact is estimated using information from the GLSS, only empirical literature is available to estimate the magnitude of the indirect impact.[17] The multiplier used, equal to 3, is consistent with the results in Coady and Newhouse (2006) and El Said and Leigh (2006), but slightly higher than those in Arze del Granado, Coady and Gillingham (2010) for sub-Saharan countries.[18] In fact, due to the small amount of money households spend on transport fuels, the main effect is the indirect one.

TABLE 16. ENVIRONMENTALLY-EFFICIENT FUEL TAXES: BASIC RESULTS OF THE SIMULATION OF GLOBAL AND LOCAL CORRECTIVE TAXATION

	Global and local impacts			
	Gasoline a)	Diesel a)	Gasoline b)	Diesel b)
Present tax and levies (cedis per litre)	0.23	0.15	0.23	0.15
Price (cedis per litre)	2.73	2.79	2.73	2.79
Adjustment for global and local impact (cedis per litre)	0.54	0.46	0.54	0.46
New price (cedis per litre)	3.04	3.1	3.04	3.1
% increase in price	11.4	11.1	11.4	11.1
Short-term elasticity	0.26	0.13	0.56	0.56
2013 consumption (litres per year)**	1 044 058	1 664 348	1 044 058	1 664 348
Consumption after new tax (litres per year)**	1 013 234	1 640 308	977 667	1 560 789
Short-term % change in consumption and damages	-3.0	-1.4	-6.4	-6.2
Long-term elasticity	0.8	0.8	0.8	0.8
Long-term % change in consumption and damages	-9.1	-8.9	-9.1	-8.9
Estimated tax collections before tax reform (cedis)**	240 133	249 652	240 133	249 652
Estimated tax collections after first step of reform (cedis)**	547 146	754 541	527 940	717 963
Additional collections (cedis)**	307 013	504 889	287 807	468 311
Additional collections (% of GDP)	0.3	0.6	0.3	0.5
% increase in tax collections	128	202	120	188

Note: a) Low elasticity; b) High elasticity.
** Consumption and collections data in 000.
Source: Authors' calculations based on Tables 9 and 14.

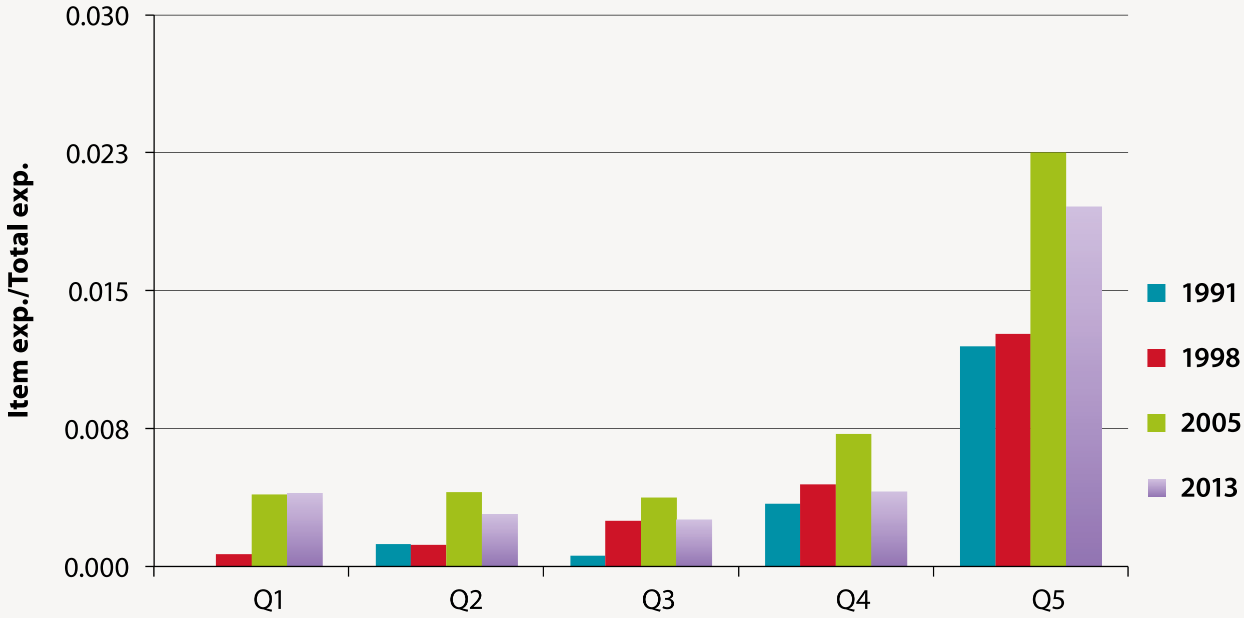
Unfortunately, the last GLSS published refers to 2005/06 and the microdata for 2012/13 have not yet been released. This study is based on expenditure data from the 2005/06 GLSS updated with reference to 2013.[19]

The shares of fuel expenditure on total consumption by quintiles from 1991 to 2013 are reported on the vertical axis of Figure 3. Quintiles are ranked on the horizontal axis from left, the poorest, to right, the richest. Differences between years are small while, as expected, differences among quintiles are very large: poor households spent and still spend small amounts for transport fuels. On the whole, the pattern of fuel expenditure is progressive, meaning that as total household expenditure, and hence income, grows, the share spent on fuel also grows. At the same time, an increase in the tax would impact heavily on the poorest households because of their very low level of consumption, particularly on the two lowest quintiles. Equity considerations would require the payment of compensation.

Table 17 reports the direct impact on household expenditures of the reform aimed at internalizing all the local externalities, taking into account the short-term impact of elasticity. Specifically, the column on the right shows the expenditure needed to keep the level of consumption unchanged. The increase over current expenditure (centre column) represents the reform's direct impact on households. It increases with the level of household expenditure.

Table 18 shows the direct impact of the reform on household expenditures to correct both global and local damages.

FIGURE 3. SHARES OF TRANSPORT FUEL EXPENDITURE IN TOTAL HOUSEHOLD CONSUMPTION EXPENDITURE BY QUINTILE, 1991-2013



Source: Authors' elaboration on the GLSS 1991/92, 1998/99, 2005/06.

TABLE 17. MEAN ANNUAL HOUSEHOLD TRANSPORT FUEL EXPENDITURE BY QUINTILE BEFORE AND AFTER TAX CHANGES, 2013 (CEDIS), LOCAL CORRECTIVE TAXATION (WITH HIGH ELASTICITY)

Quintile	Annual household expenditure	Annual expenditure after tax (corrected by elasticity)
	Gasoline and diesel	Gasoline and diesel
1	16.4	16.7
2	20.4	20.9
3	20.5	20.9
4	53.7	54.7
5	434.0	442.6
Total	**132.8**	**135.4**

Note: Quintiles are based on household equivalent expenditures.
Source: Authors' elaboration on the 2005/06 GLSS (Ghana Statistical Service, 2008).

TABLE 18. MEAN ANNUAL HOUSEHOLD TRANSPORT FUEL EXPENDITURE BY QUINTILE BEFORE AND AFTER TAX CHANGES, 2013 (CEDIS), GLOBAL AND LOCAL CORRECTIVE TAXATION (WITH HIGH ELASTICITY)

Quintile	Annual household expenditure	Annual expenditure after tax (corrected by elasticity)
	Gasoline and diesel	Gasoline and diesel
1	16.4	17.1
2	20.4	21.3
3	20.5	21.3
4	53.7	55.9
5	434.0	452.3
Total	132.8	138.4

Note: Quintiles are based on household equivalent expenditures.
Source: Authors' elaboration on the 2005/06 GLSS (Ghana Statistical Service, 2008).

Table 19 shows the results for four different compensation schemes with reference to the correction of both global and local damages, i.e. the most ambitious reform, and applying the lowest elasticity value. The compensating schemes are as follows:

- Scheme 1 fully compensates households in the first and second quintiles, and partially compensates (50 per cent) households in the third quintile.
- Scheme 2 fully compensates households in the first, second and third quintiles.
- Scheme 3 fully compensates households in the first quintile and partially compensates (50 per cent) households in the second quintile.
- Scheme 4 fully compensates only the households in the first and second quintiles.

