INTERNATIONAL MONETARY FUND

ENERGY SUBSIDY REFORM: LESSONS AND IMPLICATIONS

January 28, 2013

EXECUTIVE SUMMARY

Energy subsidies have wide-ranging economic consequences. While aimed at protecting consumers, subsidies aggravate fiscal imbalances, crowd-out priority public spending, and depress private investment, including in the energy sector. Subsidies also distort resource allocation by encouraging excessive energy consumption, artificially promoting capital-intensive industries, reducing incentives for investment in renewable energy, and accelerating the depletion of natural resources. Most subsidy benefits are captured by higher-income households, reinforcing inequality. Even future generations are affected through the damaging effects of increased energy consumption on global warming. This paper provides: (i) the most comprehensive estimates of energy subsidies currently available for 176 countries; and (ii) an analysis of "how to do" energy subsidy reform, drawing on insights from 22 country case studies undertaken by IMF staff and analyses carried out by other institutions.

Energy subsidies are pervasive and impose substantial fiscal and economic costs in most regions. On a "pre-tax" basis, subsidies for petroleum products, electricity, natural gas, and coal reached $480 billion in 2011 (0.7 percent of global GDP or 2 percent of total government revenues). The cost of subsidies is especially acute in oil exporters, which account for about two-thirds of the total. On a "post-tax" basis—which also factors in the negative externalities from energy consumption—subsidies are much higher at $1.9 trillion (2½ percent of global GDP or 8 percent of total government revenues). The advanced economies account for about 40 percent of the global post-tax total, while oil exporters account for about one-third. Removing these subsidies could lead to a 13 percent decline in CO_2 emissions and generate positive spillover effects by reducing global energy demand.

Country experiences suggest there are six key elements for subsidy reform. These are: (i) a comprehensive energy sector reform plan entailing clear long-term objectives, analysis of the impact of reforms, and consultation with stakeholders; (ii) an extensive communications strategy, supported by improvements in transparency, such as the dissemination of information on the magnitude of subsidies and the recording of subsidies in the budget; (iii) appropriately phased price increases, which can be sequenced differently across energy products; (iv) improving the efficiency of state-owned enterprises to reduce producer subsidies; (v) targeted measures to protect the poor; and (vi) institutional reforms that depoliticize energy pricing, such as the introduction of automatic pricing mechanisms.

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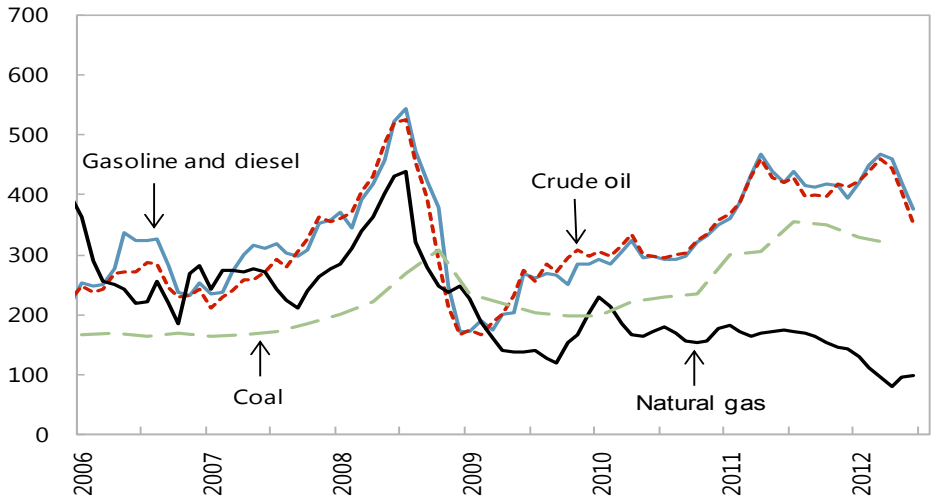
BACKGROUND

1. The recent surge in international energy prices, combined with incomplete pass-through to domestic prices, has prompted calls to phase out energy subsidies.[1] International energy prices have increased sharply over the past three years, with the exception of natural gas (Figure 1). Yet many low- and middle-income economies have been reluctant to adjust their domestic energy prices to reflect these increases. The resulting fiscal costs have been substantial and pose even greater fiscal risks for these countries if international prices continue to increase. In advanced economies, pass-through has been higher, but prices remain below the levels needed to fully capture the negative externalities of energy consumption on the environment, public health, and traffic congestion.

Figure 1. International Prices of Oil, Coal, and Natural Gas, 2006–2012
(Indexed January 2000=100)

International energy prices, other than for natural gas, have rebounded since the 2008–09 global crisis.



Sources: IMF *World Economic Outlook* (WEO), U.S. Energy Information Administration (EIA), and the Organisation for Economic Co-operation and Development (OECD).

Note: Coal price is average of quarterly U.S. import prices (EIA) and quarterly OECD import price (IEA/OECD). Natural gas price is average of the monthly U.S. import and export prices (EIA); these prices are weighted averages for LNG and pipeline natural gas. Crude oil price is average of Brent, Dubai, and WTI monthly prices (WEO/Primary Commodities Price System). Gasoline price is monthly New York Harbor conventional gasoline spot price (EIA). Diesel price is monthly Los Angeles ultra-low sulfur CARB diesel spot price (EIA). Gasoline and diesel prices are then averaged.

[1]The G-20 Pittsburgh Communiqué in September 2009 called for a phase out of inefficient fossil fuel subsidies in all countries. This commitment was reaffirmed at the 2012 Los Cabos meeting of the G-20.

2. Energy subsidies have wide-ranging economic consequences. Subsidy expenditures aggravate fiscal imbalances, and crowd out priority public spending and private investment, including in the energy sector. Underpriced energy distorts resource allocation by encouraging excessive energy consumption, artificially promoting capital-intensive industries (thus discouraging employment creation), reducing incentives for investment in renewable energy, and accelerating the depletion of natural resources. Subsidies lead to higher energy consumption, exerting pressure on the balance of payments of net energy importers, while also promoting smuggling to neighbors with higher domestic prices. As most subsidy benefits are captured by higher-income households, energy subsidies have important distributive consequences that are often not fully understood. Even future generations are affected through the reduced availability of key inputs for growth and the damaging effects of increased energy consumption on greenhouse gas emissions and global warming.

3. Yet energy subsidies have been difficult to reform. Subsidy reform has been a frequent topic of discussion between IMF staff and member countries—in some cases over decades. The adjustment of prices for subsidized energy has often led to widespread public protests by those who benefit from subsidies and to either a complete or partial reversal of price increases.[2] The absence of public support for subsidy reform partly reflects a lack of confidence in the ability of governments to reallocate the resulting budgetary savings to benefit the broader population, as well as concerns that vulnerable groups will not be protected. This is particularly challenging in oil-exporting countries, where subsidies are seen as a mechanism to distribute the benefits of natural resource endowments to their populations; in addition, these countries typically lack capacity to administer targeted social programs. Governments are also often concerned about the inflationary effects of higher domestic energy prices and their adverse impact on the international competitiveness of domestic producers. Furthermore, subsidy reform can be complex when it involves efforts to reduce inefficiencies and production costs, as is often the case for the electricity sector.

4. This paper focuses on "how to do" energy subsidy reform in light of country experiences. The second section reviews the challenges arising from energy subsidies, emphasizing their fiscal costs, adverse macroeconomic and environmental impacts, and the regressive distribution of subsidy benefits. A novel feature of the paper is that it presents the most comprehensive estimates of energy subsidies available covering petroleum products, electricity, natural gas, and coal. A central objective of the paper is to learn from past subsidy reform experiences, both successful and otherwise, to identify key design features that can facilitate reform. In this regard, the third section draws on lessons from international reform experiences from 22 country case studies (covering 28 reform episodes) undertaken by IMF staff, which are provided in a supplement to this paper. These are combined with insights from past IMF analyses (including Gupta and others, 2000; Coady and others, 2006; IMF, 2008a; Coady and others, 2010; and Arze del Granado, Coady, and Gillingham, 2012) as well as from analyses carried out by other institutions (including Global Subsidies Initiative, 2010; UNEP, 2002 and 2008; World Bank, 2010; Vagliasindi, 2012).

[2]Examples of reform reversals where price increase had to be quickly reversed—either partially or fully due to public demonstrations—include Bolivia (2010), Cameroon (2008), Nigeria (2012), Venezuela (1989), and Yemen (2005).

ENERGY SUBSIDIES

A. Definition and Measurement

5. Energy subsidies comprise both consumer and producer subsidies. Consumer subsidies arise when the prices paid by consumers, including both firms (intermediate consumption) and households (final consumption), are below a benchmark price, while producer subsidies arise when prices received by suppliers are above this benchmark.[3] Where an energy product is internationally traded, the benchmark price for calculating subsidies is based on the international price.[4] Where the product is mostly non-traded (such as electricity), the appropriate benchmark price is the cost-recovery price for the domestic producer, including a normal return to capital and distribution costs. This approach to measuring subsidies is often referred to as the "price-gap approach" (Koplow, 2009), and is used widely in analyses by other international agencies. In most economies, there are elements of both producer and consumer subsidies, although in practice it may be difficult to separate the two.[5] The advantage of the price gap approach is that it also helps capture consumer subsidies that are implicit, such as those provided by oil-exporting countries that supply petroleum products to their populations at prices below those prevailing in international markets. The price gap approach does not capture producer subsidies that arise when energy suppliers are inefficient and make losses at benchmark prices.[6]

6. Consumer subsidies include two components: a pre-tax subsidy (if the price paid by firms and households is below supply and distribution costs) and a tax subsidy (if taxes are below their efficient level). Box 1 describes the calculation of these two components. Most economies impose consumption taxes to raise revenue to help finance public expenditures. Efficient taxation requires that all consumption, including that of energy products, be subject to this taxation. The efficient taxation of energy further requires corrective taxes to capture negative environmental and other externalities due to energy use (such as global warming and local pollution).[7] The discussion below focuses on both "pre-tax subsidies" and "post-tax subsidies," where the latter includes an allowance for efficient taxation.

[3]The calculation of producer subsidies should incorporate any subsidies received on inputs.

[4]The benchmark price is the international price adjusted for distribution and transportation costs. The estimates in this paper assume similar distribution and transportation margins across countries.

[5]Producer and consumer subsidies have different economic consequences. Unlike consumer subsidies, producer subsidies do not lead to excessive consumption of energy.

[6]In many developing countries, cost-recovery prices are abnormally high because of inefficiencies in state-owned enterprises in the energy sector.

[7]These taxes are often referred to as "Pigouvian" or "corrective" taxes. In this paper, only broad estimates of these tax subsidies will be reported. A subsequent study by the Fiscal Affairs Department will provide more refined, country-specific estimates.

Box 1. Pre-tax and Post-tax Consumer Subsidies

A consumer subsidy is defined as the difference between a benchmark price and the price paid by energy consumers (including both households for final consumption and enterprises for intermediate consumption). There are two concepts of consumer subsidies: pre-tax subsidies and post-tax subsidies.

For the calculation of pre-tax subsidies for internationally traded goods (such as the refined petroleum products considered in this paper), the benchmark price is the international price appropriately adjusted for transport and distribution costs [1] (Pw) so that:

$$\text{Pre-tax subsidy} = Pw - Pc,$$

where Pc is the price paid by consumers. When the good or service is not traded internationally, as is the case for electricity in most countries, then the benchmark price is taken as the cost-recovery price (e.g., the costs of generation, transmission, and distribution of electricity). The pre-tax subsidy is then calculated as above, but Pw is the cost-recovery price. Pre-tax subsidies only exist in countries where the price paid by consumers is below the international or cost-recovery price ($Pc<Pw$).

For the calculation of post-tax subsidies, the benchmark price includes an adjustment for efficient taxation ($t^*>0$) to reflect both revenue needs and a correction for negative consumption externalities:

$$\text{Post-tax subsidy} = (Pw + t^*) - Pc,$$

where Pw and Pc are defined as above. Therefore, when there is a pre-tax subsidy the post-tax subsidy is equal to the efficient tax plus the pre-tax subsidy. When there is no pre-tax subsidy, the post-tax subsidy is equal to the difference between efficient and actual taxation.

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[1] When the refined petroleum product is imported, the benchmark price is taken as the international fob price plus the cost of transporting the product to the country's border plus the cost of internal distribution. When the product is exported, the benchmark price is the international fob price minus the cost of transporting the product abroad (since this cost is saved when the product is consumed domestically rather than exported) plus the cost of internal distribution.

7. Although energy subsidies do not always appear on the budget, they must ultimately be paid by someone. Whether and how subsidies are reflected in the budget will depend on who incurs them and how they are financed. For example, the cost of pre-tax consumer subsidies may be incurred by state-owned enterprises (SOEs) that sell electricity or petroleum products at a price below supply costs. If the government fully finances these losses with a transfer, the consumer subsidy will be reflected in the budget as expenditure and financed through higher taxes, increased debt, or higher inflation if the debt is monetized. In many instances, however, the subsidy may be financed by the SOE and reflected in its operating losses or lower profits, lower tax payments to the government, the accumulation of payment arrears to its suppliers, or a combination of all three. Alternatively, the cost of consumer subsidies could be offset by subsidized access to energy inputs, the cost of which would again fall on the government. In practice, the ways in which subsidies are financed and recorded in the budget vary across countries and can change over time. For example, whereas Indonesia, Jordan and Malaysia fully record fuel subsidies in the budget, Sudan and Yemen only partially record subsidies, and all subsidies are off-budget in Angola. In India, the extent to

which fuel subsidies are recorded on budget has varied (Box 2). In sum, in one way or another, someone always pays the cost of subsidies.

Box 2. Financing Fuel Subsidies in India

Domestic fuel prices in India have not kept pace with rising international fuel costs, resulting in consumer price subsidies. Reflecting sharp increases in fuel import prices over 2007 and 2008, subsidies peaked at over 2 percent of GDP in FY 2008/09. As international prices collapsed over the second half of 2008, subsidies also fell sharply to just under 0.9 of a percent of GDP in FY2009/10. However, with the rebound in international prices over the last three years, subsidies again started to escalate, reaching nearly 2 percent of GDP in FY 2011/12.

Fuel subsidies have been financed through a number of channels, including off-budget sources. Subsidies are incurred in the first instance by the predominantly state-owned oil marketing companies (OMCs) who sell fuel products to consumers at subsidized prices. These losses incurred by OMCs have been financed in a variety of ways. In FY 2007/08, just less than one-half of the financing was recorded on budget, with the remaining half financed off budget. On-budget transfers mainly took the form of so-called government "oil bonds" issued to OMCs, while direct budget transfers to OMCs were negligible. Off-budget financing was split between transfers from state-owned enterprises involved in the upstream production of crude oil and OMCs' self-financing. In effect, OMCs used part of the profits from the sale of other unregulated fuel products to offset these subsidy losses. By FY 2011/12, all on-budget financing took the form of direct budget transfers to OMCs, which accounted for around three-fifths of subsidies, with the remainder financed by upstream transfers.

Pre-tax subsidies

8. Subsidies for petroleum products are calculated for 176 countries using the price gap approach drawing on data compiled by IMF staff, the OECD, and Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) for 2000–2011. Consumer subsidies are estimated for gasoline, diesel, and kerosene. Producer subsidies to refineries to cover inefficient operations are not estimated due to the lack of data. Therefore, our estimated petroleum product subsidies capture only consumer subsidies and should be seen as a lower bound. See Appendix I for details.

9. Natural gas and coal subsidies are estimated for 56 countries and are largely based on the price gap approach. These data are mostly drawn from the IEA for 2007–2011. Producer subsidies are also included for coal for 16 OECD countries.

10. A number of different methods are used to estimate electricity subsidies for 77 countries. For some countries in Africa, the Middle East, and emerging Europe, estimates of combined producer and consumer subsidies are compiled from various World Bank and IMF reports. For these countries, subsidy estimates are based on average domestic prices, and cost-recovery prices that cover production and investment costs as well as distributional losses and the non-payment of electricity bills. For other countries, consumer price subsidies are taken from IEA which are derived on the basis of the price gap approach.

Post-tax subsidies

11. The benchmark price was also adjusted for corrective taxes and revenue considerations to estimate post-tax subsidies. Rough estimates of corrective taxes, drawing on other studies, were made to account for the effects of energy consumption on global warming; on public health through the adverse effects on local pollution; on traffic congestion and accidents; and on road damage. Estimates of the global warming damages from CO_2 emissions vary widely (see Appendix I). Our estimates assume damages from global warming of $25 per ton of CO_2 emissions, following the United States Interagency Working Group on Social Cost of Carbon (2010), an extensive and widely reviewed study. For final consumption, this price also assumes that energy products are subject to the economy's standard consumption tax rate (an ad valorem tax) on top of the corrective tax. The estimates are based on VAT rates for 150 countries in 2011. For countries without a VAT, the average VAT rate of countries in the region with a similar level of income is assumed.

Caveats

12. These estimates are likely to underestimate energy subsidies and should be interpreted with caution. First, data on producer subsidies are not available for all countries and all products.[8] Second, consumer subsidies for liquefied petroleum gas (LPG) are not included due to lack of data. Third, fuel subsidy estimates are based on a snapshot of prices paid by firms and households at a point in time (end-of-year) or average of end-of-quarter prices when such data are available. Fourth, for electricity, natural gas, and coal, they lack full comparability across countries, since they are drawn from different sources and use different approaches. Fifth, they rely on the assumption of similar transportation and distribution margins across countries. Sixth, in light of these factors, our subsidy estimates may differ from those found in country budget documents (including those reported in the case studies supplement). Seventh, the estimates of corrective taxes are made on the basis of studies for just a few countries and a common assumption regarding how these would vary with country income levels. However, these weaknesses are outweighed by the merits of constructing a broad picture of the magnitude of energy subsidies across as many countries and products as possible.

Magnitude of energy subsidies

13. Global pre-tax energy subsidies are significant. The subsidy estimates capture both those that are explicitly recorded in the budget and those that are implicit and off-budget. The evolution of energy subsidies closely mimics that of international energy prices (Figure 2). Although subsidies declined with the collapse of international energy prices, they have started to escalate since 2009. In 2011, global pre-tax subsidies reached $480 billion (0.7 percent of global GDP or 2 percent of total government revenues). Petroleum and electricity subsidies accounted for about 44 percent and

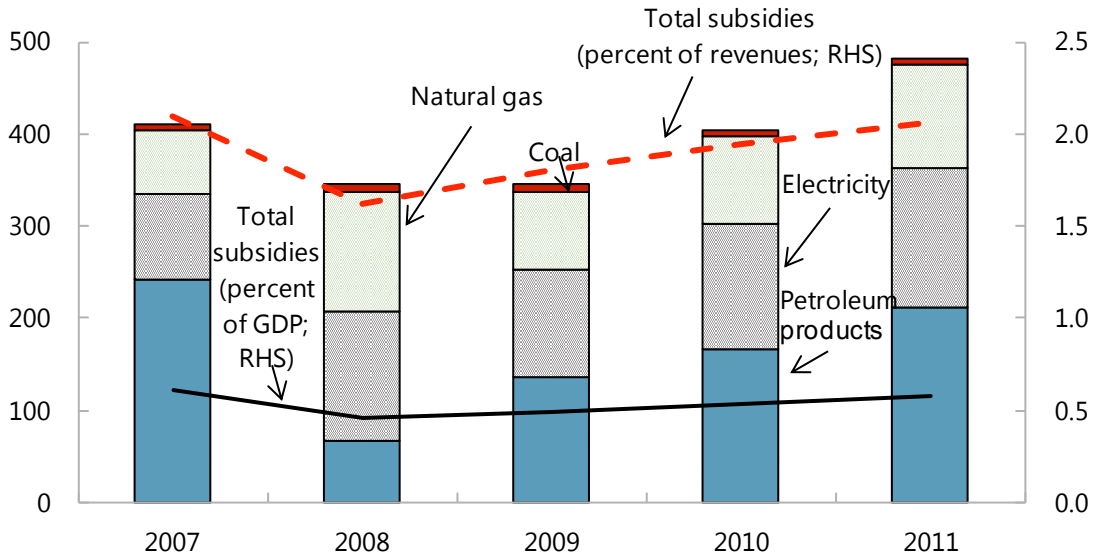
[8]In practice, identifying producer subsidies can be especially difficult since these often take the form of differential tax treatment and tax exemptions for specific sectors.

31 percent of the total respectively, with most of the remainder coming from natural gas. Coal subsidies are relatively small at $6½ billion.

Figure 2. Pre-tax Energy Subsidies, 2007–2011[1]

(Billions of U.S. dollars)

Energy subsidies have surged since the 2008–09 crisis and closely mimic changes in international prices.



Sources: Staff estimates, Organisation for Economic Co-operation and Development, International Energy Agency, Deutsche Gesellschaft für Internationale Zusammenarbeit, IMF *World Economic Outlook*, and World Bank.

