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Implementing Energy Subsidy Reforms

An Overview of the Key Issues

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Abstract

Poorly implemented energy subsidies are economically costly to taxpayers and damage the environment. This report describes the emerging lessons that could help policy makers to address implementation challenges, including overcoming political economy and affordability constraints. The analysis provides strong evidence of the success of reforms in reducing the associated fiscal burden. For the selected sample of 20 developing countries, the average energy subsidy recorded in the budget was reduced from 1.8 percent in 2004 to 1.3 percent of gross domestic product in 2010. The reduction of subsidies is particularly remarkable for net energy importers. In spite of the relatively price inelastic demand for gasoline and diesel, fossil fuel consumption in the road sector (per unit of gross domestic product) declined in the 20 countries examined from 53 (44) in 2002 to about 23 kilotonnes oil equivalent per million of gross domestic product in 2008 in the case of gasoline (diesel). The most notable decline in consumption was recorded in the low-income and lower-middle-income countries. This reflects the much higher rate of growth in gross domestic product in this group of countries. And it underlines the opportunities to influence future consumption behavior rather than modifying the existing consumption patterns, overcoming inertia and vested interests. Similar trends are recorded for power consumption. While there is no one-size-fits-all model for subsidy reform, implementation of compensatory social policies and an effective communication strategy, before the changes were introduced, made a difference in securing the successful implementation of reforms.

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Implementing Energy Subsidy Reforms
An overview of the key issues*

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JEL: H2, H30, H31, Q4

Energy and Mining (EM) Sector Board

* This paper is based on a broader study (Vagliasindi, 2012) aimed at providing the emerging lessons from a representative sample of case studies that could help policy makers to address implementation challenges, including overcoming political economy and affordability constraints, by looking at complementary instruments to compensate vulnerable groups for energy-price increases. My special thanks go to Vivien Foster for her advice and comments. I am most grateful to Nicolas Jost, Evgenia Shumilkina for their research assistance and Ani Balabanyan, Ulrich Bartsch, Husam Beides, Benu Bidani, Kwawu Gaba, Franz Gerner, Mudassar Imran, Ashish Khanna, Migara Jayawardena, Todd Johnson, Eduardo Ley, Rinku Murgai, Kari Nyman, Dejan Ostojic, Silvia Pariente-David, Giovanna Prennushi, Caterina Ruggeri, Jon Strand, Gary Stuggins, Mike Toman, Vlado Vucetic, Ruslan Yemtsov and Ariel Yepes, most helpful comments and suggestions.

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i. Introduction

Poorly implemented energy subsidies are economically costly to taxpayers and damage the environment through increased emissions of greenhouse gas and other air pollutants. Energy subsidies also create distortive price signals and result in higher energy consumption or production, or barriers to entry for cleaner energy services. Subsidies to consumption, by lowering end-use prices, can encourage increased energy use and reduce incentives to conserve energy efficiently. Universal energy-price subsidies tend to be regressive as benefits are conditional upon the purchase of subsidized goods, and increase with expenditure. The proportional adverse impact of energy subsidy removal can be greatest for the poor, even though the rich receive most of the value of the subsidy (IEA, OPEC, OECD, World Bank, 2010).

This synthesis paper is based on a broader study (Vagliasindi, 2012) aimed at providing the emerging lessons from a representative sample of case studies that could help policy makers to address implementation challenges, including overcoming political economy and affordability constraints, by looking at complementary instruments to compensate vulnerable groups for energy-price increases.

ii. Methodology

To achieve this objective, the study selected a representative sample of case studies in 20 developing countries, based on a number of criteria, including the country level of development (and consumption) and energy dependency (distinguishing between net energy exporters and importers), as reported in Table 1 below.

Table 1 Sample Selection for Case Studies Analysis

		Net Energy Importer	Net Energy Exporter
Low and Lower Middle Income		**Group A**	**Group C**
	AFR	Ghana*	Nigeria
	EAP		Indonesia*
	ECA	Armenia*, Moldova*	Azerbaijan
	MNA	Morocco*, Jordan*	Egypt*, Iran, Yemen*
	SAR	India*, Pakistan*	
Upper-Middle and High Income		**Group B**	**Group D**
	EAP		Malaysia*
	ECA	Turkey*	
	LAC	Chile, Dominican Rep., Peru	Argentina*, Mexico*

Note: Selected sample based on income, region, energy net import-export
* indicates if the country is characterized by macro unbalances
(either budget deficit higher than respectively 4% of GDP or public debt higher than 40% of GDP).

The case studies were supported by data collection related to direct budgetary subsidies, fuel and electricity tariffs, and household survey data, from official documents, complemented by

information publicly available through the websites of the finance and energy ministries and energy service providers.