TABLE 19. LOW ELASTICITY SCENARIO: AMOUNT OF COLLECTIONS NEEDED TO COMPENSATE HOUSEHOLDS IN DIFFERENT QUINTILES, 2013 (CEDIS), GLOBAL AND LOCAL CORRECTIVE TAXATION

Scheme	Direct impact	Indirect impact	Total impact
1	4 117 986	12 353 958	16 471 944
2	5 134 297	15 402 891	20 537 188
3	2 156 770	6 470 311	8 627 081
4	3 101 675	9 305 024	12 406 699

Source: Authors' elaboration on the 2005/06 GLSS (Ghana Statistical Service, 2008).

Table 20 reports the same estimates, applying the highest elasticity value.

TABLE 20. HIGH ELASTICITY SCENARIO: AMOUNT OF COLLECTIONS NEEDED TO COMPENSATE HOUSEHOLDS IN DIFFERENT QUINTILES, 2013 (CEDIS), GLOBAL AND LOCAL CORRECTIVE TAXATION

Scheme	Direct impact	Indirect impact	Total impact
1	1 944 149	5 832 448	7 776 598
2	2 423 962	7 271 886	9 695 847
3	1 018 237	3 054 710	4 072 946
4	1 464 337	4 393 011	5 857 348

Source: Authors' elaboration on the 2005/06 GLSS (Ghana Statistical Service, 2008).

As expected, the highest impact is the indirect one. The direct impact for the bottom quintiles, given the small portion of transport fuel expenditures in the poorest households, is modest compared to the direct impact for the fifth quintile. Schemes 1 and 2 imply a higher effort to compensate the intermediate quintiles, whereas schemes 3 and 4, targeted to the first and second quintiles only, are the least expensive.

The total amount required to pay full compensation to the bottom two quintiles ranges from 20.5 million cedis (equivalent to US$10.8 million in 2013 dollars) in the low elasticity scenario (Table 19) to 9.7 million cedis (Table 20) in the high elasticity scenario (US$5.1 million in 2013 dollars), which demonstrates how sensitive the results are with respect to own-price elasticity.

Full compensation for the first quintile in each of the four scenarios would absorb a limited amount of additional collections. More precisely, the compensation would amount, in the case of the most expensive scenario, to be approximately 3 per cent of the additional collections (comparing Table 16 with Table 19).[20]

Table 21 presents data on the additional collections needed to compensate only the two bottom quintiles. Total compensation for the bottom quintiles ranges from approximately 6 million cedis in the high elasticity scenario to 12.4 million cedis in the low elasticity scenario. The amount of cash needed to compensate poorer households in the two lowest quintiles remains limited. Although subsidies benefit upper quintile households to a greater degree, poor households do benefit from lower fuel prices (direct effect) and as consumers of other goods and services that weigh more on their budget (indirect effect), and redirecting additional revenues to compensate the lower quintiles could quickly assist at-risk households during the transition to the new price regime.

The impact on the competitiveness of business activities derived from the transport fuel increase should be modest in view of the small increase in the final price. No direct compensation seems to be needed.

TABLE 21. AMOUNT OF COLLECTIONS NEEDED TO COMPENSATE HOUSEHOLDS IN THE TWO BOTTOM QUINTILES, 2013 (CEDIS), GLOBAL AND LOCAL CORRECTIVE TAXATION

Low elasticity scenario			
Quintile	Direct impact	Indirect impact	Total impact
1	1 211 866	3 635 598	4 847 464
2	1 889 809	5 669 426	7 559 235
High elasticity scenario			
Quintile	Direct impact	Indirect impact	Total impact
1	572 136	1 716 408	2 288 544
2	892 201	2 676 603	3 568 804

Source: Authors' elaboration on the 2005/06 GLSS (Ghana Statistical Service, 2008).

5.7 A CORRECTIVE TAX ON FUELS USED FOR ELECTRICITY

The second component of the reform strategy is aimed at correcting the global and local impact derived from the use of fossil fuels for the production of electricity. In the first step of the reform, whose impact is simulated in this study, the tax will be levied on fuel oil used in thermal power plants.[21] All sectors of the economy would contribute to the reform, given that electricity is used as an input for the production of other goods and services.

Fuel oil and natural gas are mostly used interchangeably in the production of electricity, contributing to about 40 per cent of it. Their relative shares vary according to different factors that cannot be taken fully into account here. The study thus provides simulations of the impact on revenues and damages produced in two polar cases, where only fuel oil (light crude oil in official statistics) is used (Table 22) or where only natural gas is used (Table 23). Two different scenarios were developed. The first one simulates the revenue and distributional impacts based on the corrective taxation of global damages, while the second simulates the impact derived from the correction of local damages (polluting emissions). This assumes that, in the year referenced in the simulation, only fuel oil or natural gas is used. The effective revenue and environmental impacts will derive from the actual combination of the use of the two inputs. The environmental impact of fuel oil is higher than that of natural gas, leading to a higher correcting tax and, consequently, to greater revenues.

The distributive impact is calculated only with reference to the use of fuel oil and is presented only for the first scenario, the global impact.

The starting point in each scenario is the electricity tariff. With respect to the current average end-user tariff of 0.31 cedis per kWh (Energy Commission of Ghana, 2013), correcting for the global externality will increase the price of electricity by 0.016 cedis, whereas the correction of the local impact involves a price increase of 0.001 cedis (Table 22).[22] The price increase is partly absorbed by a reduction in consumption through the elasticity, whose short-term value, 0.15, is derived from the literature.

Table 22 also shows the potential revenues from this reform. A corrective tax imposed on fuels used as an input in thermal power plants – taking into account the global emissions damage produced by their use – has a substantial revenue potential, amounting to about 10 per cent of the additional collections deriving from the proposed tax on transport fuels.

Table 23 shows the revenue impact of a corrective tax imposed on natural gas used as an input in thermal power plants.[23] In this case, the revenue potential proves to be limited (approximately 17 million cedis in the case of a tax internalizing GHG emissions and 0.5 million cedis in the case of a tax internalizing local emissions), as a consequence of the low additional burden (+1.6 per cent in the case of the GHG tax and +0.05 per cent in the case of the local pollution tax).

TABLE 22. ENVIRONMENTALLY-EFFICIENT TAXES ON FUEL OIL USED FOR ELECTRICITY: BASIC RESULTS OF THE SIMULATION

Impact	Global pollution	Local pollution
Price (cedis per kWh)	0.307	0.307
Adjustment for damages (cedis per kWh)	0.016	0.001
New price (cedis per kWh)	0.323	0.308
% increase in price	5.36	0.47
Elasticity to price	0.15	0.15
2013 consumption (kWh)*	3 368 062	3 368 062
Consumption after new tax (kWh)*	3 340 909	3 365 675
Estimated tax collections after reform (cedis)*	55 125	4 880

* in 000.
Sources: Authors' elaboration on the 2005/06 GLSS (Ghana Statistical Service, 2008); Energy Commission of Ghana, 2013.

TABLE 23. ENVIRONMENTALLY-EFFICIENT TAXES ON NATURAL GAS USED FOR ELECTRICITY: BASIC RESULTS OF THE SIMULATION

Impact	Global pollution	Local pollution
Price (cedis per kWh)	0.307	0.307
First step of the reform: adjustment for global and/or local damages (cedis per kWh)	0.005	0.0001
New price (cedis per kWh)	0.312	0.3071
% increase in price	1.63	0.05
Elasticity to price	0.15	0.15
2013 consumption (kWh)*	3 368 061	3 368 061
Consumption after new tax (kWh)**	3 359 834	3 367 824
Estimated tax collections after first step of the reform (cedis)**	16 799	485

*(1: global correction, 2: local correction only) ** in 000
Sources: Authors' elaboration on the 2005/06 GLSS (Ghana Statistical Service, 2008); Energy Commission of Ghana, 2013.

© bytestrolch – Wood transporter in the rain forest in Ghana.

5.8 A CORRECTIVE TAX ON FUELS USED FOR ELECTRICITY: DISTRIBUTIVE IMPACT AND COMPENSATION

Figure 4 below shows the share of household expenditure on electricity out of total expenditure. Households are ranked from left to right according to the level of total expenditure. The consumption of electricity increases with expenditure in a progressive pattern. The indirect impact derived from the use of electricity as an input in the production of most other goods and services is assumed to be three times as large as the direct impact.