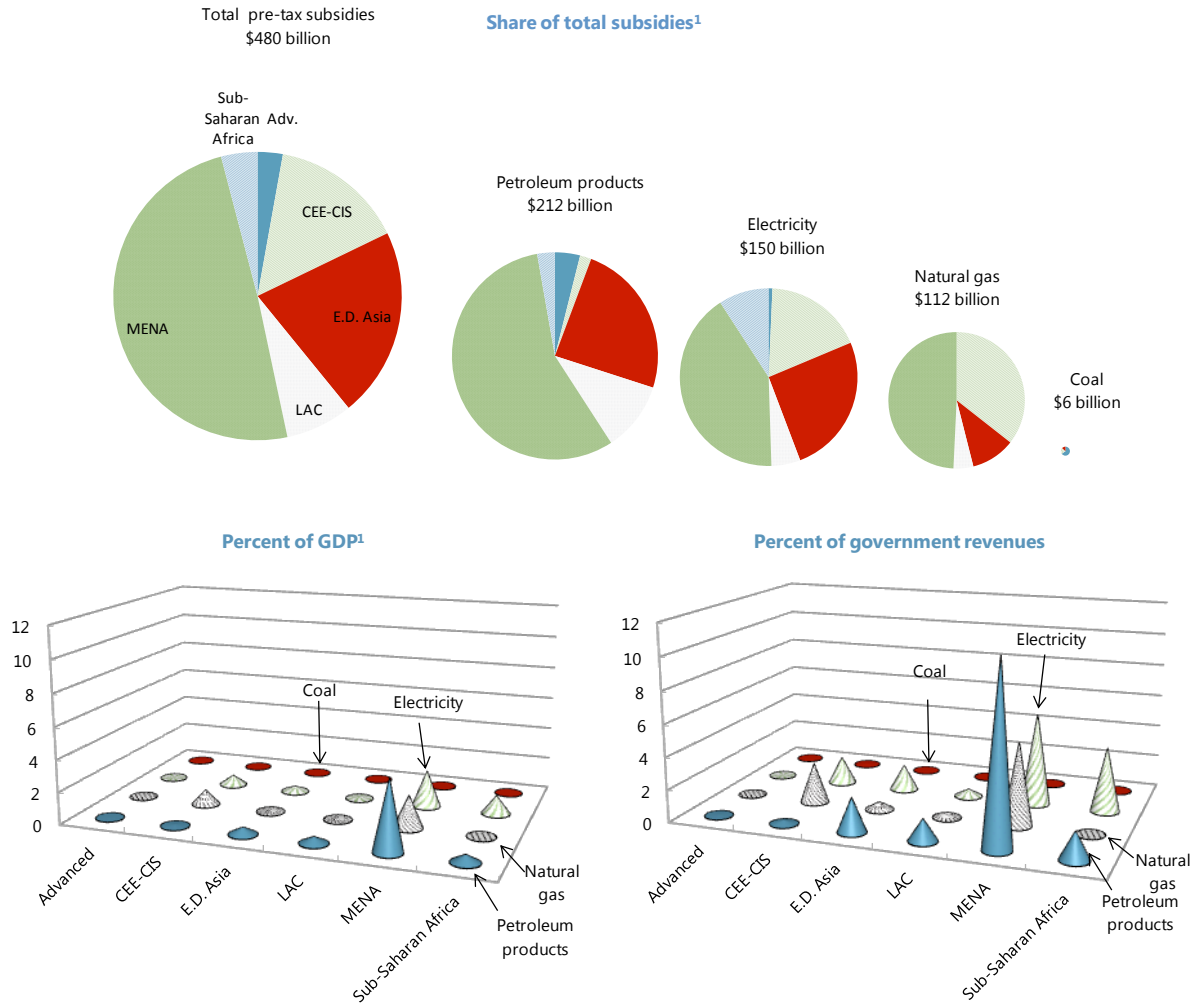
[1]Data are based on most recent year available. Total subsidies in percent of GDP and revenues are calculated as total identified subsidies divided by global GDP and revenues, respectively.

14. Pre-tax subsidies are concentrated in developing and emerging economies. Oil exporters—most of which are developing or emerging economies—tend to have the largest subsidies. This finding holds not only when measuring subsidies in absolute terms, but also as a share of GDP and on a per capita basis.

- The **Middle East and North Africa** region accounted for about 50 percent of global energy subsidies (Figure 3, Appendix Table 2). Energy subsidies totaled over 8½ percent of regional GDP or 22 percent of total government revenues, with one-half reflecting petroleum product subsidies. The regional average masks significant variation across countries. Of the 20 countries in the region, 12 have energy subsidies of 5 percent of GDP or more. Subsidies are high in this region for both oil- exporters and importers (Figure 4).

Figure 3. Pre-tax Energy Subsidies by Region, 2011

Energy subsidies are concentrated mostly in Middle East/North Africa, Central/Eastern Europe, and Emerging and Developing Asia.



Sources: Staff estimates, Organisation for Economic Co-operation and Development, International Energy Agency, Deutsche Gesellschaft für Internationale Zusammenarbeit, IMF *World Economic Outlook*, and World Bank.

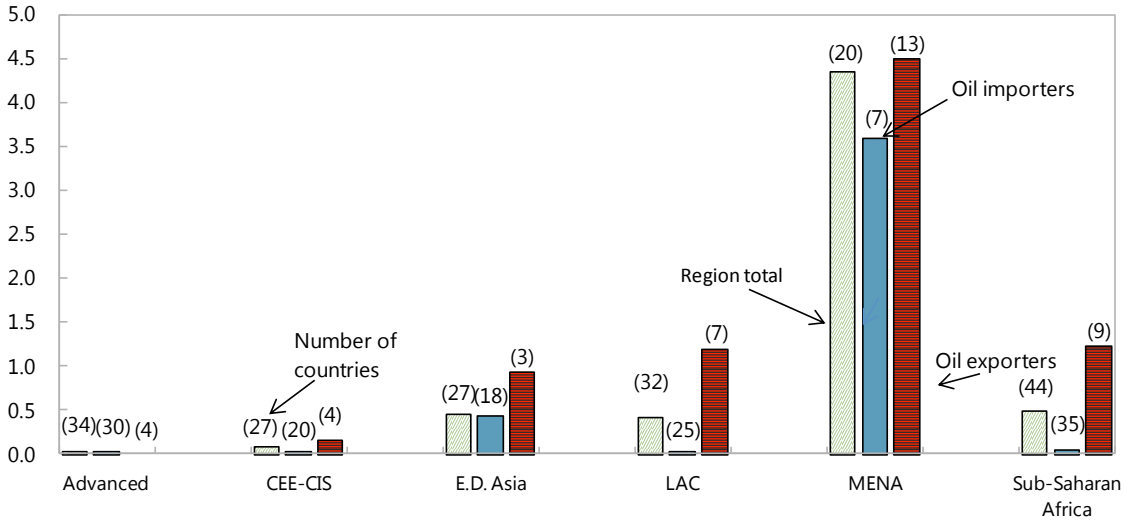
Note: Adv.=Advanced, CEE-CIS=Central and Eastern Europe and Commonwealth of Independent States, LAC=Latin America and Caribbean, S.S. Africa=Sub-Saharan Africa, MENA=Middle East and North Africa, and E.D. Asia=Emerging and Developing Asia.

[1]Data for electricity are for the most recent year available. Subsides in percent of GDP and revenues are calculated as identified subsidies divided by regional GDP and revenues, respectively.

Figure 4. Pre-tax Petroleum Subsidies Among Petroleum Importing and Exporting Countries, 2011

(Percent of GDP)

Petroleum product subsidies are systematically higher for oil exporters.



Sources: Staff estimates, Organisation for Economic Co-operation and Development, International Energy Agency, Deutsche Gesellschaft für Internationale Zusammenarbeit, IMF *World Economic Outlook*, and World Bank.

Note: CEE-CIS=Central and Eastern Europe and Commonwealth of Independent States, LAC=Latin America and Caribbean, MENA=Middle East and North Africa, and E.D. Asia=Emerging and Developing Asia.

Subsidies in percent of GDP are calculated as identified subsidies divided by regional GDP.

Number of countries in each category indicated in parentheses.

- Countries in **Emerging and Developing Asia** were responsible for over 20 percent of global energy subsidies. They amounted to nearly 1 percent of regional GDP or 4 percent of total government revenues, with petroleum products and electricity accounting for nearly 90 percent of subsidies. Energy subsidies exceeded 3 percent of GDP in four countries (Bangladesh, Brunei, Indonesia, and Pakistan).

- The **Central and Eastern Europe and CIS** accounted for about 15 percent of global energy subsidies, including the highest share (at nearly 36 percent) of global natural gas subsidies. Energy subsidies amounted to over 1½ percent of regional GDP or 4½ percent of total government revenues, with natural gas and electricity accounting for about 95 percent. They exceeded 5 percent of GDP in four countries (Kyrgyz Republic, Turkmenistan, Ukraine, and Uzbekistan).

- The **Latin America and Caribbean** made up over 7½ percent of global energy subsidies (approximately ½ percent of regional GDP or 2 percent of total government revenues), with petroleum subsidies accounting for nearly 65 percent. Energy subsidies exceeded 5 percent of GDP in two countries (Ecuador and Venezuela).

- **Sub-Saharan Africa** accounted for about 4 percent of global energy subsidies. Energy subsidies amounted to 1½ percent of regional GDP or 5½ percent of total government revenues, with electricity subsidies accounting for over 70 percent. Total subsidies exceeded 4 percent of GDP in three countries (Mozambique, Zambia, and Zimbabwe).

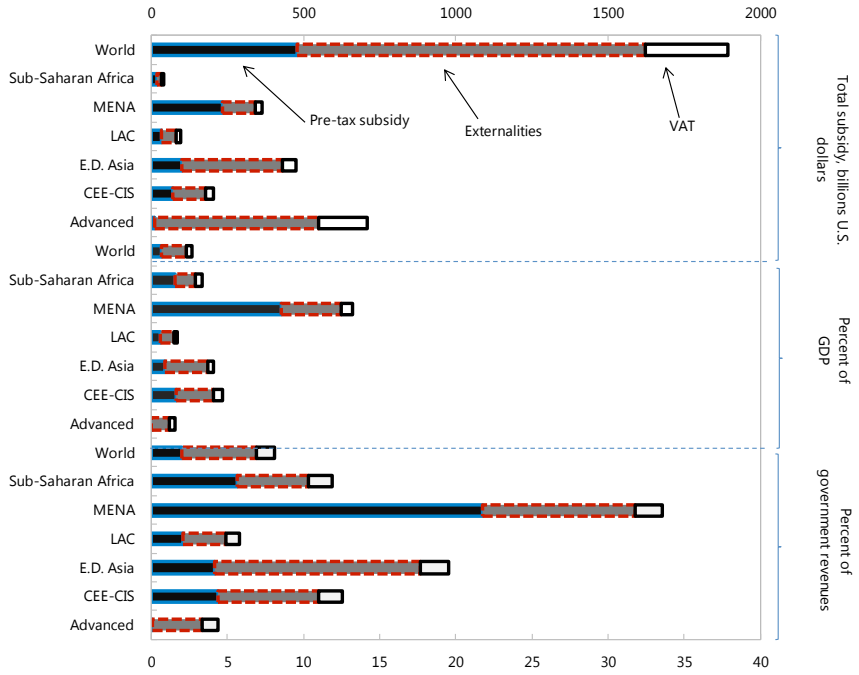
- The only **advanced economy** where energy subsidies were a non-negligible share of GDP was Taiwan Province of China at 0.3 percent of GDP (electricity).

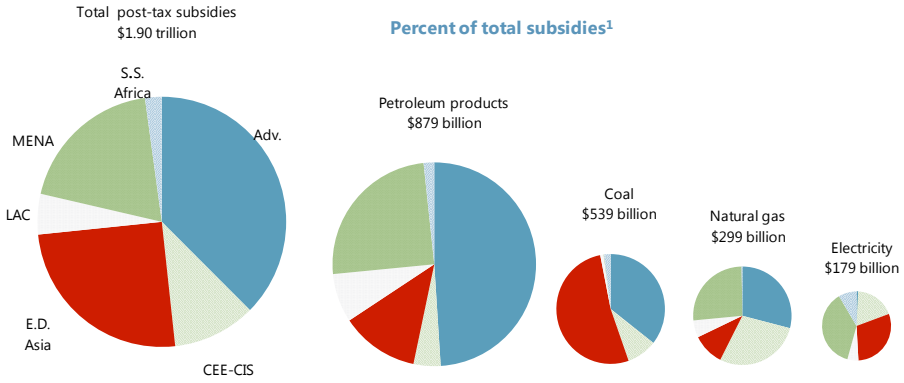
15. In summary, pre-tax subsidies are pervasive and impose significant fiscal costs in most developing and emerging regions. They are most prominent in Middle East and North Africa, especially among oil exporters. Given that energy consumption can be expected to rise as incomes grow, the size of subsidies could climb in regions where they currently account for a small share of the global total, such as sub-Saharan Africa.

16. Post-tax energy subsidies are much larger than pre-tax subsidies, amounting to $1.9 trillion in 2011—about 2½ percent of global GDP or 8 percent of total government revenue. Virtually all of the world's economies provide energy subsidies of some kind when measured on a tax-inclusive basis, including 34 advanced economies. For some products, such as coal, post-tax subsidies are substantial because prices are far below the levels needed to address negative environmental and health externalities. The fact that energy products are taxed much less than other products also contributes to the high level of post-tax subsidies. In MENA, for example, applying the same rate of VAT or sales taxes to energy products as other goods and services would generate ¾ percent of GDP. Of the global total, pre-tax subsidies account for about one-quarter, and tax subsidies account for about three-quarters (Figure 5). The advanced economies account for about 40 percent of the global total. The top three subsidizers across the world, in absolute terms, are the United States ($502 billion), China ($279 billion), and Russia ($116 billion).

Figure 5. Adjustment of Energy Subsidies for Taxes and Externalities, 2011

Energy subsidies increase substantially when externalities and tax considerations are taken on board.





Sources: Staff estimates, Organisation for Economic Co-operation and Development, International Energy Agency, Deutsche Gesellschaft für Internationale Zusammenarbeit, IMF *World Economic Outlook*, and World Bank.

Note: VAT refers to the tax subsidy provided when energy products are taxed by less than the economy's standard VAT rate (see Appendix I).

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[1]Estimates for electricity are for the most recent year available. Subsidies in percent of GDP and revenues are calculated as identified subsidies divided by global or regional GDP and revenues, respectively.

B. Macroeconomic, Environmental, and Social Implications

17. Energy subsidies depress growth through a number of channels. The effects of subsidies on growth goes beyond their adverse impact on fiscal balances and public debt (Rogoff and Reinhart, 2010; Kumar and Woo, 2010):

- *Subsidies can discourage investment in the energy sector.* Low and subsidized prices for energy can result in lower profits or outright losses for producers, making it difficult for SOEs to expand energy production and unattractive for the private sector to invest both in the short and long run (Box 3). The result is severe energy shortages that hamper economic activity.[9]

Box 3. Electricity Subsidies and Growth in Sub-Saharan Africa

Electricity subsidies in sub-Saharan Africa (SSA) are substantial and primarily reflect high costs of production. The average cost of subsidized electricity prices in a sample of 30 countries was 1.7 percent of GDP, and in 12 countries it exceeded 2 percent of GDP. On average, the effective tariff in SSA was only about 70 percent of the cost-recovery price during 2005–09. The primary driver of high subsidies has been high costs, rather than low retail prices—residential tariffs in SSA countries are much higher than in other regions of the world. High costs stem from operational inefficiencies, extensive use of back-up electricity generation, low economies of scale in generation, and limited regional integration. Therefore, in addition to increasing tariffs, reducing subsidies will require improving operational efficiency and modernizing electricity operations.

The losses incurred by electricity suppliers due to subsidized prices have severely constrained their ability to invest in new electricity capacity and improve service quality. As a result, installed per capita generation capacity in SSA (excluding South Africa) is about one-third of that of South Asia and one-tenth of that in Latin America. Similarly, per capita consumption of electricity in SSA (excluding South Africa) is only 10 kWh per month, compared with roughly 100 kWh in developing countries and 1,000 kWh in high-income countries.

Deficient electricity infrastructure and shortages dampen economic growth and weaken competitiveness. Weaknesses in electricity infrastructure are correlated with low levels of productivity (Escribano, Guasch, and Pena, 2008). For example, potential efficiency gains in electricity generation and distribution could reduce costs in the sector by more than 1 percentage point of GDP for at least 18 SSA countries. Simulations based on panel data in Calderón (2008) suggest that if the quantity and quality of electricity infrastructure in all SSA countries were improved to that of a better performer (such as Mauritius), long-term per capita growth rates would be 2 percentage points higher.

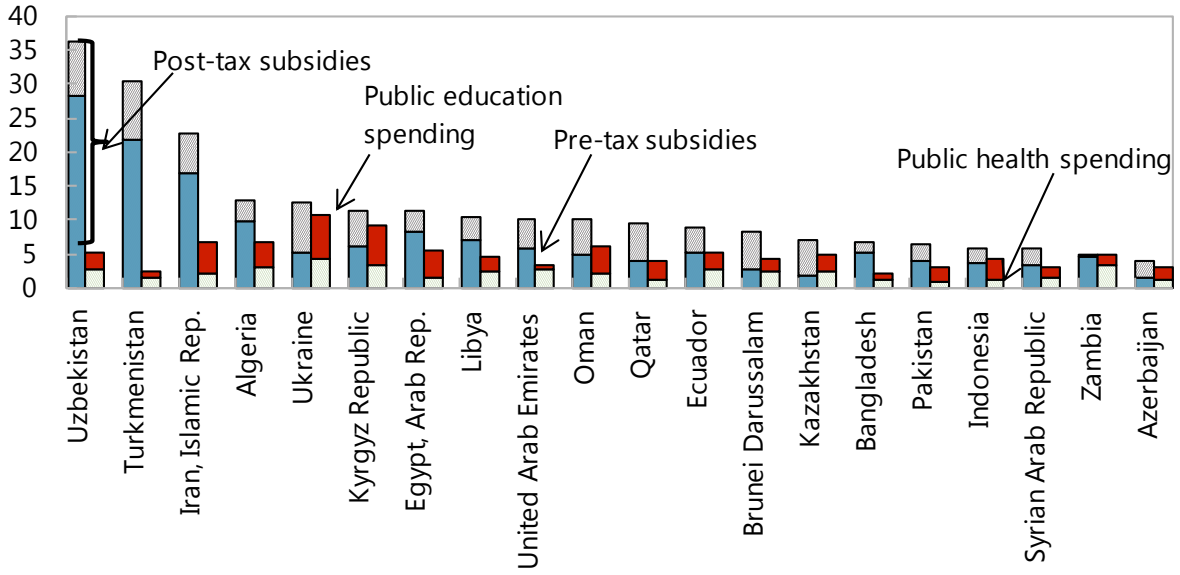
[9]Both households and firms spend considerable amounts to address electricity shortages, including through the purchase of generators. For example, in the Republic of Congo private household and enterprise generator capacity is nearly double the public generation capacity. The cost of own generation by firms is estimated in the range of $0.3–$0.7 per kWh—about three to four times as high as the price of electricity from the public grid (Foster and Steinbuks, 2008). These costs are even higher for households because of the smaller generators they use.

- *Subsidies can crowd out growth-enhancing public spending*. Some countries spend more on energy subsidies than on public health and education (Figure 6). Reallocating some of the resources freed by subsidy reform to more productive public spending could help boost growth over the long run.

Figure 6. Post-tax Subsidies and Social Spending, 2010

(Percent of GDP)

Subsidies are substantially higher than critical social spending in many countries.



Sources: International Energy Agency; World Bank; Clements, Gupta, and Nozaki (2012); IMF staff estimates; and Organisation for Economic Co-operation and Development.

Note: Health and education spending are for 2010 or latest available.

- *Subsidies diminish the competitiveness of the private sector over the longer term*. Although in the short-run subsidy reform will raise energy prices and increase production costs, over the longer term there will be a reallocation of resources to activities that are less energy and capital intensive and more efficient (Box 4), helping spur the growth of employment. Removing energy subsidies helps prolong the availability of non-renewable energy resources over the long term and strengthens incentives for research and development in energy-saving and alternative technologies. Subsidy reform will crowd-in private investment, including in the energy sector, and benefit growth over the longer term.