The criteria to inform the case studies are based on the hypothesis that energy dependence and per capita income appear to be the key drivers of subsidy reforms in developing countries. Of the two criteria, energy dependency is expected to be the most powerful to determine the choice of engaging in energy reforms, whereas the level of per capita income may pose different challenges in relation to distributional impact of such reforms on the poor and on energy efficiency efforts. Energy net importers are expected to have more incentives to undertake energy subsidy reforms, when the fiscal burden of such subsidies reaches a significant percentage of GDP, particularly when there are already macro imbalances related to given thresholds of public budget and debt. Low and middle income countries are expected to display a larger impact of energy subsidy reforms on consumptions. This reflects the opportunities to influence future behavior rather than current consumption trends, due to inertia and vested interests and the presence of affordability issues.

The performance of countries which have embraced substantial subsidy reform is compared to the counterfactual of countries that have done little to phase out energy subsidies. This comparison is undertaken within each group of countries determined by the taxonomy of energy dependence and country annual per capita income. The four groups of countries are referred to as Groups A to D. Groups A and B consist of net importer countries with low and lower middle income and upper middle and high income countries, respectively. Groups C and D represent instead energy net exporters with low and lower middle income and upper middle and high income countries, respectively.

- **Group A: Armenia, Ghana, Jordan, India, Moldova, Morocco** and **Pakistan**.
- **Group B: Chile, Dominican Republic, Peru and Turkey.**
- **Group C: Azerbaijan, Egypt, Indonesia, Iran, Nigeria, Yemen**.
- **Group D: Argentina**, **Malaysia** and **Mexico.**

iii. Key Policy Questions

The report is structured around some central policy questions highlighted below.

(a) Have energy subsidy reforms succeeded in reducing the associated fiscal burden?

To address this question the study uses both indicators of explicit and implicit subsidies:

- **Energy Explicit Budgetary Subsidy** (% GDP): Energy subsidies reported as an item of government expenditure in the consolidated general budget (% GDP)
- **Energy Implicit Subsidies** (% GDP)**:** Where available, explicit budgetary subsidies are complemented by estimates by the World Bank and IMF of implicit forms of subsidies. The hidden cost of energy subsidies is defined as the difference between actual receipts and the revenue that the energy company (e.g. a utility involved in the distribution of electric and natural gas) would receive were it to be in operation with cost-recovery tariffs based on efficient operation, with normal losses and with full bill collection. Ebinger (2006) pioneered this approach for Eastern Europe and Central

Asia from 2000 to 2003, the AICD Database applied the same methodology for Sub-Saharan Africa and collected data from 2004 to 2009.

(b) Have energy subsidy reforms succeeded in restraining energy consumption?

To provide an answer to this question the study uses both indicators of energy prices and related consumption. In the case of gasoline and diesel, road sector consumption of fuels is reported, as the transport sector is one of the most intensive users of such fuels. In the case of electricity power consumption is provided:

- **Fossil Fuel Prices** (US$ per liter): Gasoline, diesel and kerosene retail tariff (US$ per liter).
- **Electricity Prices** (US$ cent per kWh) – Residential Average Electricity Tariff level (US$ cent per kWh)
- **Road Fuel Consumption** (kt of oil equivalent per capita): Gasoline and Diesel Fuel Consumption (kt of oil equivalent per capita) by the road sector
- **Power Consumption** (kWh per capita) - Electric power consumption measures the production of power plants and combined heat and power plants less transmission, distribution, and transformation losses and own use by heat and power plants. (kWh per capita)

(c) Have energy subsidy reforms managed to avoid adverse social impacts?

To address this final question, evidence from household surveys on the distributional impact of subsidies by income quintile (or deciles, if available) as well as the materiality of energy subsidies, reporting for each fuel how much income is spent by each quintile of the population is used in the case studies.

- **Expenditure of different energy sources** (what proportion of income poor households spend on each fuel), by quintiles or deciles where available divided by rural/urban areas.
- **Welfare impact of removing energy subsidies, by fuels and/or by quintiles or deciles** (what proportion of poor households as a whole receive the subsidy).
- **Benefit incidence of energy subsidies** (how well the subsidy targets benefits to poor households as opposed to other households), **by quintiles or deciles (and fuels where available).**
- **Beneficiary incidence of energy subsidies** (what proportion of poor households as a whole receive the subsidy), **by quintiles or deciles (and fuels where available)**

iv. Summary of the Results

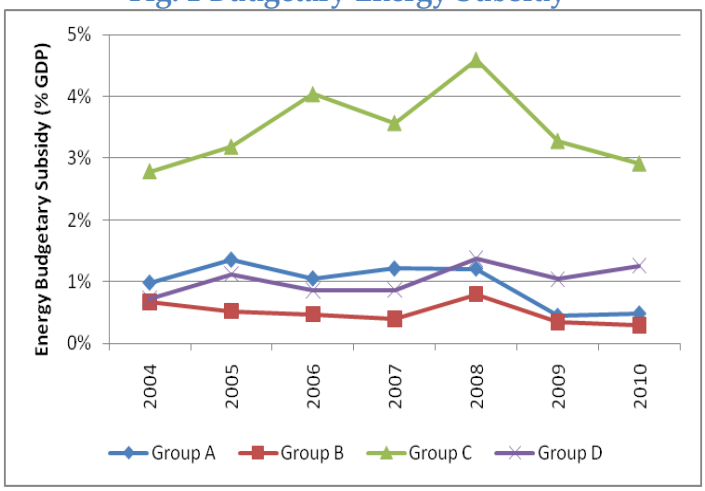
(a) Have energy subsidy reforms succeeded in reducing the associated fiscal burden?