Table 24 shows the household increase in expenditure deriving from the correction of the global impact.

The different allocation schemes used for compensating households are exactly the same as those used for transport fuels. The results of the simulations are reported in Table 25.

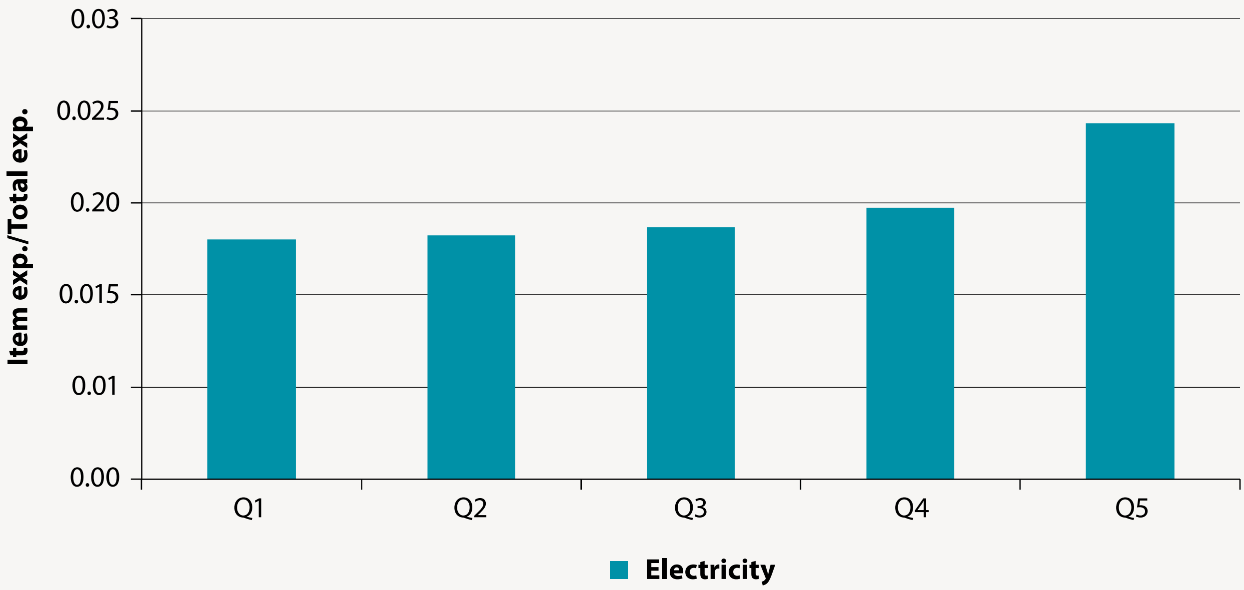
Direct compensation is approximately two times higher than compensation due to fuel taxation[24] in schemes 3 and 4 and approximately two and a half times higher in schemes 1 and 2. Total compensation, including indirect impacts, amounts to a maximum of 51 million cedis in scheme 2 (the first, second and third quintiles are totally compensated), and a minimum of 13 million cedis in scheme 3 (only the first quintile is fully compensated, and the second is only partially compensated).

TABLE 24. MEAN ANNUAL HOUSEHOLD ELECTRICITY EXPENDITURE BY QUINTILE AND ANNUAL EXPENDITURE AFTER GLOBAL DAMAGE CORRECTING TAX, 2013 (CEDIS)

	Mean annual household expenditure	Annual expenditure after tax (corrected by elasticity)
Quintile	Electricity	Electricity
1	41.8	43.7
2	79.6	83.2
3	149.0	155.7
4	223.3	233.5
5	332.5	347.5
Total	**186.8**	**195.3**

Source: Authors' elaboration on the 2005/06 GLSS (Ghana Statistical Service, 2008).

FIGURE 4. SHARE OF ELECTRICITY EXPENDITURE IN TOTAL HOUSEHOLD CONSUMPTION EXPENDITURE BY QUINTILE, 2013



Source: Authors' elaboration on the 2005/06 GLSS (Ghana Statistical Service, 2008).

TABLE 25. ELECTRICITY (INPUT: FUEL OIL; SCENARIO: CORRECTION OF GLOBAL EXTERNALITY): COST COMPENSATION TO HOUSEHOLDS IN DIFFERENT QUINTILES, 2013 (CEDIS)

Scheme	Direct impact	Indirect impact	Total impact
1	9 016 991	27 050 972	36 067 963
2	12 758 331	38 274 993	51 033 324
3	3 418 809	10 256 426	13 675 235
4	5 275 650	15 826 950	21 102 600

Note: Quintiles are based on household equivalent expenditures.
Source: Authors' elaboration on the 2005/06 GLSS (Ghana Statistical Service, 2008).

6 TAXES ON VEHICLES

6.1 THE CURRENT SYSTEM

Taxation on vehicles can complement the taxation of fuels and exploit synergies in a harmonized and comprehensive approach to environmental taxation. The taxation of vehicles in Ghana is very heterogeneous and includes different taxes and levies:

Vehicle income tax (VIT): This tax was introduced in 2003 to standardize and harmonize taxation on the ownership of commercial vehicles. The VIT is collected from commercial vehicle operators (individuals and firms operating in the transportation sector) on a quarterly basis, through the compulsory purchase of stickers from Internal Revenue Service district offices nationwide. Despite its name, this tax is not an instrument to tax income but rather the ownership and use of vehicles. The stickers are issued in various categories depending on vehicle-passenger capacity and type of vehicle, with rates that vary between 0.50 and 1.00 cedis per week. The VIT was introduced mainly to widen the tax base in the informal sector. The increasing collections from self-employed transport operators between 2003 and 2008 seem to indicate that the objective was achieved.[25]

Tariff duties: All imported vehicles are subject to duties according to their characteristics, such as engine capacity, seating capacity, usage and age.[26] In particular, all vehicle categories can be subjected to extra taxation if the vehicle is more than ten years old. This system of vehicle taxation could be used to stimulate environmentally-friendly choices, but it would require a heavier burden levied on less efficient vehicles, rather than tariffs proportional to the car value that penalize new and more efficient vehicles.

Registration fee (vehicle licence): Since 2011, vehicle owners pay 2 cedis for a road worthiness certificate, 10 cedis for a change of ownership and 300 cedis for a vehicle conversion to left-hand drive.

6.2 OPTIONS FOR REFORM

With the partial exception of tariff duties, Ghana has no effective fiscal instrument designed to reduce road transport emissions. Fiscal measures that can influence consumer choice at the time of acquisition, however, can be an effective complement to fuel taxation and assist in the transition to lower carbon-emitting vehicles. Tariff duties could be modulated in order to differentiate the burden according to fuel efficiency and emission standards rather than according to only a vehicle's age, as presently done.

The effectiveness of vehicle taxation depends on the structure of the tax and on the burden – tax rates – of the various instruments used. The structure may be modified when needed, but increasing the burden could raise strong opposition from taxpayers and produce a negative social impact. The advantage of reforming an existing vehicle purchase tax is that it will not be perceived to be overburdening consumers with an additional tax. As an alternative to a re-modulation of import tariffs to improve efficiency, *feebates* – a self-financing system of fees and rebates typically used to accelerate technological change and shift buying habits in the transportation sector – are an interesting instrument to consider. A feebate system combines fees for producers of negative externalities with rebates for individuals (in this case, car owners) that reduce the amount of externalities they produce, with no net fiscal cost on society or net revenue for the public purse. France adopted a similar policy in 2007, and the following year sales of fuel-inefficient cars fell by 42 per cent while sales of efficient cars rose by 50 per cent. Austria, Belgium, Chile and Denmark are other examples of countries that use a feebate system to internalize environmental externalities in the transportation sector (Lovins et al., 2004), and its introduction has been studied for Mauritius (Parry, 2011).

France has implemented a feebate programme (Table 26) whose design is considered close to the ideal feebate system (German and Meszler, 2010). The slope of the rebate function determines the stringency of the programme. In the case of the French system, the slope measures – €18 per gCO_2/km – a price signal able to influence the attitudes and preferences of car buyers. Moreover, and following the example proposed by the International Council on Clean Transportation (German and Meszler, 2010), a feebate rate of this magnitude leads to an added lifetime fuel cost saving of about €0.17 per litre or a lifetime carbon cost saving of about €75 per ton of avoided CO_2 emissions.[27] However, the French programme has the shortcoming of using a discontinuous rate function, which means that vehicle types with different environmental performances can have identical feebate rates.