- *Subsidies create incentives for smuggling*. If domestic prices are substantially lower than those in neighboring countries, there are strong incentives to smuggle products to higher-priced destinations. Illegal trade increases the budgetary cost for the subsidizing country while limiting the ability of the country receiving smuggled items to tax domestic consumption of energy. Fuel smuggling is a widespread problem in many regions around the world including in North America, North Africa, and the Middle East, parts of Asia, and Africa. For example, Canadians buy

cheap fuel in the United States; Algerian fuel is smuggled into Tunisia; Yemeni oil is smuggled into Djibouti; and Nigerian fuel is smuggled into many West African countries (Heggie and Vickers, 1998).[10]

Box 4. Energy Subsidy Reform and Competitiveness

The short-run effects of higher energy prices on competitiveness depend on the energy intensity of traded sectors and developments in energy prices in competing countries. Increases in energy prices to reduce subsidies—or avoid the emergence of subsidies in periods of rising international prices—increase production costs. The effects on costs will vary by sector, depending on both their direct use of energy (e.g., fuel products) and indirect use (e.g., the higher costs of intermediate inputs that use fuel) (Gupta, 1983; Dick and others, 1984). Higher fuel prices, for example, can lead to higher electricity prices, which in turn will affect costs and output in manufacturing (e.g., Clements, Jung, and Gupta, 2007). The use of input-output tables can often be helpful to trace the direct and indirect effects of higher energy prices on costs and competitiveness and to quantify which sectors will be most affected. The effect of higher energy prices on competitiveness depends on developments in energy prices in countries competing for the same markets. If all countries pass on the increase in international prices to domestic prices, for example, the effects on production costs may be similar across countries.

The adverse effects on competitiveness, at the aggregate level, can be reduced if appropriate macroeconomic policies are in place. The extent to which higher energy costs result in a persistently higher price level and an adverse effect on competitiveness will depend on the strength of "second round" effects on wages and the prices of other inputs (Fofana, Chitiga, and Mabugu, 2009). If prices rise relative to those in trading partners, the real exchange rate will appreciate, reducing competitiveness. These second-round effects can be contained with appropriate monetary and fiscal policies that help anchor inflationary expectations (IMF, 2012a). Subsidy reform helps support an appropriate fiscal policy response by reducing budget deficits and helping contain demand pressures on prices. Flexible exchange rate regimes also mitigate the impact of volatile international prices on economic growth (IMF, 2008b).

The resources freed from subsidy reform can boost competitiveness over the longer term. Subsidy reform can contribute to lower budget deficits and interest rates, thus stimulating private investment (Fofana, Chitiga, and Mabugu, 2009; Clements, Jung, and Gupta, 2007). Furthermore, if part of the freed resources is invested in productivity-enhancing public spending, growth dividends can be high (Breisinger, Engelke, and Ecker, 2011; Lofgren, 1995). By removing distortions in price signals, subsidy reform can help reallocate resources toward their best use and improve incentives to adopt energy-saving technologies. Not all sectors will benefit from subsidy reform over the longer term, because those that cannot adapt to higher energy prices will suffer a loss of competitiveness. Yet in the aggregate, the effects on competitiveness are positive. Empirical estimates suggest that higher investment in more efficient and energy-saving technologies could boost growth by up to 1 percent over the long term (Burniaux and others, 2009; Ellis, 2010; UNEP, 2008; and von Moltke, McKee, and Morgan, 2004).

[10] In 2011, it was estimated that more than 80 percent of gasoline consumed in Benin was smuggled from Nigeria (IMF, 2012c).

18. Energy subsidies exacerbate the difficulties of both oil importers and exporters in dealing with the volatility of international energy prices. The balance of payments of many energy-importing countries is vulnerable to international price increases (IMF, 2008b).[11] The adverse impact can be mitigated by passing through international price increases and by providing greater incentives for improving energy efficiency and lowering energy consumption (Dudine and others, 2006).[12] The volatility of subsidies also complicates budget management. For oil exporters, energy subsidies accentuate macroeconomic volatility by increasing subsidies during periods of international price increases (Gelb and others, 1988). Allowing domestic prices to rise with international prices can help cool off domestic demand during commodity booms and build up fiscal buffers for use during periods of declining prices. To offset concerns about the transmission of high international price volatility to domestic prices, some smoothing of price increases can be considered (see paragraph 45).

19. The negative externalities from energy subsidies are substantial. Subsidies cause over-consumption of petroleum products, coal, and natural gas, and reduce incentives for investment in energy efficiency and renewable energy. This over-consumption in turn aggravates global warming and worsens local pollution. The high levels of vehicle traffic that are encouraged by subsidized fuels also have negative externalities in the form of traffic congestion and higher rates of accidents and road damage. The subsidization of electricity can also have indirect effects on global warming and pollution, but this will depend on the composition of energy sources for electricity generation. The subsidization of diesel promotes the overuse of irrigation pumps, resulting in excessive cultivation of water-intensive crops and depletion of groundwater.

20. Eliminating energy subsidies would generate substantial environmental and health benefits. To illustrate the impact of subsidies on global warming and local pollution, the effects of raising energy prices to levels that would eliminate tax-inclusive subsidies for petroleum products, natural gas, and coal were estimated (see Appendix II).[13] The results suggest that this reform would reduce CO_2 emissions by 4½ billion tons, representing a 13 percent decrease in global energy-related CO_2 emissions. Eliminating subsidies would also generate significant health benefits by reducing local pollution from fossil fuels in the form of SO_2 and other pollutants. In particular, this reform would result in a reduction of 10 million tons in SO_2 emissions and a 13 percent reduction in other local pollutants.

[11]IMF (2008b) estimated that a 20 percent increase in international oil prices would reduce international reserves in developing economies by more than half a month of imports.

[12]Based on a review of 124 developed and developing countries, Dahl (2012) estimates a range of values for the demand price elasticity between -0.11 and -0.33 for gasoline, and between -0.13 and -0.38 for diesel. Long-run price elasticities are estimated to be larger than those found for the short-term. For developed countries, Goodwin and others (2004) found a mean price elasticity for fuel consumption ranging from -0.25 (short run) to -0.64 (long run).

[13]The impact of electricity subsidy removal is not assessed due to data limitations.

21. The over-consumption of energy products due to subsidies can also have effects on global energy demand and prices. The multilateral removal of pre-tax fuel subsidies in non-OECD countries, under a gradual phasing-out, would reduce world prices for crude oil, natural gas, and coal by 8 percent, 13 percent, and 1 percent respectively in 2050 relative to the no-change baseline (OECD, 2009; IEA, 2011c). The reduction would be substantially larger if prices were raised to levels that eliminated subsidies on a post-tax basis. These spillover effects suggest that non-subsidizers would share the gains from subsidy reform, as well as extending the availability of scarce natural resources.

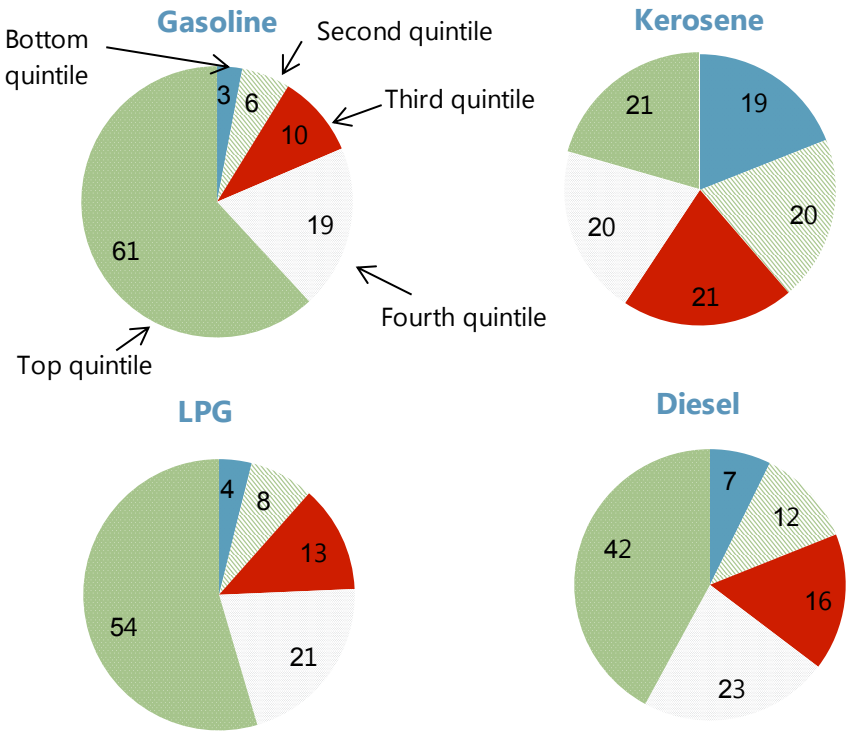
C. Equity Implications

22. Energy subsidies are highly inequitable because they mostly benefit upper-income groups. Energy subsidies benefit households both through lower prices for energy used for cooking, heating, lighting and personal transport, but also through lower prices for other goods and services that use energy as an input. On average, the richest 20 percent of households in low- and middle-income countries capture six times more in total fuel product subsidies (43 percent) than the poorest 20 percent of households (7 percent) (Figure 7). The distributional effects of subsidies vary markedly by product, with gasoline being the most regressive (i.e., subsidy benefits increase as income increases) and kerosene being progressive. Subsidies to natural gas and electricity have also been found to be badly targeted, with the poorest 20 percent of households receiving 10 percent of natural gas subsidies and 9 percent of electricity subsidies (IEA, 2011a). While subsidies primarily benefit upper-income groups, a sharp increase in energy prices can nevertheless have a significant impact on the budgets of poor households, both directly through the removal of the subsidies and indirectly through the reduction in real income because of higher consumer prices. For example, a $0.25 per liter increase in fuel prices can reduce real consumption of the poorest 20 percent of households by about 5½ percent (Arze del Granado, Coady, and Gillingham, 2012). This underscores the need for mitigating measures to ensure that fuel subsidy reform does not result in increased poverty (Sterner, 2012). In the case of electricity, the ability to differentiate tariff levels according to consumption levels (e.g., a lifeline tariff) can help protect low-income groups during electricity subsidy reforms. Nevertheless, such subsidies do not reach poor households who have no access to electricity, which limits their progressivity. Only 30 percent of households, for example, are connected to the grid in sub-Saharan Africa (IFC, 2012).

23. Energy subsidies divert public resources away from spending that is more pro-poor. In many subsidizing countries, equity could be improved by reallocating outlays toward better-targeted programs in health, education, and social protection. Over the longer term, the removal of subsidies, accompanied by a well designed safety net and an increase in pro-poor spending, could yield significant improvements in the well-being of low-income groups. In oil-exporting countries, subsidies are often used as a tool for sharing oil wealth with its citizens. But given the high share of benefits that accrues to upper-income groups, the inefficiencies that subsidies create in resource allocation, and in some countries the large share of the expatriate population, energy subsidies are a much less effective policy instrument for distributing wealth than other public spending programs.

Figure 7. Distribution of Petroleum Product Subsidies by Income Groups
(Percent of total product subsidies)

The distribution of subsidies varies across products, with gasoline being the most regressive and kerosene progressive.



Source: Arze del Granado and others, 2012.

REFORMING ENERGY SUBSIDIES: LESSONS FROM EXPERIENCE

A. Overview

24. This section provides insights from country case studies to identify ingredients for successful subsidy reform. The country case studies include both successful and unsuccessful subsidy reform episodes over the past two decades across a broad range of countries and different energy products. A total of 22 country case studies were undertaken covering 28 major reform episodes (Table 1 and supplement). These involve episodes in which governments attempted to reduce the fiscal burden of subsidies by raising energy prices to households and firms or improving the efficiency of state-owned enterprises in the energy sector. They contain cases where governments attempted to reduce pre-tax subsidies but also where governments sought to restore energy taxation to levels that had prevailed prior to increases in international energy prices and to levels needed to eliminate post-tax subsidies.[14] The studies include cases where countries successfully implemented reforms that led to a permanent and sustained reduction of subsidies (success); those which achieved a reduction of subsidies for at least a year, but where subsidies have reemerged or remain a policy issue (partial success); and subsidy reforms that failed, with price increases or efforts to improve efficiency in the energy sector being rolled back soon after the reform began (unsuccessful). Out of the 28 reform episodes, 12 were classified as a success, 11 as a partial success—often because of reversals or incomplete implementation—and five as unsuccessful. Out of the 22 case studies, 14 address fuel subsidy reform, seven electricity sector reform, and one involves coal sector reform. The studies cover seven countries from sub-Saharan Africa, two countries in emerging and developing Asia, three countries in the Middle East and North Africa, four countries in Latin America and the Caribbean, and three countries in Central and Eastern Europe and the CIS. In 14 of the 28 episodes, an IMF-supported program was in place, and in all but two the program contained conditionality on energy subsidy reform.

25. The selection of countries for the case studies reflects the availability of data and of previously documented evidence on country-specific reforms. The larger number of studies on fuel subsidies reflects the wider availability of data and past studies of these reforms. The countries were chosen to ensure coverage of different regions of the world and a mix of reform outcomes.

[14]For instance, as a result of subsidy reforms over the late 1980s and the 1990s, Turkey has eliminated subsidies on a post-tax basis.

Table 1. Summary of Country Energy Subsidy Reform Episodes

Region/Country	Energy product	Reform episode	Reform outcome	Reform impact	IMF-supported program during the reform episode	Conditionality on energy subsidy reform
CEE-CIS						
Turkey	Fuel	1998	Successful	SOEs turned from net loss to net profitability	Yes	Yes
Armenia	Electricity	Mid-1990s	Successful	Electricity sector financial deficit declined from 22 percent of GDP in 1994 to zero after 2004	Yes	Yes
Turkey	Electricity	1980s	Successful	Generated additional revenues for maintenance	Yes	Yes
Poland	Coal	1990–1998	Unsuccessful	n.a.	Yes	Yes
	Coal	1998	Successful	The industry became financially viable and achieved substantial reduction in government transfer	No	
Emerging and Developing Asia						
Indonesia	Fuel	1997	Unsuccessful	n.a.	Yes	Yes
	Fuel	2003	Unsuccessful	n.a.	No	
	Fuel	2005	Partially successful	Subsidies declined from 3.5 percent of GDP in 2005 to 1.9 percent in 2006	No	
	Fuel	2008	Partially successful	Subsidies declined from 2.8 percent of GDP in 2008 to 0.8 percent in 2009	No	
Philippines	Fuel	1996	Successful	0.1+ percent of GDP	Yes	Yes
Philippines	Electricity	2001	Successful	Subsidies declined from 1.5 percent of GDP in 2004 to zero in 2006	No	
LAC						
Brazil	Fuel	Early 1990s–2001	Successful	From 0.8 percent of GDP in subsidies in mid-1990s to revenue generating since 2002	Yes	Yes
Chile	Fuel	Early 1990s	Successful	n.a.	No	
Peru	Fuel	2010	Partially successful	0.1 percent of GDP	No	
Brazil	Electricity	1993–2003	Successful	0.7 percent of GDP	Yes	Yes
Mexico	Electricity	1999/2001/2002	Unsuccessful	n.a.	Yes	No
MENA						
Iran	Fuel	2010	Partially successful	Growth in the consumption of petroleum products initially stabilized	No	
Mauritania	Fuel	2008	Unsuccessful	n.a.	Yes	No
	Fuel	2011	Partially successful	Subsidies declined from 2 percent of GDP in 2011 to close to zero in 2012	Yes	Yes
Yemen	Fuel	2005	Partially successful	Subsidies declined from 8.7 percent of GDP in 2005 to 8.1 percent in 2006	No	
	Fuel	2010	Partially successful	Subsidies declined from 8.2 percent of GDP in 2010 to 7.4 percent in 2011	Yes	Yes
Sub-Saharan Africa						
Ghana	Fuel	2005	Partially successful	50 percent price increase on average	No	
Namibia	Fuel	1997	Partially successful	0.1+ percent of GDP	No	
Niger	Fuel	2011	Partially successful	0.9 percent of GDP	No	
Nigeria	Fuel	2011–12	Partially successful	Subsidies declined from 4.7 percent of GDP in 2011 to 3.6 percent in 2012	No	
South Africa	Fuel	1950s	Successful	Successfully avoided subsidies and secured supply	No	
Kenya	Electricity	Mid-1990s	Successful	Subsidies declined from 1.5 percent of GDP in 2001 to zero in 2008	Yes	Yes
Uganda	Electricity	1999	Successful	2.1 percent of GDP	Yes	Yes

Source: IMF staff.

Note: n.a.=not applicable.

Note: CEE-CIS=Central and Eastern Europe and Commonwealth of Independent States, LAC=Latin America and Caribbean, S.S. Africa=Sub-Saharan Africa, and MENA=Middle East and North Africa.

The findings from the country studies identified in Table 1 are complemented with the insights from additional country studies conducted previously by the IMF and others, including Gupta and others (2000); Coady and others (2006); IMF (2008b); Coady and others (2010); Global Subsidies Initiative (2010); the UNEP (2002 and 2008); World Bank (2010); Vagliasindi (2012); and Arze del Granado, Coady, and Gillingham (2012).[15] They also draw on lessons from technical assistance reports on energy subsidies undertaken by the Fiscal Affairs Department.[16]

B. Barriers to Reform

26. Country reform experiences suggest a number of barriers to successful subsidy reform. While there is no single recipe for success, addressing these barriers, which vary from country to country, can increase the likelihood of reforms achieving their objectives and help avoid policy reversals.

- ***Lack of information regarding the magnitude and shortcomings of subsidies.*** The full fiscal cost of energy subsidies—including both producer and consumer subsidies—are rarely reflected in the budget. This is especially the case for oil exporters, since the subsidies provided by low energy prices are often implicit, i.e., not explicitly recorded in the budget.[17] Populations are also often unaware of how domestic energy prices compare with international market prices, the consequences of low energy prices for both the budget and economic efficiency, and the benefit distribution of energy subsidies. As a result, the public is unable to make a connection between subsidies, constraints on expanding high-priority public spending, and the adverse effects of subsidies on economic growth and poverty reduction. This is especially important for oil exporters, where subsidies are very large. Out of the 28 reform episodes, 17 indicate that the lack of information was a barrier to reform, including fuel subsidy reforms in Ghana, Mexico, Nigeria, the Philippines, Uganda, and Yemen, and electricity subsidy reforms in Mexico and Uganda. Most countries that successfully reformed energy subsidies undertook an evaluation of the magnitude of energy subsidies prior to implementing subsidy reforms. Public discussions based on such studies were an important component of the information campaigns in fuel subsidy reforms in Ghana, Namibia, and the Philippines.

- ***Lack of government credibility and administrative capacity.*** Even where the public recognizes the magnitude and shortcomings of energy subsidies, it often has little confidence that the government will use savings from subsidy reform wisely. This is especially true in countries with a history of widespread corruption, lack of transparency in the conduct of public policy, and perceived inefficiencies in public spending. The middle class may fiercely resist the

[15]The case studies do not disentangle the effects of subsidy reform on macroeconomic variables such as inflation and the real exchange rate. This would require isolating these effects over the period in which subsidy reforms were implemented, which on average was five years.

[16]Over the past five years, there were 19 technical assistance missions to member countries addressing the issue of energy subsidy reform. About one third of these missions were to sub-Saharan Africa and another third to the MENA region.

[17]Gupta and others (2004) estimate implicit subsidies in oil exporters at 3½ percent of GDP, on average, in 1999.

removal of these subsidies because they are viewed as one of the few concrete benefits they receive from the state. This is especially the case for oil exporters that have ample fiscal resources yet lack the administrative capacity to implement cash transfer programs. Lack of credibility was seen as an important factor behind the less successful fuel subsidy reforms in Indonesia in 2003 and Nigeria in 2011.

- ***Concerns regarding the adverse impact on the poor.*** Although most of the benefits from energy subsidies are captured by higher-income groups, as noted earlier, energy price increases can still have a substantial adverse impact on the real incomes of the poor, both through higher energy costs of cooking, heating, lighting, and personal transport, as well as higher prices for other goods and services, including food. This is an important consideration for countries that do not have a well-functioning social safety net that is capable of effectively protecting the poor from the adverse impact of higher energy prices. In 20 episodes, subsidy reform was accompanied by specific measures to mitigate the impact of price increases on the poor. In seven episodes, price increases were initially concentrated on products that were less important for poor household budgets.

- ***Concerns regarding the adverse impact on inflation, international competitiveness, and volatility of domestic energy prices.*** Increases in energy prices will have short-term effects on inflation, which may give rise to expectations of further increases in prices and wages unless appropriate macroeconomic policies are in place (Box 4). This may especially be a concern for countries that have difficulty in anchoring inflation expectations. Higher energy prices may also lead to concerns about the international competitiveness of energy-intensive sectors. In addition, countries are hesitant to liberalize energy prices in order to avoid high volatility in domestic prices arising from international price developments. In Armenia, the impact of electricity price increases on inflation was mitigated by the implementation of macroeconomic stabilization measures. In Iran and Nigeria, fuel subsidy reform was accompanied by specific measures intended to mitigate the impact of price increases on energy-intensive sectors.