TABLE 26. THE FRENCH FEEBATE SYSTEM

EU CO_2 (g/km)	French rebate (€)	Equivalent rebate (US$)	Gasoline equivalent US mpg	Equivalent US CO_2 (g/mile)
≤60	5 000	6 591	≥96.1	≤92.1
61-100	1 000	1 318	57.6-96.0	92.2-153.4
101-120	700	923	48.9-57.5	153.5-180.9
121-130	200	264	45.5-48.8	181.0-194.5
131-160	0	0	37.7-45.4	194.6-234.8
161-165	-200	-264	36.6-37.6	234.9-241.4
166-200	-750	-989	30.8-36.5	241.5-287.5
201-250	-1 600	-2 109	25.1-30.7	287.4-352.2

Note: Equivalent rebates assume an exchange rate of US$1.318 per €.
Source: German and Meszler, 2010.

The empirical literature (such as Greene, Patterson, Singh and Li, 2005; Davis, Levine, Train and Duleep, 1995; DRI/McGraw-Hill, 1991) finds that individuals and firms react primarily to feebates by adopting fuel economy technologies. In turn, the increase in fuel economy originates from technological changes to vehicles (about 85 to 95 per cent) made by manufacturers and very little due to consumers choosing different makes, models and classes of vehicles (about 5 to 15 per cent). For developing countries where complex programmes to reduce fuel consumption and CO_2 emissions have not yet been developed, feebates represent a relatively simple instrument to induce reduced fuel consumption and CO_2 emissions:

Standards require detailed knowledge of the vehicle fleet, current technology composition, future technology development, technology costs and benefits, lead-time, and models to assess the combined impact of all these factors. Feebates only require assessment of four factors: (1) The value placed upon the fuel consumption/CO_2 reductions (i.e. the feebate rate); (2) A flat system with a single pivot point, or a system adjusted for vehicle size; (3) A revenue neutral program or one that raises funds or is subsidized; (4) A consumer based or manufacturer based program. An effective system can be designed with far less technical knowledge or expertise. (German and Meszler, 2010:16).

In the case of Ghana, a feebate system would not require a minimum market size in order to function. Moreover, feebates would be an alternative to a re-modulation of import tariffs on the grounds of efficiency. Based on best practice, an efficient feebate system should be designed with the following features: (1) the feebate rate should be linear and continuous (discontinuities reduce the effectiveness of the programme); (2) the choice of the pivot point should reflect the objective of revenue neutrality and the pivot should be adjusted according to technological change; the pivot point serves to balance fees and rebates, ensuring the long-term sustainability of the policy. As such, the feebate programme should be viewed and designed as a transfer, moving resources from customers choosing low performing vehicles to those choosing higher performing vehicles; (3) a linear metric should be applied (i.e. CO_2 per km); and (4) an attribute adjustment should be made based on vehicle size.

7 CONCLUSION

Ghana is facing serious environmental problems. At the same time, the country is on the verge of becoming a relatively important oil and gas producer. This creates opportunities, but also challenges. Pressure to continue the subsidization of energy products could grow stronger and, if continued, these subsidies could impact heavily on national finances, stimulate the excessive consumption of fuels and deprive the Government of a substantial and dynamic source of revenue that could be used for environmental purposes.

Given these considerations, this study has focused on energy taxation reform, which could provide substantial revenue for green economy investments and help curb pollution. The proposed reform would start with the elimination of subsidies, switching to a market-based system for the determination of energy prices, and continue with the introduction of a taxation system aimed at correcting externalities from energy use. The target would be the correction of both global (GHG emissions) and local transport externalities (pollution, traffic congestion and accidents, and road damages) due to gasoline and diesel usage, and the correction of both global and local damages generated by the use of fuel oil and, alternatively, of natural gas in the production of electricity.

This study provided detailed analysis of the process used in Ghana to determine the price of fuels from which subsidization arises, followed by an illustration of alternative instruments to reform energy taxation, focusing on pure emission taxes and re-modulated excises. After considering the costs and benefits of the two alternatives, re-modulated excises was selected as the best option. In particular, the study focused on fuel tax reform, and simulations of the proposed reform's environmental and revenue impact were conducted. Both effects appear to be substantial and could be expanded in future stages of the reform by targeting other energy products, such as coal for the production of electricity and natural gas for other uses. Table 27 summarizes the revenue impact of the options proposed in this study.

TABLE 27. REVENUE IMPACT OF THE FUEL TAX REFORM (% OF ADDITIONAL COLLECTIONS ON GDP)

	Gasoline	Diesel	Gasoline	Diesel	Electricity (input fuel oil)	Electricity (input natural gas)
	Low elasticity scenario		High elasticity scenario			
Local damage*	0.2	0.2	0.2	0.2	0.01	0.001
Global damage	-	-	-	-	0.06	0.02
Global and local damages	0.4	0.6	0.3	0.5	0.07	0.021

* Local damages due to the production of electricity include only pollution, whereas those due to transport include also congestion, accidents and road damage.
Source: Authors.

The proposed reforms would contribute substantially to the creation of the much-needed fiscal space for green economy investments. A tax correcting for global and local damages produced by fossil fuels in the production of electricity and transportation would provide almost one additional percentage point of collections on GDP (between 0.89 and approximately 1 per cent, depending on the elasticity scenario), representing an increase of about 7 per cent over the collections of 2013 or 15.3 per cent of GDP.

Detailed attention has been devoted to updating the results of the latest available Ghana Living Standards Survey and to the distributive impact of the reform, by calculating its welfare impact on households with different income and expenditure levels. A number of compensation schemes for the poorest affected households were explored, with simulations of their cost in terms of revenue. Given the concentration of expenditure on fuels and electricity in the richest quintiles of the population, the cost of compensation should be reasonably low, leaving most of the revenue available for green investments.

Consideration has also been given to vehicle taxation in view of its strong complementarity with fuel taxation. One suggestion is the introduction of a feebate system aimed at stimulating higher fuel efficiency with no cost to taxpayers as a whole, but with a redistribution of the burden between owners of high fuel-efficient vehicles and owners of low fuel-efficient vehicles.

Reforms of fiscal policies in the energy and transportation sectors, such as those outlined here, are a crucial first step within any general green economy strategy. Removing inefficient and environmentally-harmful subsidies is a necessary precondition. In addition, internalizing social damages in the price of fossil fuels is one of the most effective ways to promote technological change and generate fiscal space for the green investments that Ghana has identified as a priority.

ANNEXES

ANNEX 1 ASSESSING THE WELFARE IMPACT OF TAXES/SUBSIDIES ON FUELS: METHODOLOGY AND RESULTS

Distributive impact: method used in this report

The latest available household expenditure survey (GLSS 5) dates from 2005/06 (Ghana Statistical Service, 2008). A report on the most recent survey (GLSS6) with results has been issued, but the microdata were not available at the time of this study. A distinct methodological approach is used in this study, mainly a partial equilibrium estimate of fossil fuel price elasticity, to obtain own and cross-elasticity parameters for different baskets of goods.

To estimate the impact of fuel price increases on household welfare in Ghana, the full demand model is used in order to take into account quantity reactions to alternative price scenarios.

The basic model estimated here, based on Deaton and Muellbauer (1980), modified to take into account the non-linear effect on total expenditures (Banks, Blundell and Lewbel, 1996) and household characteristics, is the following:

$$w_i = \alpha_i + \sum_{j=1}^{k} \gamma_{ij} lnp_j + \beta_i ln\left\{\frac{m}{P(\mathbf{p})}\right\} + \frac{\lambda_i}{b(\mathbf{p})}\left[ln\left\{\frac{m}{P(\mathbf{p})}\right\}\right]^2 \qquad (1)$$

where:

w_i are budget shares of different expenditure items (food, non-food, housing, transport and transport fuels). They are temporarily referred – absent information on more disaggregated prices per unit of consumption – to the following COICOP regrouping (the United Nations Classification of Individual Consumption According to Purpose), used as a benchmark:

Group 1 Food and non-alcoholic beverages

Group 2 Non-food expenditures (miscellaneous basket of goods: expenditures)

Group 3 Housing expenditures (housing + household furnishing and maintenance)

Group 4 Transport expenditures

Group 5 Alcohol and tobacco, narcotics

Group 6 Transport fuels (gasoline and diesel)

$\mathbf{p}$ is the price vector and $\mathrm{b}(\mathrm{p})$ is defined as $\prod_{i=1}^{k} p_i^{\beta_i}$ and $\ln \mathrm{P}(\mathbf{p})$ is a price index defined as:

$$\alpha_0 + \sum_{i=1}^{k} \alpha_i \, lnp_i + \frac{1}{2}\sum_{i=1}^{k}\sum_{j=1}^{k} \gamma_{ij} \, lnp_i lnp_j$$

m is total expenditure. The usual error term ε_i is added to (1).

The following constraints are imposed on the model to be estimated:

Since budget shares (w_i) add to 1, then:

$$\sum_{i=1}^{k} \alpha_i = 1, \sum_{i=1}^{k} \beta_i = 0, \sum_{i=1}^{k} \lambda_i = 0, \sum_{i=1}^{k} \gamma_{ij} = 0 \ \forall_j, \sum_{j=1}^{k} \gamma_{ij} = 0 \ \forall_j.$$

For the Slutsky symmetry condition, there is also: $\gamma_{ij} = \gamma_{ji}$

Given a certain scenario $\frac{\mathrm{dp_i}}{\mathrm{p_i}}$ (price variations), it is possible to compute revenue simulations based on own-price elasticities. As in Table 16, the distributive results can be recalculated according to different expenditure quintiles (Q1-Q5).

Given the sizeable number of missing household responses related to transport fuel consumption, the econometric estimates of own-price elasticity were run only on the subsample of households with positive expenditures. An implicit bias is obtained through the restriction to positive expenditure observations (Shonkwiler and Yen, 1999) but different estimates that take into account censored observations, or zero expenditure observations, show unreliable own-price elasticity parameters.

Prices: methodological issues

In this econometric model, a critical choice has to be made to select appropriate prices (p_j), absent reliable data on quantity and price for each respondent household.

Since no information was made available from the survey for the price of fuels (transport and housing fuels) and other commodities, a preliminary analysis of available methodologies was conducted. Based on the literature on demand analysis using microdata, the main methodological options are reported below:

1) Unit prices (unit values)

Unit prices (unit values): given information on quantity and expenditure, unit values are obtained by dividing expenditure by quantities for each item (eventually corrected by the ratio of regional/national consumer price index (CPI) for the corresponding item). Pros: the use of unit prices reflects household spatial variations in price. Cons: unit prices are different from market prices, and they are biased by (a) measurement errors; and (b) quality biases. An alternative methodology to correct for (a) and (b) is Ordinary Least Square regression on consumer choices (Deaton, 1988). Most research is conducted without correction for quality (measurement errors controlled by econometric techniques, as in Deaton, 1988).

2) Market prices

This option consists in recovering market price indices from information made available by national statistical offices or other sources and merged with household expenditure data. Essentially, the aggregation of household-specific price indices requires separate household surveys and monthly or yearly time series of household consumption data, and COICOP 3-4 digit CPI. See an example in Tiezzi (2005).

3) CPI weighting to compute pseudo-prices

Two options are available:

a) Recovering information on prices using expenditure shares for each item, following the methodology proposed in Atella, Menon and Perali (2003), based on the theoretical approach outlined in Lewbel (1989).

b) Building up prices for each expenditure macro-item using a modified version of the approach proposed by Robles and Torero (2010), exploiting the regional unit variation of CPI, and focusing on cross-sectional variation in price indices obtained at the household level.

In the absence of a full set of disaggregated CPI indices for Ghana, quantity and market price information on single goods, the 3b methodology was used. This methodology exploits a re-aggregation of commodities based on CPI indices to simulate cross-sectional variation in prices between different households and goods.

Indirect price indices: for each household, a different price index is computed for each of the five groups described above (I=1 to 5)[28]

$$P_I^{psu} = \sum_{i \in I} \frac{CPI_i(hou \in region)}{CPI_i(hou \in national)} \times \frac{W_i^{psu}}{SW_i^{psu}} \qquad (2)$$

Here the CPI (hou∈region) in the numerator is the price index for the expenditure subgroup $i \in I$ in the region to which the household belongs, CPI (hou∈national) is the price index for the expenditure subgroup $i \in I$ at the national level, and W_i^{psu} is the share of total consumption of the median subgroup i computed using the primary sampling unit level as reference (rather than the household level) (denominator: sum of median shares, sw_i).

Ghana statistical service publications provided price indices for subgroups $i \in I$ (base year = 2002) for 2005/06, at the national and regional levels. They are regrouped according to the COICOP classification into 11 different aggregates (excluding miscellaneous basket of goods):

1. Food and non-alcoholic beverages (Group 1)
2. Alcoholic beverages, tobacco and narcotics (Group 5)
3. Clothing and footwear (Group 2)
4. Housing, water, electricity, gas and other (Group 3)
5. Furnishings and household equipment (Group 3)
6. Health (Group 2)
7. Transport (Group 4)
8. Communications (Group 4)
9. Recreation and culture (Group 2)
10. Education (Group 2)
11. Hotels, cafés and restaurants (Group 2)

Where only one subgroup *i* was used to build P_I^{psu}, indirect prices (Groups 1 and 5),[29] equation (2), were modified accordingly (no sum was made on subgroups, and a simple re-weighting of household budget shares was obtained for item $i \in I$ with the price indices ratio).

For transport fuel expenditures (gasoline and diesel, Group 6), no information is available on specific price indices or on market prices for each household with positive expenditures. In this case, a simple weighted average of official petrol and diesel prices at the end of 2005 and in the first half of 2006 was used, available from the National Petroleum Authority.

Group 6 (transport fuels) parameter elasticity

The international literature on fuel price elasticity in African countries shows large variations in terms of both methodology and results. With reference to Ghana, some recent estimates indicate price elasticity values for gasoline and diesel that are lower than those observed for higher-income countries (see the static model in Dahl, 2012).[30] The range is between -0.13 (gasoline) and -0.26 (diesel). The present analysis could contribute to clarifying whether these results are driven by the fact that a lower price response prevails in lower-income countries. Since only relatively rich individuals may have personal vehicles, they may be less responsive to price changes and dominate the overall own-price effect. Another argument is based on empirical evidence available for poor countries, showing that high-cost vehicles and longer-use vehicles are making the national fleet older than that in richer countries. The consequence is that the stock of household vehicles in poorer countries turns over to more fuel-efficient vehicles more slowly, thus lowering the responsiveness of households to fuel prices.

Fuel expenditures in GLSS 5 are very infrequent and uneven. Heterogeneity and zero expenditure on transport fuels trigger parameter instability. As already indicated, corrections were not used to take into account censored demand in the basic model (1) estimate (see, for example, Shonkwiler and Yen, 1999) as the expected improvement in estimates was not significant.

Model (1) was estimated on the subsample of households with positive transport fuel expenditures, and compensated own-price elasticity on Group 6 results in 0.5630 (Table 28), higher than the short-term parameters estimated in Dahl (2012). This result is used to correct for gasoline and diesel total consumption in the distributive impact simulations.

TABLE 28. COMPENSATED OWN- AND CROSS-PRICE ELASTICITY, GHANA GLSS 5, 2005/06

	Compensated					
	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6
Group 1	-0.3843	0.0678	0.1433	0.0568	0.0279	0.0886
Group 2	0.1241	-0.4506	0.1231	0.1460	0.0476	0.0098
Group 3	0.5205	0.2392	-0.8422	0.0449	-0.0322	0.0698
Group 4	0.3074	0.4389	0.0701	-0.9120	-0.0335	0.1292
Group 5	0.7923	0.7146	-0.2506	-0.1734	-1.1678	0.0848
Group 6	0.3589	0.0203	0.0778	0.0938	0.0123	-0.5630

Source: Authors' elaboration on the 2005/06 GLSS (Ghana Statistical Service, 2008).