- ***Opposition from specific interest groups benefiting from the status quo.*** Politically vocal groups that benefit from subsidies can be powerful and well organized and can block reforms. For example, in some countries the urban middle class and industrial sector (which also benefits from subsidies) can be an obstacle to reform. On the other hand, those benefitting from reform are often dispersed and less organized. Reform strategies therefore need to address the concerns of the losers. In Poland, initial mining sector reforms were unsuccessful because they did not provide adequate support for miners. In Mexico, strong opposition from labor unions contributed to the failure of the electricity sector reform. An important stumbling block to reform in many countries is often SOEs in the energy sector, which can resist efforts to strengthen governance and performance.

- ***Weak macroeconomic conditions.*** Public resistance to subsidy reform is lower when economic growth is relatively high and inflation is low—although subsidy reform cannot always be postponed and is often required as part of efforts to constrain inflation and stimulate growth. Rising household incomes can help households better afford the increases in energy prices

entailed by subsidy reform. In Peru, the implementation of subsidy reforms in early 2010 during a period of stable prices and strong economic growth helped make the reform politically more palatable. In Turkey, reforms of the electricity sector coincided with a period of economic growth and improving standards of living, which assured the public that reforms were moving the country in the right direction. High inflation is also an obstacle to reform. When inflation is high, frequent large changes in controlled prices are needed to avoid the emergence of fuel subsidies (as in Brazil).

C. Designing a Subsidy Reform Strategy

27. Many countries have incorporated specific measures into their subsidy reform strategies to overcome the above barriers. Staff's review of country reform experiences suggests the following key elements can increase the likelihood of successful subsidy reform: (i) a comprehensive reform plan; (ii) a far-reaching communications strategy, aided by improvements in transparency; (iii) appropriately phased energy price increases, which can be sequenced differently across energy products; (iv) improving the efficiency of SOEs to reduce producer subsidies; (v) targeted mitigating measures to protect the poor; and (vi) depoliticizing energy pricing to avoid the recurrence of subsidies. Each of these elements is discussed in turn below in more detail.

(i) Comprehensive reform plan

28. Most of the successful reforms were well planned with a clear reform strategy. In Iran, the 2010 fuel subsidy reform incorporated clear objectives, compensating measures, and a timetable for reform, preceded by an extensive public relations campaign. The public information campaign emphasized that the main objective of the reform was to replace price subsidies with cash transfers to reduce incentives for excessive energy consumption and smuggling. Bank accounts were opened for most citizens prior to the reform and compensating cash transfers deposited into these accounts preceding the implementation of price increases. In Namibia, the authorities undertook comprehensive planning, with broad consultation with civil society and a well-crafted plan that included the introduction of a fuel price adjustment mechanism and a targeted subsidy for those living in remote areas. A clear medium-term reform strategy backed by careful planning was also a major factor behind the successful electricity price liberalization reforms in the Philippines and Turkey. By contrast, the lack of effective planning contributed to less successful outcomes in some countries (fuel subsidy reform in Indonesia in 1998 and only partial success in Nigeria in 2011). A good reform plan often requires extensive time to prepare, as in Iran.

29. A comprehensive reform plan requires establishing clear long-term objectives, assessing the impact of reforms, and consulting with stakeholders.

***Clear long-term objectives*.** Subsidy reforms are more likely to be successful and durable if they are embedded within a broader reform agenda. In particular, reforms should incorporate both a sustainable approach to energy pricing and a plan to improve the efficiency of energy consumption and supply.

- In the Philippines and Turkey, full price liberalization and structural reform of the energy sector, for both fuel and electricity, were articulated as the ultimate goals of reform. This contributed to the eventual success of reform as the public and governments were able to focus on and adhere to long-term goals, without being distracted by setbacks at intermediate stages.

- This comprehensive strategy is especially important for electricity reforms. There is a strong inverse correlation between the size of electricity subsidies and the quality of service, reflecting the dampening effect of subsidies on investment. Yet the public is often unwilling to pay higher prices in the absence of quality improvements. Reforms in this sector should not only seek to improve access and service quality but also tackle operational inefficiencies (such as high distribution losses and inadequate bill collection and metering). The need to accompany tariff increases with service improvements can constrain the speed of reform, since improving services often requires up-front investment. Electricity subsidy reforms in Armenia, Brazil, and Kenya were successful because they were part of a broader package intended to address supply problems.

Assessing the impact of reforms. Designing a comprehensive subsidy reform strategy requires information on the likely impact of reforms on various stakeholders and the identification of measures to mitigate adverse impacts. This involves assessing the fiscal and macroeconomic effects of subsidies and identifying the winners and losers from reform. In Ghana, in 2005, the government commissioned an independent poverty and social impact analysis to assess the winners and losers from fuel subsidies and subsidy removal. This was an important foundation for persuasively communicating the necessity for reform and for designing policies to reduce the impact of higher fuel prices on the poor. In Nigeria, in contrast, the National Assembly did not support the removal of the gasoline subsidy in 2011, claiming a lack of firm data underpinning the size and incidence of subsidies.

Consultation with stakeholders. Stakeholders should be invited to participate in the formulation of the subsidy reform strategy. This "stakeholder approach" has proven successful in a number of countries (Graham, 1998; Gupta and others, 2000).

- In Kenya, electricity tariff increases faced significant difficulties early in the reform process. These were overcome after intense negotiations with stakeholders, particularly with large consumers, and efforts to communicate the objectives and benefits of the reform.

- In Namibia, the National Energy Council, chaired by the Minister of Mines and Energy, established the National Deregulation Task Force to examine fuel price deregulation through a consultative process.

- In Niger, the authorities established the Comité du Différé to discuss the best way to approach the fuel subsidy reforms and their subsequent consultation with all relevant stakeholders.

- In Indonesia, on the other hand, consultation with stakeholders was inadequate. The opposition to the 2003 fuel subsidy reform was partially motivated by the belief that the reform had been undertaken in favor of powerful interest groups.

(ii) Communications strategy

30. A far-reaching communications campaign can help generate broad political and public support and should be undertaken throughout the reform process. A review of subsidy reform experiences found that the likelihood of success almost tripled with strong public support and proactive public communications (IMF, 2011). The information campaign should explain the magnitude of energy subsidies and their implications for other parts of the budget. The benefits of removing subsidies, including on a post-tax basis, should be underscored, in particular the scope for using part of the budgetary savings or additional revenues to finance high-priority spending on education, health, infrastructure, and social protection. Information campaigns have underpinned the success of a number of countries, including fuel subsidy reforms in Ghana, Iran, Namibia, and the Philippines, and electricity subsidy reforms in Armenia and Uganda.

- In Namibia, a White Paper on Energy Policy was produced, which formed the basis of an effective public communications campaign.

- In the Philippines, a public communication campaign began at an early stage and included a nationwide road-show to inform the public of the problems of petroleum price subsidies.

- In Uganda, the government effectively communicated the cost of the electricity subsidy and its incidence to the public. As a consequence, a large portion of the media considered the raising of tariffs to be a pro-poor measure.

31. Ensuring transparency is a key component of a successful communications strategy. Useful information to be disseminated includes: (i) the magnitude of subsidies and how they are funded, including in oil-exporting countries where subsidies are provided implicitly and not shown in the budget or recorded as tax expenditures. To the extent that subsidies are off-budget, they could be reported as a memorandum item in budget documents. Data on subsidies should also cover producer subsidies, which may necessitate better reporting of the accounts of SOEs in the energy sector and reporting on SOEs in budget documents (see paragraph 35); (ii) the distribution of subsidy benefits across income groups; (iii) changes in subsidy spending over time; and (iv) the potential environmental and health benefits from subsidy reform. Prior to its successful subsidy reform, Niger started to record fuel subsidies explicitly in the budget. Making such information public allows for an independent assessment of the costs and benefits of subsidy policies. It is particularly important for determining whether subsidies are the most effective way to achieve desired outcomes, such as social protection for the poor. Subsidy expenditures should be compared to spending on priority areas and planned increases in these outlays as a consequence of the enlarged fiscal space from subsidy reform. Governments should also disclose as much information as possible about how prices are formulated and the factors behind planned price increases. Both

Ghana and South Africa regularly publish such details for petroleum products on their government websites and in the national media.

(iii) Appropriately phased and sequenced price increases

32. Phasing-in price increases and sequencing them differently across energy products may be desirable. The appropriate phasing-in and sequencing of price increases will depend on a range of factors, including the magnitude of the price increases required to eliminate subsidies, the fiscal position, the political and social context in which reforms are being undertaken, and the time needed to develop an effective communications strategy and social safety nets. In the case studies, successful and partially successful subsidy reforms required, on average, about five years.

- ***Pace and timing of energy price increases.*** Too sharp an increase in energy prices can generate intense opposition to reforms, as happened with fuel subsidy reforms in Mauritania in 2008 and Nigeria in 2012. A phased approach to reforms permits both households and enterprises time to adjust, and permits the country time to build credibility by showing that subsidy savings are being put to good use. As noted earlier, it also helps reduce the impact of subsidy reform on inflation and creates room for governments to establish supporting social safety nets. The case studies show that 17 out of the 23 reform episodes that were successful or partially successful involved a phased reduction of subsidies. In Namibia, subsidies were removed steadily according to a three-year reform plan. In Brazil, the government pursued a step by step approach to reforming petroleum subsidies during the 1990s in order to minimize opposition from key interest groups. Despite initial sharp increases in prices, gradual adjustment of fuel prices was a key design feature of the reforms introduced in Iran, where the plan was to eliminate petroleum subsidies over a five-year period. A gradual approach was also adopted by Kenya (electricity), where the authorities were able to progressively gain support for broader reform by delivering improved services. The timing of energy price increases should also be considered carefully. For example, coordinating increases in electricity with the expansion of capacity could help win broad acceptance of tariff increases, as in Uganda. Tariff increases that coincide with price increases for other socially sensitive products, such as food and fuels, may meet strong resistance.

- ***Sequencing of reform.*** Price increases can also be sequenced differently across energy products. For example, petroleum price increases can initially be larger for products that are consumed more by higher-income groups and by industry, such as gasoline and jet kerosene. As the safety net is strengthened, subsequent rounds of reform can include larger increases in prices for fuel products that are more important in the budgets of poor households and part of the budgetary savings can be used to finance targeted transfers to poor households. For electricity, tariff increases can initially focus on large residential users and commercial users. Out of the 28 reform episodes, seven reforms sequenced price increases in this way. In Brazil, for instance, petroleum product reforms started by liberalizing prices for petroleum products used primarily by industry, followed by a more extensive liberalization of gasoline prices and finally diesel prices. Reforms in Peru initially focused on raising high-octane gasoline prices.

33. However, gradual reform can create additional reform challenges. First, a slower pace of reform reduces budgetary savings in the short term. There is thus a trade-off between the objectives of achieving budgetary savings and softening the impact of reforms on households. Second, sequencing of reforms can severely distort consumption patterns. For example, there is a limit to how low kerosene prices can be maintained without serious disruption of energy markets when other petroleum product prices are raised. These problems include the redirection of kerosene and LPG from households to the transport sector and cross-border smuggling. Turkey had to curtail LPG subsidies more rapidly than planned because of a sharp increase in LPG consumption due to the conversion of vehicles to LPG. Third, a gradual reform runs the risk that opposition may build up over time. To address this concern, gradual reforms must be accompanied by the government's long-term commitment to follow-through on planned price increases, possibly over several successive administrations. This challenge can be overcome by building up a broad support base for reforms. For example, Turkey started toward a more liberalized regime for energy pricing, including fuel and electricity, in the late 1980s and early 1990s, and continued implementing the plan under subsequent administrations. Effective planning and communication promoted broad consensus on the need for petroleum and electricity sector reforms in the Philippines and enabled the government to successfully implement its reform strategy gradually.

(iv) Improving the efficiency of SOEs to reduce producer subsidies

34. Improving the efficiency of SOEs can reduce the fiscal burden of the energy sector. Energy producers often receive substantial budgetary resources—both in terms of current and capital transfers—to compensate for inefficiencies in production and revenue collection. Improvements in efficiency can strengthen the financial position of these enterprises and reduce the need for such transfers.

35. Country experiences suggest the importance of strengthening SOE governance, improving demand management and revenue collection, and better exploitation of scale economies to improve enterprise efficiency:

- Governance of SOEs can be strengthened by improving the reporting of information on operations and costs. This can help identify system inefficiencies (e.g., overstaffing) and vulnerabilities (e.g., major loss points and bottlenecks in energy flows). Countries that have adopted information systems include Kenya, Uganda, and Zambia. Consistent with the Code of Good Practices on Fiscal Transparency, all extrabudgetary activity of the central government, including that undertaken by SOEs, should be reported in budget documents (see also IMF, 2012b). A second step is to set performance targets and incentives on the basis of this information. In Cape Verde, the electricity company is allowed to keep resources from over-performance on their targets, which can then be used for investment. Introducing competition, including from the private sector, can strengthen performance. This option will be more viable for countries with larger markets, where there is scope to "unbundle" activities in both the petroleum and electricity sectors. Notwithstanding these limitations, the private sector's role in the electricity sector is growing in many emerging and low-income countries. Many of these

countries have permitted competition among private generation companies and some of them have invited the private sector to manage electricity distribution, primarily to address operational inefficiencies.

- Improved demand management (by charging higher prices during peak periods) has proven effective in shifting demand to periods where marginal costs of provision are lower (Antmann, 2009). Utilities in sub-Saharan Africa have had programs to provide free compact fluorescent bulbs, which have helped reduce demand and costs in Cape Verde, Ethiopia, Malawi, Uganda, and Rwanda. Revenue-enhancing measures include improved collection and metering. These efforts can start with large customers and then gradually extend to medium and smaller ones.

- Efficiency can be improved by exploiting regional trade in electricity (Foster and Briceño-Garmendia, 2010). For instance, Mali and Burkina Faso have been able to expand domestic supply and household access through integration into the regional market.

(v) Targeted mitigating measures

36. Well-targeted measures to mitigate the impact of energy price increases on the poor are critical for building public support for subsidy reforms. The first step in this regard is to assess the capacity to expand existing (or implement new) social programs in the short term. Implementing or expanding targeted programs immediately prior to price reforms can help demonstrate the government's commitment to protecting the poor. Untargeted cash transfers to compensate the population following a subsidy reform could be limited to the amount consumed by the poorest. This can generate fiscal savings, since poor households typically consume substantially lower quantities of energy than the rich. Further fiscal savings would be generated by targeted cash transfers to compensate only lower income groups. In some oil-exporting countries, where subsidies are often seen as a form of wealth sharing, uniform per capita transfers can be both more efficient and more equitable than untargeted energy subsidies. However, wealth sharing may be better achieved through targeted and productive public spending aimed at building physical and human capital. The degree to which compensation should be targeted is a strategic decision that involves trade-offs between fiscal savings, capacity to target, and the need to achieve broad acceptance of the reform. Out of the 28 reform episodes, 18 relied on targeted mitigating measures, including expansion of public works, education, and health programs in poor areas.

37. Targeted cash transfers or near-cash transfers (vouchers) are the preferred approach to compensation. Cash transfers give beneficiaries the flexibility to purchase the level and type of energy that best suits their needs, and at a time and place of their choosing. They also remove the need for governments to be directly involved in the distribution of subsidized energy to households, which is often extremely costly and prone to abuse (Grosh and others, 2008). Targeted cash transfers were used to protect poor households in nine out of the 28 reform episodes. Indonesia's unconditional cash transfer program, which covered 35 percent of the population, was an important component of its successful strategy in overcoming social and political opposition to fuel subsidy reforms. Its experience also suggests that such programs need good preparation and monitoring in order to effectively assist the poor. Armenia successfully introduced a targeted cash transfer

program during its electricity reform and was able to gradually reduce the coverage of households from 25 percent in 1999 to 18 percent in 2010. The recent expansion of conditional cash transfer programs throughout emerging and low-income economies, with eligibility for benefits linked to household investments in the education and health status of family members, has greatly increased the capacity of these economies to protect poor households from price and other shocks while simultaneously addressing the root causes of persistent poverty (Fiszbein and Schady, 2009; Garcia and Moore, 2012).

38. When cash transfers are not feasible, other programs can be expanded while administrative capacity is developed. This should focus on existing programs that can be expanded quickly, possibly with some improvements in targeting effectiveness (for instance, school meals, public works, reductions in education and health user fees, subsidized mass urban transport, subsidies for consumption of water and electricity below a specified threshold). This approach was used in 15 of the reform episodes, sometimes in conjunction with targeted cash transfers.

- Gabon, Ghana, Niger, Nigeria, and Mozambique expanded targeted social spending programs to protect lower-income households from fuel price increases.
- In the context of electricity reforms, Armenia, Brazil, Kenya, and Uganda kept their lower electricity lifeline tariffs fixed and concentrated tariff increases on households with higher electricity consumption levels.
- The Philippines maintained electricity subsidies for indigent families, college scholarships for low-income students, and subsidized loans to convert engines used in public transportation to less costly LPG (World Bank, 2008).
- Kenya subsidized connection costs in place of electricity price subsidies, which helped expand coverage to poor households and those in remote and rural areas. The rural electrification program helped to increase the number of connections from 650,000 in 2003 to 2 million at present, with a fund for connection fee payments financed by donors.

39. Providing an affordable alternative energy source can mitigate the impact of subsidy reform on low-income groups. A key objective of subsidies in many countries is to provide an affordable source of energy to low-income households. Subsidy reform can therefore often be more acceptable if it is accompanied by complementary measures that support this objective. Such measures were included in five reform episodes. In Indonesia and Yemen, subsidy reform was facilitated by the government's efforts to help households convert from the use of kerosene for cooking to low-cost LPG.

40. Subsidy reform involving SOE restructuring requires temporary sector-specific social measures to support employees and enterprises. In the short term, SOE restructuring may involve laying-off part of the workforce or require increased investment in energy-saving technologies. Policies that mitigate the impact on workers and promote restructuring can increase support for subsidy reform. In the case of coal sector reform in Poland, unemployed miners had access to social

assistance and job training. In the context of fuel subsidy reform, the Iranian government undertook extensive consultation with enterprises to understand the challenges they faced if energy prices increased substantially. This led to a program targeted to agriculture and energy-intensive sectors hard hit by price increases, which included direct assistance and access to subsidized fuel. Such measures should be temporary, with a clearly specified lifespan and communicated to the public to demonstrate the government's commitment to reforms.

(vi) Depoliticize energy pricing

41. Successful and durable reforms require a depoliticized mechanism for setting energy prices. Many countries have successfully implemented reforms only to see subsidies reappear when international oil prices increase. Out of 28 reform episodes, 11 were classified as partially successful because subsidies later re-emerged. In Ghana, the 2005 reform eliminated fuel subsidies but when oil prices soared in 2007 and 2008, the government abandoned its policy of linking domestic to international prices and automatic adjustment was temporarily suspended. In Indonesia, in spite of increasing international prices, subsidy reform reduced fuel subsidies from 3½ percent of GDP in 2005 to 2 percent of GDP in 2006. However, unwillingness to fully pass-through continued increases in international prices resulted in fuel subsidies escalating again to 2.8 percent of GDP in 2008.

42. Automatic pricing mechanisms can help reduce the chances of reform reversal. Establishing an automatic pricing formula for fuel products can help distance the government from pricing of energy and make it clearer that domestic price changes reflect changes in international prices which are outside the control of the government. Reliance on a formula can reassure the public that price increases would not lead to windfall profits for suppliers. South Africa has successfully implemented an automatic pricing mechanism for fuel products for over five decades. Both the Philippines and Turkey successfully implemented such a mechanism during their transition to liberalized fuel pricing. In all three countries, detailed information on the mechanism and its implementation was disseminated to the public on government websites and through other media.

43. However, adoption of such a mechanism is not a panacea for achieving a sustained reform of energy subsidies. A number of countries have abandoned such mechanisms shortly after adopting them, partly due to an unwillingness to pass through sharp international price increase to consumers. Gabon suspended its mechanism in August 2002 as international oil prices started to increase. Ghana adopted an automatic mechanism in February 2001 but suspended it before the end of the year. It reintroduced the mechanism in January 2003, only to suspend it again in June 2003. More recently, newly adopted pricing mechanisms have been suspended in other sub-Saharan African countries, including the Gambia, Sierra Leone, and Togo. The sustainability of these mechanisms can be enhanced if they are packaged and communicated as part of broader structural reforms, including expansion of targeted social safety net and social spending programs. Using price smoothing rules can also help to avoid large price increases (see paragraph 45 below).

44. Responsibility for implementing the automatic mechanism can be given to an independent body. Technical decisions on pricing can be delegated to an independent institution to ensure that subsidy reform proceeds as planned. The institution can also have the responsibility

for implementing the automatic mechanism once subsidies are eliminated. A number of countries that successfully reformed subsidies for petroleum products (including South African and Turkey) and electricity (including Armenia, Kenya, the Philippines and Turkey) gave responsibility for reforming and regulating energy prices to an independent agency.