ANNEX 2 PETROLEUM PRODUCT PRICING ADJUSTMENT FORMULA

TABLE 29. PETROLEUM PRODUCT PRICING FORMULA (REFERENCE PRICE OF MAY 2013)*

Variable name	Description	Source	Gasoline	Diesel
Reference price	FOB Mediterranean price (average of previous three months). The respective prices are: Premium 0.15 g/l and diesel 0.2%**		1 092.58	1 132.31
+Suppliers' commission (US$ per metric ton)	Tendering process		12.87	11.45
+Insurance (US$ per metric ton)	Suppliers' insurance cost		0.36	0.30
CIF (US$ per metric ton)	Total cost of insurance and freight	Sum of 1+2+3	1 105.81	1 144.06
Related charges (% of CIF)	Include: off-loading, losses, inspection, letter of credit costs, purchasers' commission, demurrage, financial costs, storage, rack loading cost, operation margin		13.85	13.85
+Related charges (US$ per metric ton)		Product of 4x5	153.15	158.45
=Total cost (US$ per metric ton)		Sum of 6+4	1 258.97	1 302.51
Conversion factor	From metric tons to litres		1 379.70	1 187.60
Ex-refinery full-cost price (US$ per litre)		Division of 7 over 8	0.9124	1.0967
Cedis per US$ exchange rate	Average exchange rate of previous three months	Bank of Ghana	1.8873	1.8873
Ex-refinery full-cost recovery price (cedis per litre)		Product of 9x10	1.722	2.0699
Administered current price (cedis per litre)		NPA (April 2013)	1.5039	1.6094
+Excise duty			0.0278	0.018
+TOR debt recovery levy			0.08	0.08
+Road Fund levy			0.06	0.06
+Energy Fund levy			0.0005	0.0005
+Exploration			0.001	0.001
+Cross-Sub. levy			0.05	-0.0269
+Primary distribution margin			0.04	0.04
+BOST margin			0.03	0.03
+Fuel marking margin			0.01	0.01
=ex-deposit price (cedis per litre)			1.8032	1.822
Unified Petroleum Price Fund			0.079	0.079
Marketers' margin			0.0986	0.0986
Dealers' (retailers/operators) margin			0.0688	0.0688
Indicative maximum price (ex-pump)			2.049	2.0684
Trigger mechanism				

Variable name	Description	Source	Gasoline	Diesel
Volume sales in previous month (litres)			123 777 550	143 874 700
Actual refinery sales in previous month			186 149 057	231 551 942
Refinery sales at full-cost recovery			213 164 354	297 808 992
Per cent difference (relative subsidy)			-14.51	-28.61
Triggered if actual and full-cost recovery total sales differ by more than 2.5 per cent.				

* Calculations based on January-March 2013.
** The lead content is expressed in terms of grams per litre of petroleum product.
Sources: International Energy Agency, 2014; National Petroleum Authority of Ghana, 2014; Platts, 2014; Unione Petrolifera Italiana, 2014.

REFERENCES

Aragon, F.; Rud, J.P. (2012). *Mining, Pollution and Agricultural Productivity: Evidence from Ghana*. Burnaby, British Columbia: Simon Fraser University. Available at: http://summit.sfu.ca/item/10934.

Arku, R. et al. (2008). "Characterizing air pollution in two low-income neighbourhoods in Accra, Ghana", in *Science of the Total Environment*, vol. 402, pp. 217-231.

Armah, F.A.; Odoi, J.O.; Luginaah, I. (2013). "Indoor Air Pollution and Health in Ghana: Self-Reported Exposure to Unprocessed Solid Fuel Smoke", in *EcoHealth*, October.

Arze del Granado, J.; Coady, D.; Gillingham, R. (2010). *The Unequal Benefits of Fuel Subsidies: A Review of Evidence for Developing Countries*, IMF Working Paper 10/202. Washington, DC: IMF.

Atella, V.; Menon, M.; Perali, F. (2003). *Estimation of Unit Values in Cross Sections Without Quantity Information and Implications for Demand and Welfare Analysis*, CEIS Tor Vergata – Research Paper Series No. 12. Rome, Italy: University of Rome.

Banks, J.; Blundell, R.; Lewbel, A. (1996). "Tax reform and welfare measurement: do we need demand system estimation?", in *The Economic Journal*, vol. 106, Issue 438, pp. 1227-1241.

Beaton, C. et al. (2013). *A Guidebook to Fossil-fuel Subsidy Reform for Policy-makers in Southeast Asia,* International Institute for Sustainable Development, Global Subsidies Initiative. Available at: www.iisd.org/gsi/sites/default/files/ffs_guidebook.pdf.

Busby, G.; Isham, J.; Pritchett, L.; Woolcock, M. (2004). *The Varieties of Resource Experience: How Natural Resource Export Structures Affect the Political Economy of Economic Growth*, Middlebury College Economics Discussion Paper No. 03-08R. Middlebury, Vermont.

Coady, D.; Newhouse, D. (2006). "Evaluating the Fiscal and Social Costs of Increases in Domestic Fuel Prices", in Coudouel, A.; Dani, A.A.; Paternostro, S. (eds.), *Poverty and Social Impact Analysis of Reforms: Lessons and Examples from Implementation*. Washington, DC: World Bank.

Dahl, C.A. (2012). "Measuring global gasoline and diesel price and income elasticities", in *Energy Policy*, vol. 41, pp. 2-13.

Davis, W.B.; Levine, M.D.; Train, K.; Duleep, K.G. (1995). *Effects of Feebates on Vehicle Fuel Economy, Carbon Dioxide Emissions, and Consumer Surplus*, DOE/PO-0031. Washington, DC: US Department of Energy, Office of Policy.

Deaton, A. (1988). "Quality, Quantity, and Spatial Variation of Price", in *American Economic Review,* vol. 78, No. 3, pp. 418-430.

Deaton, A.; Muellbauer, J. (1980). *Economics and Consumer Behavior*. Cambridge, Massachusetts: Cambridge University Press.

DRI/McGraw-Hill. (1991). *An Analysis of Public Policy Measures to Reduce Carbon Dioxide Emissions from the U.S. Transportation Sector*. Lexington, Massachusetts.

The Economist. (2015). "The global debt clock". Available at: http://www.economist.com/content/global_debt_clock (accessed February 2015).

El Said, M.; Leigh, D. (2006). *Fuel Price Subsidies in Gabon: Fiscal Cost and Distributional Impact,* IMF Working Paper 06/243. Washington, DC: IMF.

Energy Commission of Ghana. (2013). *2013 Energy Outlook for Ghana*. Accra: Energy Commission.

—. (2014a). *National Energy Statistics 2000-2013*. Accra: Energy Commission.

—. (2014b). *2014 Energy Outlook for Ghana*. Accra: Energy Commission.

Fiahagbe, E. (2012). *Air Quality Monitoring in Accra*. Accra: EPA-Ghana. Available at: http://www.unep.org/transport/pcfv/PDF/GFEI_AfricaLaunch/Air_Monitoring_Accra.pdf.

Alan Gelb and Associates. (1988). *Oil Windfalls: Blessing or Curse?*, published for The World Bank. New York: Oxford University Press.

German, J.; Meszler, D. (2010). *Feebate Review and Assessment: Best Practices for Feebate Program Design and Implementation*. Washington, DC: The International Council on Clean Transportation.

Ghana Revenue Authority. (2014). Available at: http://www.gra.gov.gh/index.php/tax-information/income-tax (accessed 20 April 2015).

Ghana Statistical Service. (2008). *Ghana Living Standards Survey Round 5 (GLSS 5)*. Available at: http://www.statsghana.gov.gh/docfiles/glss5_report.pdf.

—. (2014). *Ghana Living Standards Survey Round 6 (GLSS 6) Main Report*. Available at: http://www.statsghana.gov.gh/docfiles/glss6/GLSS6_Main%20Report.pdf.

—. (2015). *National Accounts Statistics: Revised Gross Domestic Product 2014*. Available at: http://www.statsghana.gov.gh/docfiles/GDP/GDP2015/Revised_Annual_GDP2014_Jan2015.pdf.

Government of Ghana, Ministry of Environment, Science and Technology [MEST]. (2010). *Ghana Goes for Green Growth: National engagement on climate change.* Accra: MEST.

Government of Ghana, Ministry of Finance. (2013). *2013 Annual Report on the Petroleum Funds*. Accra: Ministry of Finance. Available at: http://mofep.gov.gh/sites/default/files/reports/petroleum/Annual-Report-on-Petroleum-Funds-2013.pdf.

—. (2014). *Mid-Year Review of the Budget Statement and Economic Policy and Supplementary Estimates*. Accra: Ministry of Finance. Available at: http://www.mofep.gov.gh/sites/default/files/budget/2014%20Mid%20Year%20Review%20and%20Tables.pdf.

Government of Nigeria. (2012). *Report of the Petroleum Revenue Special Task Force* [Ribadu Report]. Abuja: PRSTF.

Graham, D. J.; Glaister, S. (2002). "The Demand for Automobile Fuel: A Survey of Elasticities", in *Journal of Transport Economics and Policy* (JTEP), vol. 36(1), pp. 1-25.

Greene, D.; Patterson, P.; Singh, M.; Li, J. (2005). "Feebates, rebates and gas-guzzler taxes: a study of incentives for increased fuel economy," in *Energy Policy*, vol. 33, pp. 757-775.

Gylfason, T. (2001). "Natural Resources, Education and Economic Development", in *European Economic Review*, vol. 45, Issue 4-6, pp. 847-859.

Intergovernmental Panel on Climate Change. (2006). *IPCC Guidelines for National Greenhouse Gas Inventories*. Available at: http://www.ipcc-nggip.iges.or.jp/public/2006gl/.

International Energy Agency. (2013). *Energy Balances of Non-OECD Countries: Beyond 2020 Documentation (2013 edition)*. Available at: http://wds.iea.org/wds/pdf/documentation_WEDBAL_2013.pdf.

—. (2014). *Monthly energy prices*. Available at: http://www.iea.org/statistics/relatedsurveys/monthlyenergyprices/.

International Monetary Fund, Fiscal Affairs Department. (2014a). *Ghana: 2014 Article IV Consultation – Staff Report; Press Release; and Statement by the Executive Director for Ghana*, IMF Country Report No. 14/129. Available at: http://www.imf.org/external/pubs/ft/scr/2014/cr14129.pdf.

—. (2014b). *Data Base for Getting Energy Price Right*.

Jacobson, M.Z.; Seinfeld, J.H.; Carmichael, G.R.; Streets, D.G. (2004). "The effect on photochemical smog of converting the U.S. fleet of gasoline vehicles to modern diesel vehicles", in *Geophysical Research Letters*, vol. 31, L02116, doi:10.1029/2003GL018448.

Karl, T. L. (1997). *The Paradox of Plenty: Oil Booms and Petro-States*. Berkeley and Los Angeles: University of California Press.

Kenya Revenue Authority. (2014). Available at: http://www.kra.go.ke/index.php/domestic-taxes/income-tax/type-of-taxes (accessed 20 April 2015).

Koranteng Jnr, Y. (2011). *Vehicle Income Tax (VIT) in Ghana, Challenges and Prospects, A Case Study of Kumasi Metropolis*. Thesis submitted to the Institute of Distance Learning, Kwame Nkrumah University of Science and Technology, Kumasi. Available at: http://ir.knust.edu.gh/bitstream/123456789/4438/1/YEBOAH%20KORANTENG.pdf.

KPMG. (2012). "Thinking Beyond Borders: Management of Extended Business Travelers: Mauritius". Available at: https://www.kpmg.com/Global/en/IssuesAndInsights/ArticlesPublications/thinking-beyond-borders/documents/mauritius.pdf.

Lewbel, A. (1989). "Identification and Estimation of Equivalence Scales under Weak Separability", in *Review of Economic Studies*, vol. 56(2), pp. 311-316.

Lovins, A. et al. (2004). *Winning the Oil Endgame: Innovation for Profits, Jobs, and Security*. Snowmass, Colorado: Rocky Mountain Institute.

Lund, J. F.; Carlsen, K.; Hansen, C. P.; Treue, T. (2012). "The political economy of timber governance in Ghana", in Broekhoven, G.; Savenije, H.; von Scheliha, S. (eds.), *Moving Forward With Forest Governance*, pp. 117-126. Wageningen, The Netherlands: Tropenbos International.

Mansour, M. (2014). *A Tax Revenue Dataset for Sub-Saharan Africa: 1980-2010*, Fondation pour les études et recherches sur le développement international (Ferdi), Working Paper I19.

Mathrani, S. et al. (2013). *Energizing economic growth in Ghana: making the power and petroleum sectors rise to the challenge*. Washington, DC: World Bank. Available at: http://documents.worldbank.org/curated/en/2013/06/18027411/energizing-economic-growth-ghana-making-power-petroleum-sectors-rise-challenge.

Mehlum, H.; Moene, K.; Torvik, R. (2006). "Institutions and the Resource Curse," in *The Economic Journal*, vol. 116, Issue 508, pp. 1-20.

Mwampamba, T.; Ghilardi, A.; Sander, K.; Chaix, K.J. (2013). "Dispelling common misconceptions to improve attitudes and policy outlook on charcoal in developing countries", in *Energy for Sustainable Development*, vol. 17, pp. 75-85.

National Petroleum Authority of Ghana. (2014). Price Data. Available at: http://npa.gov.gh/npa_new/Downloads.php.

Natural Resource Governance Institute [NRGI]. (2014). "Ghana/Transparency Snapshot". Available at: http://www.resourcegovernance.org/countries/africa/ghana/transparency-snapshot.

Navajas, F.; Panadeiros, M.; Natale, O. (2012). *Workable Environmentally Related Energy Taxes*, IDB Working Paper Series No. IDB-WP-351. Inter-American Development Bank.

Osei-Boateng, C.; Ampratwum, E. (2011). *The Informal Sector in Ghana*. Accra: Friedrich Ebert Stiftung. Available at: http://library.fes.de/pdf-files/bueros/ghana/10496.pdf.

Parry, I. (2005). *Should Fuel Taxes Be Scrapped in Favor of Per-Mile Charges?,* Resources for the Future Discussion Paper 05-36. Washington, DC: Resources for the Future.

—. (2011). *Reforming the Tax System to Promote Environmental Objectives: An Application to Mauritius*, IMF Working Paper 11/124. Washington, DC: IMF. Available at: https://www.imf.org/external/pubs/ft/wp/2011/wp11124.pdf.

Parry, I.; Pizer, W. (2007). *Emissions Trading versus CO_2 Taxes: Backgrounder.* Washington, DC: Resources for the Future.

Parry, I.; Small, K. (2005). "Does Britain or the United States Have the Right Gasoline Tax?", in *American Economic Review*, vol. 95, No. 4, pp. 1276-1289.

Platts. (2014). *Oilgram Price Report - Sample Issues*. McGraw Hill Financial. Available at: http://www.platts.com/products/oilgram-price-report.

Pyper J.; ClimateWire. (2012). “Diesel Cars Make a Comeback in the U.S.”, in *Scientific American*, 24 April.

Robinson, J.A.; Torvik, R.; Verdier, T. (2006). “Political foundations of the resource curse”, in *Journal of Development Economics*, vol. 79, Issue 2, pp. 447-468.

Robles, M.; Torero, M. (2010). “Understanding the Impact of High Food Prices in Latin America”, in *Economia* (Journal of the Latin American and Caribbean Economic Association), vol. 10, No. 2.

Ross, M.L. (1999). “The Political Economy of the Resource Curse”, in *World Politics*, vol. 51, Issue 2, pp. 297-322.

—. (2001). “Does Oil Hinder Democracy?”, in *World Politics*, vol. 53, Issue 3, pp. 325-361.

Sachs, J.D.; Warner, A.M. (1995). *Natural Resource Abundance and Economic Growth*, Development Discussion Paper No. 517a. Cambridge, Massachusetts: Harvard Institute for International Development.

—. (1999). “The big push, natural resource booms and growth”, in *Journal of Development Economics*, vol. 59, pp. 43-76.

Shonkwiler, J.S.; Yen, S.T. (1999). “Two-Step Estimation of a Censored System of Equations,” in *American Journal of Agricultural Economics*, vol. 81, Issue 4, pp. 972-982.

Sterner T. (2007). “Fuel taxes: An important instrument for climate policy”, in *Energy Policy*, vol. 35, Issue 6, pp. 3194-3202.

Tanaka, K.; Berntsen T.; Fuglestvedt, J.S.; Rypdal, K. (2012). “Climate Effects of Emission Standards: The Case for Gasoline and Diesel Cars”, in *Environmental Science & Technology*, vol. 46, Issue 9, pp. 5205-5213.