45. A smoothing rule can be incorporated into the automatic pricing mechanism to avoid sharp increases in domestic prices (Coady and others, 2012). Countries often abandon automatic pricing mechanisms when international prices increase sharply. In China, for example, a key barrier to the adoption of an automatic pricing mechanism has been concern about the political and social consequences of fully passing through such sharp price increases. Some countries (including Chile, Colombia, Malawi, Nigeria, Peru, Thailand, and Vietnam) have used smoothing rules to address this problem. Smoothing mechanisms can also help contain inflationary expectations if supported by appropriate macroeconomic policies. They can help dampen the effects of international price and exchange rate volatility. Several sub-Saharan countries, including the Gambia, Sierra Leone, and Togo, are considering the use of smoothing rules. With a smoothing mechanism, periods of sharp increases in international prices would only gradually be transmitted to domestic prices. For instance, energy prices changes could be limited to a maximum of, say, 5 percent of the current consumer price in any given month.

46. To protect the budget over the medium term, smoothing must be applied both to price increases (when subsidies increase or taxes fall) and to price decreases (when subsidies decrease or taxes increase). How much smoothing the government chooses to implement will depend on its preference between lower price and higher fiscal volatility. Peru adopted a smoothing rule in 2004 whereby international price changes were fully passed through to domestic prices as long as the latter fell within a fixed price band. When prices fell outside this price band, the cost (if above) or benefit (if below) was absorbed by the budget. Since 2010, the band price limits are updated to reflect trends in international prices, with adjustments limited to 5 percent. While stabilization funds have also been used to smooth price increases, experience with such funds has been mixed, with funds exhausting their reserves during periods of sharp increases in international prices or incurring large contingent liabilities for the budget (Chile, Namibia, Peru, the Philippines, and Thailand).

47. Over the longer term, subsidy reforms for petroleum products should aim to fully liberalize pricing. More liberalized regimes—where prices are determined by private sector suppliers and move freely with international prices—tend to be more robust to the reintroduction of subsidies than automatic pricing mechanisms (Baig and others, 2007). Under a liberalized regime, the role of the government is to ensure that fuel markets are competitive and there is free entry and exit from the sector. A well functioning social safety net should be in place before countries liberalize to ensure that low-income groups can be protected from future price increases and thus avoid public pressure to reintroduce subsidies. Successful implementation of an automatic pricing mechanism can facilitate the transition to a liberalized pricing regime by getting the public used to frequent changes in domestic energy prices. It can also build up the confidence of private suppliers that the government will not return to subsidized pricing. This approach was used in the Philippines,

which adopted an automatic pricing mechanism in 1996 as part of its transition to a liberalized supply and pricing regime in 1998.

48. In the electricity sector, the small size of the market in some countries limits the scope for competition and price liberalization. In many emerging and low-income economies, the electricity market is small. Under these circumstances, the market may not support many firms of a size sufficient to reap economies of scale and produce at the lowest possible cost. In such cases, price regulation will be needed, and competition alone will not be the best approach to reforming the sector (Besant-Jones, 2006). Prices should be determined by an autonomous agency and set at a level that is sufficient to avoid subsidies and ensure an adequate return to investment under efficient operations. Enhancing the progressivity of tariff structures by imposing higher tariff rates for larger consumers can also reduce subsidy expenditures while protecting the poor. For instance, there is scope to make tariff structures more progressive in many African countries. Greater emphasis could also be given to subsidizing connections, rather than consumption of electricity.

References

Antmann, Pedro, 2009, "Reducing Technical and Non-Technical Losses in the Power Sector," Background Paper for the World Bank Group Energy Sector Strategy (Washington: World Bank).

Arze del Granado, Javier, David Coady, and Robert Gillingham, 2012, "The Unequal Benefits of Fuel Subsidies: A Review of Evidence for Developing Countries," *World Development*, Vol. 40 (November) pp. 2234–48.

Baig, Taimur, Amine Mati, David Coady, and Joseph Ntamatungiro, 2007, "Domestic Petroleum Product Prices and Subsidies: Recent Developments and Reform Strategies," IMF Working Paper No. 07/71 (Washington: International Monetary Fund). Available via the Internet: http://www.imf.org/external/pubs/ft/wp/2007/wp0771.pdf.

Besant-Jones, John E., 2006, "Reforming Power Markets in Developing Countries: What Have We Learned?" Energy and Mining Sector Board Discussion Paper No. 19 (Washington: World Bank).

Breisinger Clemens, Wilfried Engelke, and Oliver Ecker, 2011, "Petroleum Subsidies in Yemen: Leveraging Reform for Development," Policy Research Working Paper No. 5577 (Washington: World Bank).

Burniaux, Jean-Marc, Jean Chateau, Romain Duval, and Stéphanie Jamet, 2009, "The Economics of Climate Change Mitigation: How to Build the Necessary Global Action in a Cost-Effective Manner," OECD Economics Department Working Papers No. 701 (Paris: Organisation for Economic Co-operation and Development).

Calderón, César, 2008, "Infrastructure and Growth in Africa," Policy Research Working Paper No. 4914 (Washington: World Bank).

Clements, Benedict, Sanjeev Gupta, and Masahiro Nozaki, 2012, "What Happens to Social Spending in IMF-Supported Programs?" *Applied Economics*, Vol. 45, No. 28, pp. 4022–33.

Clements, Benedict, Hong-Sang Jung, and Sanjeev Gupta, 2007, "Real and Distributive Effects of Petroleum Price Liberalization: The Case of Indonesia," *The Developing Economies*, Vol. 45, No. 2, pp. 220–37.

Coady, David, Javier Arze del Granado, Luc Eyraud, Hui Jin, Vimal Thakoor, Anita Tuladhar, and Lilla Nemeth, 2012, "Automatic Fuel Pricing Mechanisms with Price Smoothing: Design, Implementation, and Fiscal Implications," Technical Notes and Manuals No. 12/03 (Washington: International Monetary Fund). Available via the Internet: http://www.imf.org/external/pubs/ft/tnm/2012/tnm1203.pdf.

Coady, David, Moataz El-Said, Robert Gillingham, Kangni Kpodar, Paulo Medas, and David Newhouse, 2006, "The Magnitude and Distribution of Fuel Subsidies: Evidence from Bolivia, Ghana, Jordan, Mali, and Sri Lanka," IMF Working Paper No. 06/247 (Washington: International Monetary Fund). Available via the Internet: http://www.imf.org/external/pubs/ft/wp/2006/wp06247.pdf.

Coady, David, Robert Gillingham, Rolando Ossowski, John Piotrowski, Shamsuddin Tareq, and Justin Tyson, 2010, "Petroleum Product Subsidies: Costly, Inequitable, and Rising," IMF Staff Position Note No. 10/05 (Washington: International Monetary Fund). Available via the Internet: http://www.imf.org/external/pubs/ft/spn/2010/spn1005.pdf.

Dahl, Carol A., 2012, "Measuring Global Gasoline and Diesel Price and Income Elasticities," *Energy Policy*, Vol. 41, pp. 2–12.

Dick, Herman, Sanjeev Gupta, David Vincent, and Herbert Voight, 1984, "The Impact of Oil Price Increases on Four Oil-Poor Developing Countries: A Comparative Analysis," *Energy Economics*, Vol. 6 (January), pp. 59–70.

Dudine, Paolo, James John, Mark Lewis, Luzmaria Monasi, Helaway Tadesse, and Jörg Zeuner, 2006, "Weathering the Storm So Far: The Impact of the 2003–05 Oil Shock on Low-Income Countries," IMF Working Paper No. 06/171 (Washington: International Monetary Fund). Available via the Internet: http://www.imf.org/external/pubs/ft/wp/2006/wp06171.pdf.

Ebert, Sebastian, Gerhard P. Metschies, Dominik Schmid, Armin Wagner, 2009, *International Fuel Prices 2009* (Eschborn: Deutsche Gesellschaft für Technische Zusammenarbeit, 6th ed.).

Energy Information Administration (EIA), 2012, "Coal Consumption by Sector," U.S. Department of Energy. Available via the Internet: http://www.eia.gov/coal/data.cfm#consumption.

Ellis, Jennifer, 2010, "The Effects of Fossil-Fuel Subsidy Reform: A Review of Modelling and Empirical Studies" Untold Billions: Fossil-Fuel Subsidies, Their Impacts and the Path to Reform, (Geneva: Global Subsidies Initiative).

Environmental Protection Agency (EPA), 2012, "Quarterly Emissions Tracking," U.S. Environmental Protection Agency. Available via the Internet: http://www.epa.gov/airmarkt/quarterlytracking.html.

Escribano, Alvaro, J. Luis Guasch, and Jorge Pena, 2008, "A Robust Assessment of the Impact of Infrastructure on African Firms' Productivity," Africa Infrastructure Country, Diagnostic Working Paper (Washington: World Bank).

European Commission, Economic and Financial Affairs, 2007, "2007 Report on Public Finances in EMU," *European Economy*, Vol. 3 (Brussels).

Fernandez, Raquel, and Dani Rodrik, 1991, "Resistance to Reform: Status Quo Bias in the Presence of Individual-Specific Uncertainty," *The American Economic Review*, Vol. 81 (December), pp. 1146–55.

Fiszbein, Ariel, and Norbert Schady, 2009, *Conditional Cash Transfers: Reducing Present and Future Poverty*, Policy Research Report (Washington: World Bank).

Fofana, Ismaél, Margaret Chitiga, and Ramos Mabugu, 2009, "Oil Prices and the South African Economy: A Macro-Meso-Micro Analysis," *Energy Policy*, Vol. 37 (December), pp. 5509–18.

Foster, Vivien, and Jevgenijs Steinbuks, 2008, "Paying the Price for Unreliable Power Supplies: In-House Generation of Electricity by Firms in Africa," Policy Research Working Paper No. 4913, (Washington: World Bank).

Garcia, Morito, and Charity M.T. Moore, 2012, *The Cash Dividend: The Rise of Cash Transfers in Sub-Saharan Africa*, (Washington: World Bank).

Gelb, Alan, and others, 1988, *Oil Windfalls: Blessings or Curse?* (New York: Oxford University Press).

Global Subsidies Initiative, 2010, "Strategies for Reforming Fossil-Fuel Subsidies: Practical Lessons from Ghana, France and Senegal," The Untold Billions: Fossil-Fuel Subsidies, Their Impacts and the Path to Reform (Winnipeg: International Institute for Sustainable Development).

Graham, Carol, 1998, *Private Markets for Public Goods: Raising the Stakes in Economic Reform*, (Washington: World Bank).

Grosh, Margaret, Carlo del Ninno, Emil Tesliuc, and Azedine Ouerghi, 2008, *For Promotion and Protection: The Design and Implementation of Effective Safety Nets,* (Washington: World Bank).

Gupta, Sanjeev, 1983, "India and the Second OPEC Oil Shock—An Economy-Wide Analysis," *Review of World Economics*, Vol. 119 (March), No. 1, pp. 122–37.

———, Benedict Clements, Kevin Fletcher, and Isabel Inchauste, 2004, "Issues in Domestic Petroleum Pricing in Oil-Producing Countries," in *Fiscal Policy Formulation and Implementation in Oil-Producing Countries,* ed. by J. Davis, R. Ossowski, and A. Fedelino (Washington: International Monetary Fund).

Gupta, Sanjeev, Marijn Verhoeven, Robert Gillingham, Christian Schiller, Ali Mansoor, and Juan Pablo Cordoba, 2000, *Equity and Efficiency in the Reform of Price Subsidies: A Guide for Policymakers* (Washington: International Monetary Fund).

Heggie, Ian G., and Piers Vickers, 1998, "Commercial Management and Financing of Roads," World Bank Technical Paper No. 409 (Washington: World Bank). Available via the Internet: http://documents.worldbank.org/curated/en/1998/05/441617/commercial-management-financing-roads.

International Finance Corporation, 2012*, From Gap to Opportunity: Business Models for Scaling Up Energy Access* (Washington).

International Energy Agency (IEA), 2011a, "Development in Energy Subsidies," Chapter 14 of the 2011 *World Energy Outlook* (Paris).

———, 2011b, "Fossil-Fuel Subsidies—Methodology and Assumptions," *World Energy Outlook*. Available via the Internet: http://www.iea.org/publications/worldenergyoutlook/resources/energysubsidies/methodologyforcalculatingsubsidies.

———, 2011c, *World Energy Outlook,* (Paris).

———, Organization of the Petroleum Exporting Countries (OPEC), Organisation for Economic Co-operation and Development (OECD), and World Bank, 2010, "Analysis of the Scope of Energy Subsidies and Suggestions for the G-20 Initiative," Joint report by IEA, OPEC, OECD, World Bank (Paris). Available via the Internet: www.oecd.org/env/45575666.pdf.

Institute for Fiscal Studies (IFS), 2012, "Tax and Benefit Tables" (London). Available via the Internet: www.ifs.org.uk/fiscalFacts/taxTables.

International Monetary Fund, 2008a, "Fuel and Food Price Subsidies—Issues and Reform Options" (Washington). Available via the Internet: www.imf.org/external/np/pp/eng/2008/090808a.pdf.

———, 2008b, "Food and Fuel Prices—Recent Developments, Macroeconomic Impact, and Policy Responses" (Washington). Available via the Internet: www.imf.org/external/np/pp/eng/2008/063008.pdf.

———, 2011, *Regional Economic Outlook: Middle East and Central Asia*, World Economic and Financial Surveys (Washington).

———, 2012a, "Managing Global Growth Risks and Commodity Price Shocks: Vulnerabilities and Policy Challenges for Low-Income Countries" (Washington). Available via the Internet: www.imf.org/external/np/pp/eng/2011/092111.pdf.

_____, 2012b, "Fiscal Transparency, Accountability, and Risk, "IMF Policy Paper (Washington). Available via the Internet: https://www.imf.org/external/np/pp/eng/2012/080712.pdf.

_____, 2012c, *Regional Economic Outlook: Sub-Saharan Africa: Sustaining Growth amid Global Uncertainty*, World Economic and Financial Surveys (Washington).

———, forthcoming, "Getting Fuel Prices Right" (Washington).

Koplow, Doug, 2009, Measuring Energy Subsidies Using the Price-Gap Approach: What Does It Leave Out?" IISD Trade, Investment and Climate Change Series (Winnipeg: International Institute for Sustainable Development). Available via the Internet: http://www.iisd.org/publications/pub.aspx?pno=1165.

Kerkelä, Leena, 2004, "Distortion Costs and Effects of Price Liberalisation in Russian Energy Markets: A CGE Analysis," BOFIT Discussion Paper No. 2/2004 (Helsinki: The Bank of Finland Institute for Economies in Transition).

Kojima, Masami, William Matthews, and Fred Sexsmith, 2010, "Petroleum Markets in Sub-Saharan Africa: Analysis and Assessment of 12 Countries," Extractive Industries for Development Series No. 15 (Washington: World Bank).

Kumar, Manmohan S., and Jaejoon Woo, 2010, "Public Debt and Growth," IMF Working Paper No. 10/174 (Washington: International Monetary Fund). Available via the Internet: http://www.imf.org/external/pubs/ft/wp/2010/wp10174.pdf.

Laan, Tara, Christopher Beaton, and Bertille Presta, "Strategies for Reforming Fossil-Fuel Subsidies: Practical Lessons from Ghana, France and Senegal," The Untold Billions: Fossil-Fuel Subsidies, Their Impacts and the Path to Reform (Geneva: Global Subsidies Initiative).

Lofgren, Hans, 1995, "Macro and Micro Effects of Subsidy Cuts: A Short Run CGE Analysis for Egypt," TMD Discussion Paper No. 5 (Washington: International Food Policy Research Institute).

McGuire, Martin C., and Mangur Olson, Jr., 1996, "The Economics of Autocracy and Majority Rule: The Invisible Hand and the Use of Force," *Journal of Economic Literature*, Vol. 34 (March), pp. 72–96.

National Research Council (NRC), 2009, "Hidden Costs of Energy: Unpriced Consequences of Energy Production and Use," Committee on Health, Environmental, Other External Costs and Benefits of Energy Production and Consumption, (Washington: The National Academies Press).

Nordhaus, William, 2011, "Estimates of the Social Cost of Carbon: Background and Results from the RICE-2011 Model," NBER Working Paper No. 17540 (Cambridge: National Bureau of Economic Research).

Organisation for Economic Co-operation and Development, 2009, "The Economics of Climate Change Mitigation Policies and Options for Global Action beyond 2012," (Paris).

———, 2012a, "Inventory of Estimated Budgetary Support and Tax Expenditures for Fossil Fuels" (Paris).

———, 2012b, "Mortality Risk Valuation in Environment, Health and Transport Policies" (Paris).

Parry, Ian W.H., 2011, "How Much Should Highway Fuels Be Taxed?" In, *U.S. Energy Tax Policy*, ed. by Gilbert E. Metcalf, (Cambridge: Cambridge University Press).

———, and Kenneth A. Small, 2005, "Does Britain or the United States Have the Right Gasoline Tax?" *American Economic Review*, Vol. 95, No. 4, pp. 1276–89.

Parry, Ian W. H., and Jon Strand, 2011, "International Fuel Tax Assessment: An Application to Chile," IMF Working Paper No. 11/168 (Washington: International Monetary Fund). Available via the Internet: http://www.imf.org/external/pubs/ft/wp/2011/wp11168.pdf.

Rogoff, Kenneth, and Carmen Reinhardt, 2010, "Growth in a Time of Debt," *American Economic Review*, Vol. 100, No. 2, pp. 573–8.

Stern, Nicholas, 2006, *Stern Review on the Economics of Climate Change* (London: Her Majesty's Treasury).

Sterner, Thomas, 2012, ed., 2012, *Fuel Taxes and the Poor: The Distributional Effects of Gasoline Taxation and Their Implications for Climate Policy* (Washington: RFF Press).

———, and the International Energy Agency (IEA), 2002, "Reforming Energy Subsidies: An Explanatory Summary of the Issues and Challenges in Removing or Modifying Subsidies on Energy that Undermine the Pursuit of Sustainable Development" (Paris).

United Nations Environment Programme (UNEP), 2008, "Reforming Energy Subsidies: Opportunities to Contribute to the Climate Change Agenda," Division of Technology, Industry and Economics (Paris).

United States Agency for International Development (USAID), 2004, "A Practical Guide to Energy Subsidy Reform," Contract No. LAG-I-00-0005-00, Task Order 06 (Washington).

U.S. Interagency Working Group on Social Cost of Carbon, 2010, "Technical Support Document: Social Cost of Carbon for Regulatory Impact Analysis under Executive Order 12866" (Washington).

Vagliasindi, M., 2012, *Implementing Energy Subsidy Reforms: Evidence from Developing Countries*, Directions in Development—Energy and Mining (Washington: World Bank).

von Moltke, Anja, Colin McKee, and Trevor Morgan, 2004, *Energy Subsidies: Lessons Learned in Assessing Their Impact and Designing Policy Reforms* (Sheffield: Greenleaf Publishing).

World Bank, 2008, "Philippines Quarterly Update—November 2008" (Manila). Available via the Internet: http://siteresources.worldbank.org/INTPHILIPPINES/Resources/PHL2Q2008quarterlyreportasofNov14.pdf.

———, 2010, "Subsidies in the Energy Sector: An Overview," Background Paper for the World Bank Group Energy Sector Strategy (Washington).

Appendix I. Estimating Pre-tax and Post-tax Global Energy Subsidies

This appendix describes the data sources and methodologies used for the estimation of subsidies for petroleum products, coal, natural gas, and electricity.

A. Pre-tax Subsidies

Petroleum products

Pre-tax consumer subsidies for gasoline, diesel, and kerosene are estimated as the difference between international prices adjusted for transport margins and domestic consumer prices for 176 countries between 2000 and 2011.[18] International prices are taken as the monthly average of spot prices from IEA. For importers, margins are calculated as $0.10 per liter to cover international transport costs and another $0.10 per liter to cover domestic distribution and retailing costs. For net oil exporters, no adjustment is made as the two costs are assumed to cancel out each other. Domestic consumer prices for petroleum products (for both firms and households) are taken from publicly available sources for Organization of Economic Cooperation and Development (OECD) countries. For other countries, domestic prices were provided by country authorities to IMF staff, supplemented by survey data from the Deutsche Gesellschaft für Internationale Zusammenarbeit (Ebert and others, 2009). For gasoline, the price is for regular unleaded or other grades, based on availability. Where consumer prices were unavailable, they were imputed based on observed pass through behavior. This was done for approximately 54 countries in 2009 and one country (Venezuela) in 2011. End-of-year prices are used to estimate subsidies except for 30 countries, mostly in the MENA region, where quarterly price data are available.

Fuel product consumption levels used to calculate total subsidies are based on OECD and International Energy Agency (IEA) data, and include consumption by both households and enterprises.

Coal and natural gas

Consumer subsidy estimates are based on IEA data for coal in 39 countries and for natural gas in 37 countries between 2007 and 2011. IMF staff estimates on natural gas subsidies are available for additional four countries in the MENA region. In addition, producer coal subsidies for 16 countries between 2007 and 2011 are based on OECD data. This calculation measures subsidies as the difference between the reference price and the domestic price paid by households and firms. The IEA reference prices for natural gas and coal, both traded goods, are defined differently for net importers and net exporters. For net importers, the reference price was defined as the price at the nearest international market, adjusted for quality differences, the cost of freight and insurance, distribution and marketing costs, and any value added tax (VAT). The price does not include excise

[18]Subsidies for oil-based heating fuels and non-road transportation vehicles, which are substantial in some countries, are not included due to data limitations.

duties. For net exporters, the reference price was calculated as the price at the nearest international market, adjusted for quality differences, less the costs of freight and insurance, plus distribution, marketing, and VAT. It should be noted that the quantities of coal and natural gas used in this calculation do not include the amount used for electricity and heat generation. To estimate pre-tax subsidies, the VAT is subtracted from the IEA estimates, using the standard VAT rate in the country. Producer subsidies for coal are based on OECD producer support estimates that capture the amount of tax subsidies (such as special income tax treatment) or budgetary expenditures designed to support producer incomes (OECD, 2012a).

Electricity

Given the varying availability of data, a number of different approaches are taken to measure subsidies. For 40 countries from Africa and Middle East, and a few selected emerging economies of Europe, estimates of combined producer and consumer subsidies are compiled from various World Bank reports and IMF staff estimates; thus, they are not necessarily comparable. For these countries, subsidy estimates are based on average domestic prices and cost-recovery prices that cover production costs, investment cost, distributional loss and the non-payment of electricity bills. An upward adjustment is also made for the input subsidies that electricity producers may receive through their use of subsidized fossil fuel products. For 31 of these 40 countries, the latest year for which data are available is 2009.

For 37 countries, estimates of consumer price subsidies between 2007 and 2011 are taken from the International Energy Agency, based on the difference between costs (adjusted for any subsidy on fossil fuel inputs) and average domestic prices (IEA, 2011b). As these prices do not include investment cost, non-payment of electricity and distributional losses, the estimates may understate subsidies. In total, the sample covers 77 countries.

B. Post-tax Subsidies

Post-tax subsidies are estimated as pre-tax subsidies plus:

- *a corrective (or "Pigouvian") tax*, reflecting an (excise) tax on energy products to charge for externalities associated with CO_2 emissions, local pollution, and (in the case of gasoline and motor diesel) other externalities such as traffic congestion and accidents.

- a revenue component, reflecting an (ad valorem) tax on energy products that would be consistent with taxation of any other consumer good at the standard value-added tax (VAT) or general sales tax (GST) rate.

Corrective taxes

This section discusses the estimation of taxes needed to correct for externalities from petroleum products, coal, and natural gas. To avoid double counting we do not measure externalities from electricity generation and, due to the lack of available evidence, we do not measure externalities for

other generation fuels.[19] Environmental and transportation-related externalities have been quantified for the United States and just a few other countries.[20]

Petroleum products

Combustion of petroleum products (gasoline, diesel and kerosene) contributes to global warming through CO_2 emissions and local pollution. In addition, externalities associated with motor vehicle use—which we apportion to gasoline and diesel fuels—include traffic congestion and accidents, and (primarily in the case of trucks) road damage. Appendix Table 1 summarizes some estimates of motor fuel taxes to correct for these externalities that have been conducted for the United States, the United Kingdom, and Chile. The corrective tax estimate for Chile is higher, reflecting a combination of elevated local emission rates and a high incidence of pedestrian deaths and traffic congestion.

Appendix Table 1. Corrective Motor Fuel Taxes, Selected Countries
(Cents per liter, 2011 dollars)

	Gasoline (cars)			Diesel (trucks)	
	United States	United Kingdom	Chile	United States	Chile
Total	36	42	71	37	62
Contribution of:					
local pollution	3	4	18	10	16
carbon	6	5	6	6	6
congestion	15	26	19	10	16
accidents	12	8	28	3	12
noise	0	0	0	2	1
road damage	0	0	0	6	12

Sources: IFS (2012), Parry (2011), Parry and Strand (2012), and Parry and Small (2005).

Notes: The above studies estimate corrective diesel fuel taxes for the United States and Chile, but not for the United Kingdom.

[19]For example, for nuclear power it is extremely difficult to quantify the risks from radioactive waste and meltdowns.

[20]More detailed work for other countries is underway in the Fiscal Affairs Department to provide more precise estimates (IMF, forthcoming).

For CO_2 emissions, we assume an illustrative value for global warming damages of $25 per ton (in 2010 dollars) of CO_2 emissions, following the US IAWG (2010). The estimates in the literature have varied considerably, ranging from $12 per ton (Nordhaus, 2011) to $85 per ton (Stern, 2006). The $25 per ton of CO_2 emission translates into $0.05–$0.06 per liter of gasoline or diesel as shown Appendix Table 1. The same value ($25 per ton of CO_2 emissions) is used in the calculation of global warming damages from the consumption of coal and natural gas.

A careful assessment of the non-carbon corrective fuel taxes for other countries would take into account a variety of local factors that affect the willingness-to-pay for reductions in these negative externalities, including, most importantly, income, local emission rates, population density, travel delays, and the frequency of traffic accidents. Data on these factors across other countries are not readily available, except for income per capita. We make adjustments to the estimates of willingness to pay by comparing a given country's income (say Colombia) in purchasing parity terms with the United States, the United Kingdom, and Chile.[21] An income elasticity of 0.8 is assumed between the willingness to pay for reductions in externalities and per-capita income, following the OECD (OECD, 2012b). We then apply this correction to the estimates of externalities per liter described in Appendix Table 1 for the United States, the United Kingdom, and Chile. We then take the average across the three countries to arrive at our estimate for Colombia.

Coal

To estimate the corrective tax per ton of coal for global warming damages, we first derive CO_2 emissions per ton of coal, based on IEA data on coal consumption and CO_2 emissions from coal by country. The corrective tax per ton of coal is then calculated by multiplying CO_2 emission per ton of coal consumption with the global warming damages of $25 per ton of CO_2 emission.

Beyond its CO_2 emissions, the other major externality associated with coal combustion is local air pollution (most importantly fine particulates formed from SO_2 emissions). A state-of-the-art modeling exercise for the United States by a committee of experts (NRC, 2010) put the local pollution damages from the average coal plant in 2005 at about $65 (in 2010 dollars) per (short) ton. Local pollution damages are adjusted the same way as for petroleum products when extrapolating to other countries. This approach assumes that scrubber use and coal content in other countries are similar to that of the United States. We do not adjust for differences in the pollution content of coal, or for use of flue-gas de-sulfurization technologies (scrubbers) in other countries compared with the United States.

[21]Post-tax subsidies as a share of GDP for low-income countries would increase from 3.3 percent of GDP to 5.3 percent without this adjustment for non-carbon externalities of petroleum products and coal.

Natural gas

Natural gas is far less emissions-intensive than coal—it produces about half the carbon emissions per unit of energy, and only very minimal SO_2 emissions. Here only a carbon damage is applied to natural gas. Similar to coal, the corrective tax per thousand cubic feet of natural gas is calculated based on IEA data on natural gas consumption, CO_2 emissions from natural gas by country, and the global warming damages of $25 per ton of CO_2 emissions.

Revenue component

Here a scenario where energy products would be taxed just like other goods is considered. In principle, individual products should be taxed more heavily, or less heavily, than the average consumer good (on revenue-raising grounds), depending on whether taxing them causes a significant shift towards untaxed goods (i.e., leisure and products that are exempt from VAT). However, there is little empirical support on which to make these types of adjustments, and hence they are not pursued here. The estimates are based on VAT rates for 150 countries in 2011. For countries where VAT rates are not available or do not apply, the average VAT rate of countries with a similar level of income in the region is assumed.

Calculating subsidies with corrective tax and revenue components

To quantify the magnitude of subsidies, the subsidy-free post-tax prices are derived by applying the VAT/GST rates to both pre-tax international prices/cost recovery prices and excise tax for externalities. The subsidy-free post-tax prices are then compared with domestic prices and combined with consumption levels to compute subsidies. In the case of electricity, VAT/GST is only estimated for countries with pre-tax subsidies. This approach is followed because both domestic prices and cost recovery prices are unknown for other countries. In the case of coal and natural gas, it is assumed that domestic prices in countries without pre-tax subsidies are the same as international reference prices.

One complication is that revenue from VAT would only be effectively assessed on energy products as final consumption goods, not those as intermediate inputs for other consumption goods. To separate intermediate inputs from final consumption goods, we use IEA energy consumption data by industry type. It is assumed that energy products for residential use, commercial and public services, and gasoline for road use are final consumption goods. This approximation indicates that, on average, 99 percent of gasoline consumption, 7 percent of diesel consumption, 39 percent of kerosene consumption, 12 percent of coal consumption, 46 percent of natural gas consumption, and 51 percent of electricity consumption can be categorized as final consumption.

Appendix Table 2. Pre-tax Subsidies for Petroleum Products, Electricity, Natural Gas, and Coal, 2011[22]

(Percent of GDP by region)

Country	Petroleum products	Electricity	Natural gas	Coal
Advanced				
Australia	0.00	n.a.	n.a.	0.00
Austria	0.00	n.a.	n.a.	n.a.
Belgium	0.00	n.a.	n.a.	n.a.
Canada	0.00	n.a.	n.a.	0.00
Cyprus	0.00	n.a.	n.a.	n.a.
Czech Republic	0.00	n.a.	n.a.	0.00
Denmark	0.00	n.a.	n.a.	n.a.
Estonia	0.00	n.a.	n.a.	n.a.
Finland	0.00	n.a.	n.a.	n.a.
France	0.00	n.a.	n.a.	n.a.
Germany	0.00	n.a.	n.a.	0.07
Greece	0.00	n.a.	n.a.	n.a.
Hong Kong SAR	0.00	n.a.	n.a.	n.a.
Iceland	0.00	n.a.	n.a.	n.a.
Ireland	0.00	n.a.	n.a.	0.05
Israel	0.00	n.a.	n.a.	n.a.
Italy	0.00	n.a.	n.a.	n.a.
Japan	0.00	n.a.	n.a.	n.a.
Korea	0.00	n.a.	0.00	0.02
Luxembourg	0.00	n.a.	n.a.	n.a.
Malta	0.00	n.a.	n.a.	n.a.
Netherlands	0.00	n.a.	n.a.	n.a.
New Zealand	0.09	n.a.	n.a.	n.a.
Norway	0.00	n.a.	n.a.	n.a.
Portugal	0.00	n.a.	n.a.	n.a.
Singapore	0.00	n.a.	n.a.	n.a.
Slovak Republic	0.00	n.a.	n.a.	0.01
Slovenia	0.00	n.a.	n.a.	0.02
Spain	0.00	n.a.	n.a.	0.03
Sweden	0.00	n.a.	n.a.	n.a.
Switzerland	0.00	n.a.	n.a.	n.a.
Taiwan Province of China	n.a.	0.22	0.00	0.03
United Kingdom	0.00	n.a.	n.a.	n.a.
United States	0.05	n.a.	n.a.	0.00

[22]These subsidy estimates may differ from those in the country budget documents due to the methodologies described in this appendix.

Appendix Table 2. Pre-tax Subsidies for Petroleum Products, Electricity, Natural Gas, and Coal, 2011 (Continued)

(Percent of GDP by region)

Country	Petroleum products	Electricity	Natural gas	Coal
CEE-CIS				
Albania	0.00	n.a.	n.a.	n.a.
Armenia	0.45	0.05	n.a.	n.a.
Azerbaijan	0.84	0.73	1.16	0.00
Belarus	0.00	0.26	n.a.	n.a.
Bosnia and Herzegovina	0.00	n.a.	n.a.	n.a.
Bulgaria	0.00	n.a.	n.a.	n.a.
Croatia	0.00	n.a.	n.a.	n.a.
Georgia	0.55	n.a.	n.a.	n.a.
Hungary	0.00	n.a.	n.a.	0.00
Kazakhstan	0.65	0.94	0.15	0.28
Kosovo	0.00	n.a.	n.a.	n.a.
Kyrgyz Republic	3.47	5.43	n.a.	n.a.
Latvia	0.00	n.a.	n.a.	n.a.
Lithuania	0.00	n.a.	n.a.	n.a.
Macedonia, FYR	0.00	n.a.	n.a.	n.a.
Moldova	0.00	n.a.	n.a.	n.a.
Mongolia	0.00	n.a.	n.a.	n.a.
Montenegro, Rep. of	0.00	n.a.	n.a.	n.a.
Poland	0.00	n.a.	n.a.	0.14
Romania	0.00	n.a.	n.a.	n.a.
Russia	0.00	0.99	1.09	0.00
Serbia	0.00	n.a.	n.a.	n.a.
Tajikistan	0.00	1.95	n.a.	n.a.
Turkey	0.00	n.a.	n.a.	0.02
Turkmenistan	6.00	2.32	14.80	n.a.
Ukraine	0.00	1.61	3.59	n.a.
Uzbekistan	0.02	5.71	18.88	n.a.
Emerging and Developing Asia				
Afghanistan	0.00	0.11	n.a.	n.a.
Bangladesh	0.90	2.63	1.60	0.00
Bhutan	0.51	n.a.	n.a.	n.a.
Brunei Darussalam	2.34	0.98	0.00	0.00
Cambodia	0.00	n.a.	n.a.	n.a.
China	0.00	0.15	n.a.	n.a.
Fiji	0.01	n.a.	n.a.	n.a.
India	1.25	0.32	0.17	0.00
Indonesia	2.58	0.66	0.00	0.00
Kiribati	n.a.	n.a.	n.a.	n.a.
Lao P.D.R.	0.00	n.a.	n.a.	n.a.
Malaysia	1.24	0.33	0.31	0.00
Maldives	0.19	n.a.	n.a.	n.a.
Myanmar	0.54	n.a.	n.a.	n.a.
Nepal	0.00	n.a.	n.a.	n.a.
Pakistan	0.13	1.31	2.54	0.00
Papua New Guinea	n.a.	n.a.	n.a.	n.a.
Philippines	0.00	0.00	0.00	0.00
Samoa	n.a.	n.a.	n.a.	n.a.
Solomon Islands	0.00	n.a.	n.a.	n.a.
Sri Lanka	1.16	0.47	0.00	0.00
Thailand	0.15	1.64	0.14	0.25
Timor-Leste	0.00	n.a.	n.a.	n.a.
Tonga	0.00	n.a.	n.a.	n.a.
Tuvalu	0.00	n.a.	n.a.	n.a.
Vanuatu	0.00	n.a.	n.a.	n.a.

Appendix Table 2. Pre-tax Subsidies for Petroleum Products, Electricity, Natural Gas, and Coal, 2011 (Continued)
(Percent of GDP by region)

Country	Petroleum products	Electricity	Natural gas	Coal
LAC				
Antigua and Barbuda	0.49	n.a.	n.a.	n.a.
Argentina	0.00	1.03	0.77	0.00
Bahamas, The	0.00	n.a.	n.a.	n.a.
Barbados	0.04	n.a.	n.a.	n.a.
Belize	0.00	n.a.	n.a.	n.a.
Bolivia	2.40	n.a.	n.a.	n.a.
Brazil	0.00	n.a.	n.a.	n.a.
Chile	0.00	0.00	0.00	0.00
Colombia	0.00	0.00	0.00	0.00
Costa Rica	0.00	n.a.	n.a.	n.a.
Dominica	0.00	n.a.	n.a.	n.a.
Dominican Republic	0.00	n.a.	n.a.	n.a.
Ecuador	6.31	0.18	0.00	0.00
El Salvador	0.00	0.00	0.00	0.00
Grenada	0.00	n.a.	n.a.	n.a.
Guatemala	0.00	n.a.	n.a.	n.a.
Guyana	0.00	n.a.	n.a.	n.a.
Haiti	n.a.	n.a.	n.a.	n.a.
Honduras	0.02	n.a.	n.a.	n.a.
Jamaica	0.00	n.a.	n.a.	n.a.
Mexico	0.00	0.00	0.00	0.00
Nicaragua	0.00	n.a.	n.a.	n.a.
Panama	0.02	n.a.	n.a.	n.a.
Paraguay	0.00	n.a.	n.a.	n.a.
Peru	0.00	0.00	0.00	0.00
St. Kitts and Nevis	0.20	n.a.	n.a.	n.a.
St. Lucia	0.19	n.a.	n.a.	n.a.
St. Vincent and the Grenadines	0.00	n.a.	n.a.	n.a.
Suriname	0.00	n.a.	n.a.	n.a.
Trinidad and Tobago	2.75	n.a.	n.a.	n.a.
Uruguay	0.00	n.a.	n.a.	n.a.
Venezuela	5.58	1.02	0.59	n.a.

Appendix Table 2. Pre-tax Subsidies for Petroleum Products, Electricity, Natural Gas, and Coal, 2011 (Continued)

(Percent of GDP by region)

Country	Petroleum products	Electricity	Natural gas	Coal
MENA				
Algeria	4.30	1.08	5.36	0.00
Bahrain	5.37	2.57	n.a.	n.a.
Djibouti	0.00	0.45	n.a.	n.a.
Egypt	6.74	2.30	1.60	0.00
Iran	4.20	3.61	4.83	0.00
Iraq	9.92	1.39	0.25	0.00
Jordan	2.15	3.81	n.a.	n.a.
Kuwait	3.09	2.91	1.29	0.00
Lebanon	0.07	4.46	n.a.	n.a.
Libya	6.40	1.85	0.59	0.00
Mauritania	0.00	0.85	0.80	n.a.
Morocco	0.66	n.a.	n.a.	n.a.
Oman	3.01	0.76	2.20	n.a.
Qatar	1.22	1.20	1.07	0.00
Saudi Arabia	7.46	2.48	n.a.	0.00
Sudan	1.37	n.a.	n.a.	n.a.
Syria	n.a.	n.a.	n.a.	n.a.
Tunisia	0.77	2.23	n.a.	n.a.
United Arab Emirates	0.48	1.86	3.37	n.a.
Yemen	4.67	1.33	n.a.	n.a.
Sub-Saharan Africa				
Angola	1.30	0.27	0.00	0.00
Benin	0.00	1.78	n.a.	n.a.
Botswana	0.02	0.36	n.a.	n.a.
Burkina Faso	0.00	0.78	n.a.	n.a.
Burundi	0.00	n.a.	n.a.	n.a.
Cameroon	1.69	2.16	n.a.	n.a.
Cape Verde	0.00	2.17	n.a.	n.a.
Central African Republic	0.00	n.a.	n.a.	n.a.
Chad	0.00	0.00	n.a.	n.a.
Comoros	n.a.	n.a.	n.a.	n.a.
Congo, Democratic Republic of the	0.00	1.57	n.a.	n.a.
Congo, Republic of	1.20	2.62	n.a.	n.a.
Côte d'Ivoire	0.00	2.72	n.a.	n.a.
Equatorial Guinea	0.28	n.a.	n.a.	n.a.
Eritrea	n.a.	n.a.	n.a.	n.a.
Ethiopia	0.19	1.24	n.a.	n.a.
Gabon	0.16	n.a.	n.a.	n.a.
Gambia, The	0.00	n.a.	n.a.	n.a.
Ghana	0.62	2.86	n.a.	n.a.
Guinea	0.00	n.a.	n.a.	n.a.
Guinea-Bissau	0.00	n.a.	n.a.	n.a.
Kenya	0.00	0.00	n.a.	n.a.
Lesotho	0.00	0.85	n.a.	n.a.
Liberia	0.00	n.a.	n.a.	n.a.
Madagascar	0.11	0.89	n.a.	n.a.