Tiezzi, S. (2005). “The welfare effects and the distributive impact of carbon taxation on Italian households”, in *Energy Policy*, vol. 33, pp. 1597-1612.

Unione Petrolifera Italiana. (2014). *Petroleum Product Prices*. Available at: http://www.unionepetrolifera.it/?page_id=525.

United Nations Environment Programme. (2014). *Green Economy Fiscal Policy Scoping Study – Ghana*. Nairobi: UNEP.

World Health Organization. (2009). *Global Health Risks: Mortality and burden of disease attributable to selected major risks*. Geneva: WHO. Available at: http://www.who.int/healthinfo/global_burden_disease/GlobalHealthRisks_report_Front.pdf.

NOTES

1. Kenya and Mauritius are interesting benchmarks as both countries are currently engaged in furthering green growth. Kenya is less developed than Ghana and it too recently discovered oil reserves. It has a stringent public finance stance and is not subsidizing fuels. Mauritius is currently pursuing a number of green growth policies, both in the tax and non-tax sectors. Its public finances are under control and it has achieved quite high efficiency in tax administration.

2. Although no specific data are available for Ghana, some comparative information is useful. It is estimated, for instance, that only 1 per cent of the charcoal produced in Mexico is reported to the authorities and that in Dar es Salaam, Tanzania as much as 90 per cent of charcoal transported in the city is unreported (see Mwampamba Ghilardi, Sander and Chaix, 2013 for the relevant literature).

3. The Ghana Stabilization Fund aims to adjust for unexpected decreases in revenues due to a fall in the petroleum price or a reduction in production volumes.

4. The Ghana Heritage Fund has been promoted to sustain welfare policies for future generations when the petroleum will be completely exploited.

5. Natural resources may become a "curse" for currently developing countries if they are not managed well. There is a large body of evidence on this (for example, for the Organization of the Petroleum Exporting Countries as a whole, GDP per capita on average decreased by 1.3 per cent each year from 1965 to 1998; Gylfason, 2001) and fast-growing cross-country literature (Sachs and Warner, 1995; Sachs and Warner, 1999; Busby, Isham, Pritchett and Woolcock, 2004; Mehlum, Moene and Torvik, 2006). Also, a number of works on resource-dependent economies show a link between resource abundance and insufficient development (Alan Gelb and Associates, 1988; Karl, 1997; Ross, 1999; Ross, 2001; Robinson, Torvik and Verdier, 2006, p. 477).

6. The Corruption Perceptions Index ranks countries on the perceptions of corruption in their public sector. The Index score ranks the perceived level of corruption in the public sector on a scale of 0 to 100, where 0 means high corruption and 100 means very clean. The 2013 score for Ghana is 46 and the country ranked 63rd in the list. See http://www.transparency.org/cpi2013/results.

7. According to the World Bank, "Ghana has evolved into a stable and mature democracy throughout the last two decades. The country continues to show good performance on democratic governance, arising from strong multi-party political system, growing media pluralism and strong civil society activism." See http://www.worldbank.org/en/country/ghana/overview#1.

8. The GIFMIS is a financial information technology system that replaced the manual system of government financial transactions in 2009/10. It aims to give a comprehensive and detailed picture of every expenditure made by ministries, departments and agencies, and hence of the overall management of government consolidated funds. The TSA, implemented at the Bank of Ghana since 2009, is an accounting system that aims to ensure efficiency in the cash management and flow of public sector funds.

9. The estimate is calculated by applying the total tax rate per litre to the litres consumed and assuming no leakages due to evasion or specific regimes. This clearly leads to an overestimate of collections. Unfortunately, data on actual collections are not available.

10. See, for instance, Pyper and ClimateWire, 2012; Tanaka, Berntsen, Fuglestvedt and Rypdal, 2012; Jacobson, Seinfeld, Carmichael and Streets, 2004.

11. Extensive literature on how to implement fuel taxation reforms provides real-world based evidence and advice for policymakers (see, for instance, Beaton et al., 2013).

12. Already during previous increases in the price of fuel, the Government of Ghana examined diverse combinations of compensatory measures. Suggesting options in this field would go beyond the scope of this study.

13. For an in-depth discussion of the relative advantages and disadvantages of carbon taxes, emissions trading and standards in climate change policy, see, for example, Parry and Pizer (2007).

14. "The smaller the portion due to reduced driving, the smaller will be the gain from reducing mileage-related externalities per gallon of fuel reduction. This consideration is important because evidence suggests that only around 40 per cent of the fuel reduction over time will come from reduced driving; 60 per cent of it will come from increased fuel economy" (Parry, 2005:7).

15. The release of 2012/13 household data (Ghana Living Standards Survey Round 6) is reported on the official website of the Ghanaian Statistical Office, but microdata have not been made available yet.

16. "Long-term" refers to a timespan long enough to allow for technological change (specifically, the replacement of the current stock of vehicles with new stock with higher fuel efficiency, induced by the higher prices).

17. Unfortunately, data from the Social Accounting Matrix are not updated, precluding their use to estimate the indirect impacts.

18. On average, the indirect effect is twice as large as the direct effect.

19. Updating involved converting expenditure data from the 2005/06 GLSS to the 2013 reference year. Values for 2013 on expenditure by quintiles of households were obtained by multiplying the 2005/06 survey data by the percentage increase from 2005 to 2013 in per capita household final consumption expenditure. Final consumption data were taken from Ghana Statistical Service National Account estimates (2014 revision). This method takes into account inflation and real growth in household consumption, as well as updated population numbers, and data are adjusted to the latest available national account revisions.

20. All estimates of revenues needed to compensate households in the first quintile only, or both the first and second quintiles, could be biased as a result of the low number of households that have reported positive consumption. Standard error simulations for transport fuel expenditure by the bottom quintiles make estimates of the required compensation imprecise, but the methodological point remains valid.

21. The simulation of the distributive impact is conducted only with reference to fuel oil (light crude oil in the official statistics of Ghana) since the proportion of fuel oil and natural gas varies continuously. This amounts to the assumption that, in the year referenced in the simulation, only fuel oil is used. The environmental impact of fuel oil is higher than that of natural gas, leading to a higher correcting tax and, consequently, to greater revenues.

22. Damages from one litre of fuel oil (light crude oil) for thermoelectric generation is assumed to be equivalent to damages from one litre of diesel. Since information on Ghanaian thermal plant efficiency in translating fuel oil to kWh is unavailable, it is assumed that one litre of diesel produces approximately 40.57 megajoules (MJ) per kg in net calorific value; hence, rescaling with an efficiency factor of 0.40, 16.23 MJ per kg (1.13 litres) of oil (or 14.36 MJ per litre). Using a standard conversion factor for MJ/kWh and rescaling, approximately 3.99 kWh per litre of oil is used. This last factor has been used to convert monetary values per litre of fuel into monetary values per kWh produced (parameters are taken from IMF, 2014b).

23. Corrective taxes for the global and local impact of natural gas used in power plants are calculated using the conversion factor of 1 gigajoule = 277.7 kWh.

24. In the more costly compensation scenario relative to fuel taxation.

25. Detailed information on revenues generated by the VIT (total, and annual percentage increases from 2000 to 2005) is provided by Koranteng (2011): Table 4.4, p. 62.

26. Tariff duties are scaled as follows: Import duty from 0 per cent to 20 per cent; Import VAT from 0 per cent to 12.5 per cent; National Health Insurance levy from 0 per cent to 2.5 per cent; ECOWAS levy of 0.5 per cent; Export Development Fund levy of 0.5 per cent; Examination fee of 1 per cent.

27. The underlying assumption is a vehicle lifespan of 241,402 km.

28. Group 6 is excluded since official prices were used.

29. See note 28.

30. According to Tiezzi (2005), in Italy transport fuel elasticity was -0.544, to give an example from an OECD country.

© demerzel21 – Aerial view of Accra, Ghana.

Deutsche Gesellschaft
für Internationale
Zusammenarbeit (GIZ) GmbH

www.unep.org

United Nations Environment Programme
P.O. Box 30552 Nairobi, Kenya
Tel.: ++254-(0)20-762 1234
Fax: ++254-(0)20-762 3927
E-mail: uneppub@unep.org

UNEP

Job Number: DTI/1905/GE