Appendix Table 2. Pre-tax Subsidies for Petroleum Products, Electricity, Natural Gas, and Coal, 2011 (Concluded)

(Percent of GDP by region)

Country	Petroleum products	Electricity	Natural gas	Coal
Sub-Saharan Africa, concluded.				
Malawi	0.00	1.60	n.a.	n.a.
Mali	0.00	0.93	n.a.	n.a.
Mauritius	0.00	n.a.	n.a.	n.a.
Mozambique	0.00	4.93	n.a.	n.a.
Namibia	0.00	0.52	n.a.	n.a.
Niger	0.00	0.00	n.a.	n.a.
Nigeria	1.42	1.31	0.00	0.00
Rwanda	0.00	0.29	n.a.	n.a.
São Tomé and Príncipe	0.33	n.a.	n.a.	n.a.
Senegal	0.00	2.26	n.a.	n.a.
Seychelles	0.00	n.a.	n.a.	n.a.
Sierra Leone	0.00	n.a.	n.a.	n.a.
South Africa	0.01	0.55	0.00	0.00
Swaziland	0.00	n.a.	n.a.	n.a.
Tanzania	0.00	2.10	n.a.	n.a.
Togo	0.00	n.a.	n.a.	n.a.
Uganda	0.00	1.32	n.a.	n.a.
Zambia	0.00	4.85	n.a.	n.a.
Zimbabwe	n.a.	14.52	n.a.	n.a.
World	**0.30**	**0.22**	**0.16**	**0.01**

Note: Values are rounded to the nearest one-hundredth percent; electricity subsidies are taken from 2009 for 31 countries and natural gas data are taken from 2010 for four countries.

World estimates are calculated as identified subsidies divided by global GDP.

Sources: Staff estimates, Organisation for Economic Co-operation and Development, International Energy Agency, Deutsche Gesellschaft für Internationale Zusammenarbeit, IMF *World Economic Outlook*, and World Bank.

Appendix Table 3. Pre-tax Subsidies for Petroleum Products, Electricity, Natural Gas, and Coal, 2011[23]

(Percent of government revenues)

Country	Petroleum products	Electricity	Natural gas	Coal
Advanced				
Australia	0.00	n.a.	n.a.	0.01
Austria	0.00	n.a.	n.a.	n.a.
Belgium	0.00	n.a.	n.a.	n.a.
Canada	0.00	n.a.	n.a.	0.00
Cyprus	0.00	n.a.	n.a.	n.a.
Czech Republic	0.00	n.a.	n.a.	0.00
Denmark	0.00	n.a.	n.a.	n.a.
Estonia	0.00	n.a.	n.a.	n.a.
Finland	0.00	n.a.	n.a.	n.a.
France	0.00	n.a.	n.a.	n.a.
Germany	0.00	n.a.	n.a.	0.17
Greece	0.00	n.a.	n.a.	n.a.
Hong Kong SAR	0.00	n.a.	n.a.	n.a.
Iceland	0.00	n.a.	n.a.	n.a.
Ireland	0.00	n.a.	n.a.	0.14
Israel	0.00	n.a.	n.a.	n.a.
Italy	0.00	n.a.	n.a.	n.a.
Japan	0.00	n.a.	n.a.	n.a.
Korea	0.00	n.a.	0.00	0.06
Luxembourg	0.00	n.a.	n.a.	n.a.
Malta	0.00	n.a.	n.a.	n.a.
Netherlands	0.00	n.a.	n.a.	n.a.
New Zealand	0.30	n.a.	n.a.	n.a.
Norway	0.00	n.a.	n.a.	n.a.
Portugal	0.00	n.a.	n.a.	n.a.
Singapore	0.00	n.a.	n.a.	n.a.
Slovak Republic	0.00	n.a.	n.a.	0.02
Slovenia	0.00	n.a.	n.a.	0.05
Spain	0.00	n.a.	n.a.	0.08
Sweden	0.00	n.a.	n.a.	n.a.
Switzerland	0.00	n.a.	n.a.	n.a.
Taiwan Province of China	n.a.	1.16	0.00	0.17
United Kingdom	0.00	n.a.	n.a.	n.a.
United States	0.17	n.a.	n.a.	0.01

[23]These subsidy estimates may differ from those in the country budget documents due to the methodologies described in this appendix.

Appendix Table 3. Pre-tax Subsidies for Petroleum Products, Electricity, Natural Gas, and Coal, 2011 (Continued)

(Percent of government revenues)

Country	Petroleum products	Electricity	Natural gas	Coal
CEE-CIS				
Albania	0.00	n.a.	n.a.	n.a.
Armenia	2.06	0.22	n.a.	n.a.
Azerbaijan	1.85	1.59	2.54	0.00
Belarus	0.00	0.62	n.a.	n.a.
Bosnia and Herzegovina	0.00	n.a.	n.a.	n.a.
Bulgaria	0.00	n.a.	n.a.	n.a.
Croatia	0.00	n.a.	n.a.	n.a.
Georgia	1.95	n.a.	n.a.	n.a.
Hungary	0.00	n.a.	n.a.	0.00
Kazakhstan	2.33	3.38	0.55	1.01
Kosovo	0.00	n.a.	n.a.	n.a.
Kyrgyz Republic	10.41	16.30	n.a.	n.a.
Latvia	0.00	n.a.	n.a.	n.a.
Lithuania	0.00	n.a.	n.a.	n.a.
Macedonia, FYR	0.00	n.a.	n.a.	n.a.
Moldova	0.00	n.a.	n.a.	n.a.
Mongolia	0.00	n.a.	n.a.	n.a.
Montenegro, Rep. of	0.00	n.a.	n.a.	n.a.
Poland	0.00	n.a.	n.a.	0.36
Romania	0.00	n.a.	n.a.	n.a.
Russia	0.00	2.58	2.85	0.00
Serbia	0.00	n.a.	n.a.	n.a.
Tajikistan	0.00	7.85	n.a.	n.a.
Turkey	0.00	n.a.	n.a.	0.07
Turkmenistan	31.84	12.29	78.48	n.a.
Ukraine	0.00	3.80	8.47	n.a.
Uzbekistan	0.06	14.20	46.94	n.a.
Emerging and Developing Asia				
Afghanistan	0.00	0.52	n.a.	n.a.
Bangladesh	7.56	22.12	13.45	0.00
Bhutan	1.39	n.a.	n.a.	n.a.
Brunei Darussalam	3.77	1.57	0.00	0.00
Cambodia	0.00	n.a.	n.a.	n.a.
China	0.00	0.68	n.a.	n.a.
Fiji	0.05	n.a.	n.a.	n.a.
India	6.75	1.72	0.90	0.00
Indonesia	14.51	3.69	0.00	0.00
Kiribati	n.a.	n.a.	n.a.	n.a.
Lao P.D.R.	0.00	n.a.	n.a.	n.a.
Malaysia	5.67	1.49	1.41	0.00
Maldives	0.61	n.a.	n.a.	n.a.
Myanmar	9.35	n.a.	n.a.	n.a.
Nepal	0.00	n.a.	n.a.	n.a.
Pakistan	1.02	10.23	19.89	0.00
Papua New Guinea	n.a.	n.a.	n.a.	n.a.
Philippines	0.00	0.00	0.00	0.00
Samoa	n.a.	n.a.	n.a.	n.a.
Solomon Islands	0.00	n.a.	n.a.	n.a.
Sri Lanka	7.99	3.26	0.00	0.00
Thailand	0.66	7.24	0.61	1.08
Timor-Leste	0.00	n.a.	n.a.	n.a.
Tonga	0.00	n.a.	n.a.	n.a.
Tuvalu	0.00	n.a.	n.a.	n.a.
Vanuatu	0.00	n.a.	n.a.	n.a.

Appendix Table 3. Pre-tax Subsidies for Petroleum Products, Electricity, Natural Gas, and Coal, 2011 (Continued)
(Percent of government revenues)

Country	Petroleum products	Electricity	Natural gas	Coal
LAC				
Antigua and Barbuda	2.36	n.a.	n.a.	n.a.
Argentina	0.00	2.76	2.06	0.00
Bahamas, The	0.00	n.a.	n.a.	n.a.
Barbados	0.10	n.a.	n.a.	n.a.
Belize	0.00	n.a.	n.a.	n.a.
Bolivia	6.62	n.a.	n.a.	n.a.
Brazil	0.00	n.a.	n.a.	n.a.
Chile	0.00	0.00	0.00	0.00
Colombia	0.00	0.00	0.00	0.00
Costa Rica	0.00	n.a.	n.a.	n.a.
Dominica	0.00	n.a.	n.a.	n.a.
Dominican Republic	0.00	n.a.	n.a.	n.a.
Ecuador	15.44	0.44	0.00	0.00
El Salvador	0.00	0.00	0.00	0.00
Grenada	0.00	n.a.	n.a.	n.a.
Guatemala	0.00	n.a.	n.a.	n.a.
Guyana	0.00	n.a.	n.a.	n.a.
Haiti	n.a.	n.a.	n.a.	n.a.
Honduras	0.09	n.a.	n.a.	n.a.
Jamaica	0.00	n.a.	n.a.	n.a.
Mexico	0.00	0.00	0.00	0.00
Nicaragua	0.00	n.a.	n.a.	n.a.
Panama	0.08	n.a.	n.a.	n.a.
Paraguay	0.00	n.a.	n.a.	n.a.
Peru	0.00	0.00	0.00	0.00
St. Kitts and Nevis	0.55	n.a.	n.a.	n.a.
St. Lucia	0.68	n.a.	n.a.	n.a.
St. Vincent and the Grenadines	0.00	n.a.	n.a.	n.a.
Suriname	0.00	n.a.	n.a.	n.a.
Trinidad and Tobago	7.49	n.a.	n.a.	n.a.
Uruguay	0.00	n.a.	n.a.	n.a.
Venezuela	15.83	2.89	1.66	n.a.

Appendix Table 3. Pre-tax Subsidies for Petroleum Products, Electricity, Natural Gas, and Coal, 2011 (Continued)

(Percent of government revenues)

Country	Petroleum products	Electricity	Natural gas	Coal
MENA				
Algeria	10.84	2.72	13.52	0.00
Bahrain	18.96	9.08	n.a.	n.a.
Djibouti	0.00	1.32	n.a.	n.a.
Egypt	30.61	10.44	7.25	0.00
Iran	16.95	14.54	19.45	0.00
Iraq	12.69	1.78	0.32	0.00
Jordan	8.13	14.41	n.a.	n.a.
Kuwait	4.57	4.30	1.91	0.00
Lebanon	0.32	18.96	n.a.	n.a.
Libya	16.64	4.80	1.53	0.00
Mauritania	0.00	3.09	2.91	n.a.
Morocco	2.40	n.a.	n.a.	n.a.
Oman	7.28	1.83	5.31	n.a.
Qatar	3.17	3.12	2.78	0.00
Saudi Arabia	14.00	4.66	0.00	0.00
Sudan	7.33	n.a.	n.a.	n.a.
Syria	n.a.	n.a.	n.a.	n.a.
Tunisia	2.42	7.02	n.a.	n.a.
United Arab Emirates	1.38	5.32	9.61	n.a.
Yemen	19.03	5.42	n.a.	n.a.
Sub-Saharan Africa				
Angola	2.67	0.55	0.00	0.00
Benin	0.00	8.84	n.a.	n.a.
Botswana	0.07	1.21	n.a.	n.a.
Burkina Faso	0.00	3.59	n.a.	n.a.
Burundi	0.00	n.a.	n.a.	n.a.
Cameroon	8.92	11.42	n.a.	n.a.
Cape Verde	0.00	8.66	n.a.	n.a.
Central African Republic	0.00	n.a.	n.a.	n.a.
Chad	0.00	0.00	n.a.	n.a.
Comoros	n.a.	n.a.	n.a.	n.a.
Congo, Democratic Republic of the	0.00	5.75	n.a.	n.a.
Congo, Republic of	2.82	6.17	n.a.	n.a.
Côte d'Ivoire	0.00	13.43	n.a.	n.a.
Equatorial Guinea	0.92	n.a.	n.a.	n.a.
Eritrea	n.a.	n.a.	n.a.	n.a.
Ethiopia	1.12	7.40	n.a.	n.a.
Gabon	0.56	n.a.	n.a.	n.a.
Gambia, The	0.00	n.a.	n.a.	n.a.
Ghana	3.20	14.70	n.a.	n.a.
Guinea	0.00	n.a.	n.a.	n.a.
Guinea-Bissau	0.00	n.a.	n.a.	n.a.
Kenya	0.00	0.00	n.a.	n.a.
Lesotho	0.00	1.61	n.a.	n.a.
Liberia	0.00	n.a.	n.a.	n.a.
Madagascar	0.95	7.86	n.a.	n.a.

Appendix Table 3. Pre-tax Subsidies for Petroleum Products, Electricity, Natural Gas, and Coal, 2011 (Concluded)

(Percent of government revenues)

Country	Petroleum products	Electricity	Natural gas	Coal
Sub-Saharan Africa, concluded.				
Malawi	0.00	5.43	n.a.	n.a.
Mali	0.00	3.98	n.a.	n.a.
Mauritius	0.00	n.a.	n.a.	n.a.
Mozambique	0.00	16.40	n.a.	n.a.
Namibia	0.00	1.82	n.a.	n.a.
Niger	0.00	0.00	n.a.	n.a.
Nigeria	4.82	4.44	0.00	0.00
Rwanda	0.00	1.14	n.a.	n.a.
São Tomé and Príncipe	0.90	n.a.	n.a.	n.a.
Senegal	0.00	10.08	n.a.	n.a.
Seychelles	0.00	n.a.	n.a.	n.a.
Sierra Leone	0.00	n.a.	n.a.	n.a.
South Africa	0.02	2.01	0.00	0.00
Swaziland	0.00	n.a.	n.a.	n.a.
Tanzania	0.00	9.50	n.a.	n.a.
Togo	0.00	n.a.	n.a.	n.a.
Uganda	0.00	8.95	n.a.	n.a.
Zambia	0.00	21.59	n.a.	n.a.
Zimbabwe	n.a.	47.02	n.a.	n.a.
World	**0.91**	**0.64**	**0.48**	**0.03**

Note: Values are rounded to the nearest one-hundredth percent; electricity subsidies are taken from 2009 for 31 countries and natural gas data are taken from 2010 for four countries.

World estimates are calculated as identified subsidies divided by global government revenues.

Sources: Staff estimates, Organisation for Economic Co-operation and Development, International Energy Agency, Deutsche Gesellschaft für Internationale Zusammenarbeit, IMF *World Economic Outlook*, and World Bank.

Appendix Table 4. Post-tax Subsidies for Petroleum Products, Electricity, Natural Gas, and Coal, 2011[24]

(Percent of GDP by region)

Country	Petroleum products	Electricity	Natural gas	Coal
Advanced				
Australia	1.11	n.a.	0.13	0.55
Austria	0.13	n.a.	0.12	0.16
Belgium	0.00	n.a.	0.21	0.09
Canada	1.00	n.a.	0.31	0.21
Cyprus	0.58	n.a.	n.a.	0.01
Czech Republic	0.00	n.a.	0.27	1.37
Denmark	0.00	n.a.	0.08	0.18
Estonia	0.09	n.a.	0.15	2.58
Finland	0.00	n.a.	0.07	0.33
France	0.00	n.a.	0.10	0.07
Germany	0.00	n.a.	0.14	0.46
Greece	0.00	n.a.	0.08	0.44
Hong Kong SAR	0.40	n.a.	0.08	0.70
Iceland	0.00	n.a.	n.a.	0.11
Ireland	0.13	n.a.	0.13	0.22
Israel	0.00	n.a.	0.10	0.54
Italy	0.00	n.a.	0.23	0.11
Japan	0.35	n.a.	0.11	0.32
Korea	0.03	n.a.	0.24	1.23
Luxembourg	3.56	n.a.	0.12	0.03
Malta	0.07	n.a.	n.a.	n.a.
Netherlands	0.00	n.a.	0.31	0.17
New Zealand	1.58	n.a.	0.12	0.16
Norway	0.00	n.a.	0.07	0.04
Portugal	0.00	n.a.	0.12	0.15
Singapore	1.03	n.a.	0.19	0.01
Slovak Republic	0.00	n.a.	0.37	0.62
Slovenia	0.24	n.a.	0.09	0.50
Spain	0.13	n.a.	0.13	0.17
Sweden	0.09	n.a.	0.01	0.07
Switzerland	0.04	n.a.	0.03	0.00
Taiwan Province of China	n.a.	0.28	0.17	1.66
United Kingdom	0.00	n.a.	0.23	0.22
United States	2.42	n.a.	0.27	0.64

[24]The estimate for Luxembourg reflects, to a large extent, cross-border sales of petroleum products to neighboring countries, with buyers attracted by lower tax rates.

Appendix Table 4. Post-tax Subsidies for Petroleum Products, Electricity, Natural Gas, and Coal, 2011 (Continued)

(Percent of GDP by region)

Country	Petroleum products	Electricity	Natural gas	Coal
CEE-CIS				
Albania	0.00	n.a.	0.01	0.01
Armenia	0.84	0.40	0.86	n.a.
Azerbaijan	2.26	0.91	1.90	0.00
Belarus	0.00	0.98	2.46	n.a.
Bosnia and Herzegovina	0.00	n.a.	0.07	3.41
Bulgaria	0.00	n.a.	0.26	2.18
Croatia	0.00	n.a.	0.33	0.22
Georgia	0.74	n.a.	0.44	0.05
Hungary	0.08	n.a.	0.59	0.30
Kazakhstan	2.22	0.97	0.96	2.81
Kosovo	0.00	n.a.	n.a.	0.02
Kyrgyz Republic	6.80	5.71	0.27	1.36
Latvia	0.00	n.a.	0.41	0.11
Lithuania	0.00	n.a.	0.39	0.11
Macedonia, FYR	0.00	n.a.	0.09	1.28
Moldova	0.00	n.a.	1.54	0.12
Mongolia	0.00	n.a.	n.a.	4.56
Montenegro, Rep. of	0.00	n.a.	n.a.	0.00
Poland	0.06	n.a.	0.19	1.84
Romania	0.00	n.a.	0.42	0.55
Russia	1.52	1.27	2.47	1.03
Serbia	0.00	n.a.	0.37	2.46
Tajikistan	0.11	2.50	0.22	0.14
Turkey	0.00	n.a.	0.31	0.66
Turkmenistan	8.31	2.39	19.92	n.a.
Ukraine	0.20	1.85	6.91	2.71
Uzbekistan	0.92	5.95	25.50	0.27
Emerging and Developing Asia				
Afghanistan	0.04	0.19	n.a.	n.a.
Bangladesh	1.35	3.01	2.54	0.09
Bhutan	1.21	n.a.	n.a.	n.a.
Brunei Darussalam	5.92	1.37	1.12	0.00
Cambodia	0.00	n.a.	n.a.	0.00
China	0.20	0.30	0.09	3.23
Fiji	0.13	n.a.	n.a.	n.a.
India	1.90	0.36	0.33	1.87
Indonesia	3.87	0.72	0.30	0.47
Kiribati	n.a.	n.a.	n.a.	n.a.
Lao P.D.R.	0.00	n.a.	n.a.	n.a.
Malaysia	5.12	0.56	0.79	0.74
Maldives	1.55	n.a.	n.a.	n.a.
Myanmar	0.97	n.a.	n.a.	n.a.
Nepal	0.16	n.a.	n.a.	0.11
Pakistan	0.98	1.63	3.34	0.16
Papua New Guinea	n.a.	n.a.	n.a.	n.a.
Philippines	0.20	0.00	0.08	0.46
Samoa	n.a.	n.a.	n.a.	n.a.
Solomon Islands	0.00	n.a.	n.a.	n.a.

Appendix Table 4. Post-tax Subsidies for Petroleum Products, Electricity, Natural Gas, and Coal, 2011 (Continued)

(Percent of GDP by region)

Country	Petroleum products	Electricity	Natural gas	Coal
Emerging and Developing Asia, concluded.				
Sri Lanka	2.02	0.75	0.00	0.03
Thailand	1.40	1.76	0.72	0.84
Timor-Leste	0.01	n.a.	n.a.	n.a.
Tonga	0.00	n.a.	n.a.	n.a.
Tuvalu	0.00	n.a.	n.a.	n.a.
Vanuatu	0.00	n.a.	n.a.	n.a.
LAC				
Antigua and Barbuda	1.58	n.a.	n.a.	n.a.
Argentina	0.31	1.15	1.33	0.09
Bahamas, The	1.40	n.a.	n.a.	n.a.
Barbados	0.42	n.a.	n.a.	n.a.
Belize	0.00	n.a.	n.a.	n.a.
Bolivia	4.88	n.a.	0.70	n.a.
Brazil	0.06	n.a.	0.07	0.07
Chile	2.36	0.00	0.09	0.32
Colombia	0.00	0.00	0.17	0.20
Costa Rica	0.30	n.a.	n.a.	0.02
Dominica	1.13	n.a.	n.a.	n.a.
Dominican Republic	0.03	n.a.	0.11	0.13
Ecuador	9.70	0.33	0.05	0.00
El Salvador	0.75	0.00	0.00	0.00
Grenada	0.96	n.a.	n.a.	n.a.
Guatemala	0.72	n.a.	n.a.	0.33
Guyana	1.00	n.a.	n.a.	n.a.
Haiti	n.a.	n.a.	n.a.	n.a.
Honduras	0.43	n.a.	n.a.	0.01
Jamaica	0.41	n.a.	n.a.	0.04
Mexico	1.98	0.00	0.29	0.12
Nicaragua	0.01	n.a.	n.a.	n.a.
Panama	2.20	n.a.	n.a.	0.02
Paraguay	0.00	n.a.	n.a.	n.a.
Peru	0.22	0.00	0.24	0.03
St. Kitts and Nevis	1.19	n.a.	n.a.	n.a.
St. Lucia	0.82	n.a.	n.a.	n.a.
St. Vincent and the Grenadines	0.83	n.a.	n.a.	n.a.
Suriname	0.00	n.a.	n.a.	n.a.
Trinidad and Tobago	5.78	n.a.	4.45	n.a.
Uruguay	0.00	n.a.	0.01	0.00
Venezuela	8.11	1.24	1.05	0.00

Appendix Table 4. Post-tax Subsidies for Petroleum Products, Electricity, Natural Gas, and Coal, 2011 (Continued)

(Percent of GDP by region)

Country	Petroleum products	Electricity	Natural gas	Coal
MENA				
Algeria	6.11	1.15	6.07	0.00
Bahrain	10.01	2.96	1.87	n.a.
Djibouti	0.07	0.51	n.a.	n.a.
Egypt	8.60	2.50	2.59	0.05
Iran	7.66	3.64	6.39	0.02
Iraq	14.30	1.57	0.31	0.00
Jordan	5.27	4.10	0.34	n.a.
Kuwait	6.86	3.12	1.81	0.00
Lebanon	3.57	4.61	0.17	0.11
Libya	8.81	2.33	1.49	0.00
Mauritania	0.73	0.93	0.80	n.a.
Morocco	2.83	n.a.	0.04	0.33
Oman	6.54	0.94	3.34	n.a.
Qatar	5.42	1.26	1.76	0.00
Saudi Arabia	13.27	2.79	0.65	0.00
Sudan	2.26	n.a.	n.a.	n.a.
Syria	n.a.	n.a.	n.a.	n.a.
Tunisia	2.56	2.43	0.70	n.a.
United Arab Emirates	3.49	2.04	4.26	0.04
Yemen	6.89	1.47	1.05	n.a.
Sub-Saharan Africa				
Angola	2.51	0.31	0.04	0.00
Benin	0.17	2.01	n.a.	n.a.
Botswana	0.89	0.48	n.a.	0.34
Burkina Faso	0.29	0.94	n.a.	n.a.
Burundi	0.00	n.a.	n.a.	n.a.
Cameroon	2.49	2.41	0.05	n.a.
Cape Verde	0.00	2.57	n.a.	n.a.
Central African Republic	0.00	n.a.	n.a.	n.a.
Chad	0.00	0.02	n.a.	n.a.
Comoros	n.a.	n.a.	n.a.	n.a.
Congo, Democratic Republic of the	0.00	1.80	0.00	0.09
Congo, Republic of	2.08	2.66	0.01	n.a.
Côte d'Ivoire	0.00	2.96	0.39	n.a.
Equatorial Guinea	1.88	n.a.	n.a.	n.a.
Eritrea	n.a.	n.a.	n.a.	n.a.

Appendix Table 4. Post-tax Subsidies for Petroleum Products, Electricity, Natural Gas, and Coal, 2011 (Concluded)

(Percent of GDP by region)

Country	Petroleum products	Electricity	Natural gas	Coal
Sub-Saharan Africa, concluded				
Ethiopia	0.62	1.32	n.a.	n.a.
Gabon	0.74	n.a.	0.06	n.a.
Gambia, The	0.00	n.a.	n.a.	n.a.
Ghana	1.85	3.02	n.a.	n.a.
Guinea	0.00	n.a.	n.a.	n.a.
Guinea-Bissau	0.00	n.a.	n.a.	n.a.
Kenya	0.51	0.16	n.a.	0.01
Lesotho	0.03	0.94	n.a.	n.a.
Liberia	0.00	n.a.	n.a.	n.a.
Madagascar	0.41	0.98	n.a.	n.a.
Malawi	0.13	2.01	n.a.	n.a.
Mali	0.15	0.99	n.a.	n.a.
Mauritius	0.00	n.a.	n.a.	n.a.
Mozambique	0.24	5.07	0.09	0.01
Namibia	0.04	0.52	n.a.	0.07
Niger	0.20	0.17	n.a.	n.a.
Nigeria	2.04	1.34	0.19	0.00
Rwanda	0.00	0.39	n.a.	n.a.
São Tomé and Príncipe	0.59	n.a.	n.a.	n.a.
Senegal	0.00	2.51	0.01	0.16
Seychelles	0.00	n.a.	n.a.	n.a.
Sierra Leone	0.45	n.a.	n.a.	n.a.
South Africa	1.06	0.73	0.00	2.46
Swaziland	0.00	n.a.	n.a.	n.a.
Tanzania	0.00	2.26	0.19	0.03
Togo	0.72	n.a.	n.a.	n.a.
Uganda	0.00	1.45	n.a.	n.a.
Zambia	0.00	4.96	n.a.	0.00
Zimbabwe	n.a.	14.89	n.a.	2.13
World	**1.26**	**0.26**	**0.43**	**0.77**

Note: Values are rounded to the nearest one-hundredth percent; electricity subsidies are taken from 2009 for 31 countries and natural gas data are taken from 2010 for four countries.

World estimates are calculated as identified subsidies divided by global GDP.

Sources: Staff estimates, Organisation for Economic Co-operation and Development, International Energy Agency, Deutsche Gesellschaft für Internationale Zusammenarbeit, IMF *World Economic Outlook*, and World Bank.

Appendix Table 5. Post-tax Subsidies for Petroleum Products, Electricity, Natural Gas, and Coal, 2011[25]

(Percent of government revenues)

Country	Petroleum products	Electricity	Natural gas	Coal
Advanced				
Australia	3.46	n.a.	0.40	1.71
Austria	0.27	n.a.	0.26	0.34
Belgium	0.00	n.a.	0.42	0.19
Canada	2.61	n.a.	0.80	0.55
Cyprus	1.41	n.a.	n.a.	0.02
Czech Republic	0.00	n.a.	0.68	3.39
Denmark	0.00	n.a.	0.15	0.32
Estonia	0.20	n.a.	0.34	5.84
Finland	0.00	n.a.	0.14	0.60
France	0.00	n.a.	0.20	0.13
Germany	0.00	n.a.	0.31	1.04
Greece	0.00	n.a.	0.20	1.09
Hong Kong SAR	1.63	n.a.	0.33	2.85
Iceland	0.00	n.a.	n.a.	0.26
Ireland	0.38	n.a.	0.39	0.65
Israel	0.00	n.a.	0.26	1.34
Italy	0.00	n.a.	0.50	0.24
Japan	1.13	n.a.	0.37	1.06
Korea	0.11	n.a.	1.03	5.25
Luxembourg	8.58	n.a.	0.29	0.07
Malta	0.18	n.a.	n.a.	n.a.
Netherlands	0.00	n.a.	0.67	0.36
New Zealand	5.43	n.a.	0.43	0.53
Norway	0.00	n.a.	0.11	0.06
Portugal	0.00	n.a.	0.27	0.33
Singapore	4.15	n.a.	0.75	0.04
Slovak Republic	0.00	n.a.	1.13	1.91
Slovenia	0.59	n.a.	0.23	1.21
Spain	0.36	n.a.	0.36	0.48
Sweden	0.17	n.a.	0.03	0.15
Switzerland	0.11	n.a.	0.08	0.01
Taiwan Province of China	n.a.	1.48	0.92	8.82
United Kingdom	0.00	n.a.	0.61	0.61
United States	7.70	n.a.	0.87	2.05

[25]The estimate for Luxembourg reflects, to a large extent, cross-border sales of petroleum products to neighboring countries, with buyers attracted by lower tax rates.

Appendix Table 5. Post-tax Subsidies for Petroleum Products, Electricity, Natural Gas, and Coal, 2011 (Continued)

(Percent of government revenues)

Country	Petroleum products	Electricity	Natural gas	Coal
CEE-CIS				
Albania	0.00	n.a.	0.04	0.05
Armenia	3.86	1.81	3.93	n.a.
Azerbaijan	4.96	2.00	4.18	0.00
Belarus	0.00	2.32	5.86	n.a.
Bosnia and Herzegovina	0.00	n.a.	0.16	7.35
Bulgaria	0.00	n.a.	0.81	6.72
Croatia	0.00	n.a.	0.89	0.60
Georgia	2.62	n.a.	1.55	0.19
Hungary	0.15	n.a.	1.11	0.56
Kazakhstan	7.99	3.49	3.45	10.11
Kosovo	0.00	n.a.	n.a.	0.06
Kyrgyz Republic	20.39	17.13	0.81	4.07
Latvia	0.00	n.a.	1.14	0.30
Lithuania	0.00	n.a.	1.17	0.33
Macedonia, FYR	0.00	n.a.	0.31	4.46
Moldova	0.00	n.a.	4.20	0.34
Mongolia	0.00	n.a.	n.a.	11.49
Montenegro, Rep. of	0.00	n.a.	n.a.	0.00
Poland	0.15	n.a.	0.51	4.79
Romania	0.00	n.a.	1.34	1.74
Russia	3.96	3.30	6.45	2.67
Serbia	0.00	n.a.	0.89	6.00
Tajikistan	0.45	10.04	0.87	0.57
Turkey	0.00	n.a.	0.91	1.91
Turkmenistan	44.05	12.67	105.63	n.a.
Ukraine	0.48	4.36	16.31	6.40
Uzbekistan	2.28	14.80	63.40	0.67
Emerging and Developing Asia				
Afghanistan	0.20	0.86	n.a.	n.a.
Bangladesh	11.30	25.26	21.31	0.71
Bhutan	3.31	n.a.	n.a.	n.a.
Brunei Darussalam	9.51	2.19	1.81	0.00
Cambodia	0.00	n.a.	n.a.	0.01
China	0.88	1.34	0.42	14.27
Fiji	0.53	n.a.	n.a.	n.a.
India	10.24	1.97	1.79	10.08
Indonesia	21.74	4.04	1.67	2.62
Kiribati	n.a.	n.a.	n.a.	n.a.
Lao P.D.R.	0.00	n.a.	n.a.	n.a.
Malaysia	23.39	2.54	3.63	3.38
Maldives	4.97	n.a.	n.a.	n.a.
Myanmar	16.93	n.a.	n.a.	n.a.
Nepal	0.88	n.a.	n.a.	0.62
Pakistan	7.70	12.76	26.13	1.22
Papua New Guinea	n.a.	n.a.	n.a.	n.a.
Philippines	1.18	0.00	0.43	2.65
Samoa	n.a.	n.a.	n.a.	n.a.
Solomon Islands	0.00	n.a.	n.a.	n.a.

Appendix Table 5. Post-tax Subsidies for Petroleum Products, Electricity, Natural Gas, and Coal, 2011 (Continued)

(Percent of government revenues)

Country	Petroleum products	Electricity	Natural gas	Coal
Emerging and Developing Asia, concluded.				
Sri Lanka	13.89	5.17	0.00	0.19
Thailand	6.16	7.77	3.19	3.73
Timor-Leste	0.01	n.a.	n.a.	n.a.
Tonga	0.00	n.a.	n.a.	n.a.
Tuvalu	0.00	n.a.	n.a.	n.a.
Vanuatu	0.00	n.a.	n.a.	n.a.
LAC				
Antigua and Barbuda	7.64	n.a.	n.a.	n.a.
Argentina	0.84	3.08	3.58	0.25
Bahamas, The	7.79	n.a.	n.a.	n.a.
Barbados	1.16	n.a.	n.a.	n.a.
Belize	0.00	n.a.	n.a.	n.a.
Bolivia	13.48	n.a.	1.94	n.a.
Brazil	0.16	n.a.	0.21	0.21
Chile	9.55	0.00	0.35	1.28
Colombia	0.00	0.00	0.65	0.74
Costa Rica	2.20	n.a.	n.a.	0.14
Dominica	3.64	n.a.	n.a.	n.a.
Dominican Republic	0.21	n.a.	0.85	0.98
Ecuador	23.74	0.80	0.12	0.00
El Salvador	4.21	0.00	0.00	0.00
Grenada	4.30	n.a.	n.a.	n.a.
Guatemala	6.12	n.a.	n.a.	2.82
Guyana	3.63	n.a.	n.a.	n.a.
Haiti	n.a.	n.a.	n.a.	n.a.
Honduras	1.81	n.a.	n.a.	0.03
Jamaica	1.61	n.a.	n.a.	0.16
Mexico	8.95	0.00	1.29	0.55
Nicaragua	0.02	n.a.	n.a.	n.a.
Panama	8.88	n.a.	n.a.	0.06
Paraguay	0.00	n.a.	n.a.	n.a.
Peru	1.02	0.00	1.13	0.15
St. Kitts and Nevis	3.21	n.a.	n.a.	n.a.
St. Lucia	3.00	n.a.	n.a.	n.a.
St. Vincent and the Grenadines	3.17	n.a.	n.a.	n.a.
Suriname	0.00	n.a.	n.a.	n.a.
Trinidad and Tobago	15.71	n.a.	12.11	n.a.
Uruguay	0.00	n.a.	0.04	0.00
Venezuela	23.00	3.52	2.97	0.01

Appendix Table 5. Post-tax Subsidies for Petroleum Products, Electricity, Natural Gas, and Coal, 2011 (Continued)

(Percent of government revenues)

Country	Petroleum products	Electricity	Natural gas	Coal
MENA				
Algeria	15.40	2.89	15.31	0.00
Bahrain	35.36	10.44	6.61	n.a.
Djibouti	0.19	1.49	n.a.	n.a.
Egypt	39.07	11.35	11.79	0.23
Iran	30.89	14.66	25.75	0.07
Iraq	18.31	2.01	0.40	0.00
Jordan	19.94	15.49	1.30	n.a.
Kuwait	10.15	4.62	2.68	0.00
Lebanon	15.17	19.59	0.71	0.45
Libya	22.91	6.04	3.86	0.00
Mauritania	2.65	3.37	2.91	n.a.
Morocco	10.27	n.a.	0.13	1.21
Oman	15.80	2.27	8.06	n.a.
Qatar	14.05	3.26	4.56	0.00
Saudi Arabia	24.91	5.23	1.23	0.00
Sudan	12.11	n.a.	n.a.	n.a.
Syria	n.a.	n.a.	n.a.	n.a.
Tunisia	8.07	7.66	2.19	n.a.
United Arab Emirates	9.96	5.82	12.15	0.11
Yemen	28.05	5.99	4.26	n.a.
Sub-Saharan Africa				
Angola	5.13	0.64	0.07	0.00
Benin	0.83	9.98	n.a.	n.a.
Botswana	3.01	1.64	n.a.	1.16
Burkina Faso	1.31	4.30	n.a.	n.a.
Burundi	0.00	n.a.	n.a.	n.a.
Cameroon	13.17	12.76	0.25	n.a.
Cape Verde	0.00	10.23	n.a.	n.a.
Central African Republic	0.00	n.a.	n.a.	n.a.
Chad	0.00	0.06	n.a.	n.a.
Comoros	n.a.	n.a.	n.a.	n.a.
Congo, Democratic Republic of the	0.00	6.57	0.01	0.32
Congo, Republic of	4.88	6.25	0.02	n.a.
Côte d'Ivoire	0.00	14.59	1.91	n.a.
Equatorial Guinea	6.09	n.a.	n.a.	n.a.
Eritrea	n.a.	n.a.	n.a.	n.a.

Appendix Table 5. Post-tax Subsidies for Petroleum Products, Electricity, Natural Gas, and Coal, 2011 (Concluded)
(Percent of government revenues)

Country	Petroleum products	Electricity	Natural gas	Coal
Sub-Saharan Africa, concluded				
Ethiopia	3.69	7.89	n.a.	n.a.
Gabon	2.62	n.a.	0.22	n.a.
Gambia, The	0.00	n.a.	n.a.	n.a.
Ghana	9.53	15.50	n.a.	n.a.
Guinea	0.00	n.a.	n.a.	n.a.
Guinea-Bissau	0.00	n.a.	n.a.	n.a.
Kenya	2.04	0.66	n.a.	0.02
Lesotho	0.06	1.77	n.a.	n.a.
Liberia	0.00	n.a.	n.a.	n.a.
Madagascar	3.65	8.73	n.a.	n.a.
Malawi	0.44	6.83	n.a.	n.a.
Mali	0.64	4.24	n.a.	n.a.
Mauritius	0.00	n.a.	n.a.	n.a.
Mozambique	0.79	16.89	0.30	0.05
Namibia	0.12	1.82	n.a.	0.25
Niger	1.02	0.88	n.a.	n.a.
Nigeria	6.94	4.55	0.64	0.00
Rwanda	0.00	1.50	n.a.	n.a.
São Tomé and Príncipe	1.59	n.a.	n.a.	n.a.
Senegal	0.00	11.22	0.03	0.72
Seychelles	0.00	n.a.	n.a.	n.a.
Sierra Leone	2.64	n.a.	n.a.	n.a.
South Africa	3.86	2.65	0.00	8.93
Swaziland	0.00	n.a.	n.a.	n.a.
Tanzania	0.00	10.23	0.84	0.12
Togo	3.35	n.a.	n.a.	n.a.
Uganda	0.00	9.79	n.a.	n.a.
Zambia	0.00	22.07	n.a.	0.00
Zimbabwe	n.a.	48.22	n.a.	6.90
World	**3.77**	**0.77**	**1.28**	**2.31**

Note: Values are rounded to the nearest one-hundredth percent; electricity subsidies are taken from 2009 for 31 countries and natural gas data are taken from 2010 for four countries.

World estimates are calculated as identified subsidies divided by global government revenues.

Sources: Staff estimates, Organisation for Economic Co-operation and Development, International Energy Agency, Deutsche Gesellschaft für Internationale Zusammenarbeit, IMF *World Economic Outlook*, and World Bank.

Appendix II. Assessing the Environmental and Health Impacts of Energy Subsidy Reform

This appendix describes the methodologies used to provide calculations of the impact of energy subsidy reform on CO_2 emissions, SO_2 emissions and other local pollutants. Here we consider a scenario in which energy prices are raised to levels that would eliminate tax-inclusive subsidies for petroleum products, coal, natural gas, and electricity.

Petroleum products

CO_2 emissions. A price elasticity of -0.4 is assumed for gasoline, diesel and kerosene (Parry, 2011). The reduction in CO_2 emissions is then calculated by multiplying the reduction in consumption by the CO_2 coefficient of 0.0089 tons per gallon of gasoline. The CO_2 coefficient is assumed to be 16 percent higher for diesel and kerosene (Parry, 2011).

Local pollution. The reduction (in percentage terms) in other local pollutants due to fossil fuel combustion is approximated by the reduction in fuel consumption. Fuel combustion produces only a small amount of SO_2, and thus the impact of petroleum subsidy removal on SO_2 is not estimated.

Coal

CO_2 emissions. The reduction (in percent) in coal consumption is calculated assuming a price elasticity of -0.2 (EIA, 2012).[26] The reduction in CO_2 emissions due to the removal of coal subsidies is then estimated as the same reduction (in percent) in total CO_2 emissions from coal, based on OECD data.

SO_2 emissions. This is estimated using an SO_2 coefficient of 0.01 tons of SO_2 per short ton of coal (EPA, 2012; EIA, 2012). Local pollution other than SO_2 from coal is considered minor.

Natural gas

The reduction (in percent) in natural gas consumption is calculated assuming a price elasticity of -0.3 (EIA, 2012). The reduction in CO_2 emissions is then estimated as the same percent reduction in total CO_2 emissions from natural gas, based on OECD data. As noted previously, the impact of natural gas use on local pollution is assumed to be relatively small.

[26] An upward adjustment is made to the EIA estimate as it is generally viewed as being on the conservative side.

Electricity

Electricity subsidies increase the consumption of coal, natural gas and other generation fuels due to excess demand for electricity. However, for several reasons these effects on emissions are not quantified in this paper: (i) in some countries, part of the electricity subsidies are due to inefficiencies in the electricity sector. In other words, part of the problem is not that prices are too low, but that costs are too high. Thus, successful subsidy reforms could reduce these inefficiencies without raising prices and suppressing demand; (ii) data limitations make it difficult to quantify the environmental impact of electricity subsidy removal. For example, price and cost data are limited and there is a lack of information on the marginal energy source for electricity generation, which may be different from the average; and (iii) the environmental impact of price increases in fuel, coal and natural gas as inputs for electricity generation is already incorporated in the calculations of these energy products. In addition, electricity subsidies are relatively small as a share of total post-tax subsidies, and thus, this omission is expected to only have a small impact on the overall estimates.

Caveats

The proposed methods here are used to provide some rough estimates on the magnitude of the impacts and have several limitations. For example, they do not take into account the substitution between different energy products and resulting offsetting effects.