1. Evidence across Groups

Some interesting patterns emerge by grouping countries in our taxonomy, distinguishing countries according to their energy dependency and the level of income. As expected, net energy importers (Group A and Group B) have reduced more significantly the burden of energy subsidies in the budget, from 1% of GDP in 2004 to 0.5% of GDP in 2010 for group A and from 0.7% to 0.3% for Group B (see Fig. 1). On the other hand, for net energy exporters (Group C and D), the burden of energy subsidy in the budget increased only slightly from 2.8% of GDP in 2004 to almost 3% of

GDP in 2010 for lower income countries (Group C) and doubling from 0.7% of GDP to about 1.3% for the higher income countries (Group D).

Fig. 1 Budgetary Energy Subsidy



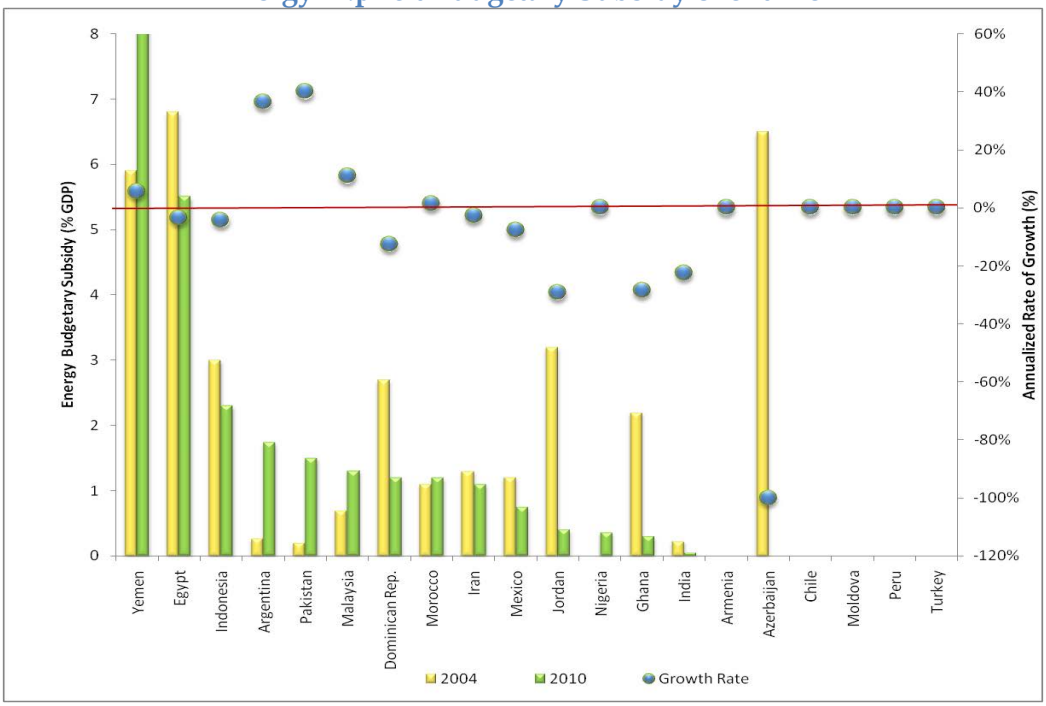
Source: World Bank

2. Cross Country Evidence

The experiences of phasing out subsidies in these developing countries show a tremendous reduction of direct budgetary subsidies. Fig. 2 shows the fiscal burden due to energy subsidies from 2004 to 2010. Countries are ranked according to the level of subsidies (as a percentage of GDP) in 2010. The annualized rate of growth of GDP energy subsidies (captured by the blue bubbles) is measured on the right hand axis. For our sample of countries the average energy subsidy recorded in the budget was reduced from 1.8% to 1.3% of GDP. Countries where subsidies represent still more than 5% of GDP are net energy exporters, such as Yemen and Egypt. Several countries, including Chile, Peru, Turkey and Moldova have not reported explicit subsidies throughout the period.

Most of the countries experienced a decline in energy subsidies as a percentage of GDP. With the notable exception of Azerbaijan, which succeeded to phase out explicit subsidies in the budget starting from a level close to 7% of GDP in 2000, countries that were most successful in reducing the fiscal burden of energy subsidies are all energy net importers, including Jordan, Ghana and India. With the exception of Pakistan, most of the countries that increased spending on energy subsidies are all high income and energy net exporters, such as Argentina and Malaysia.

Fig. 2
Energy Explicit Budgetary Subsidy over time



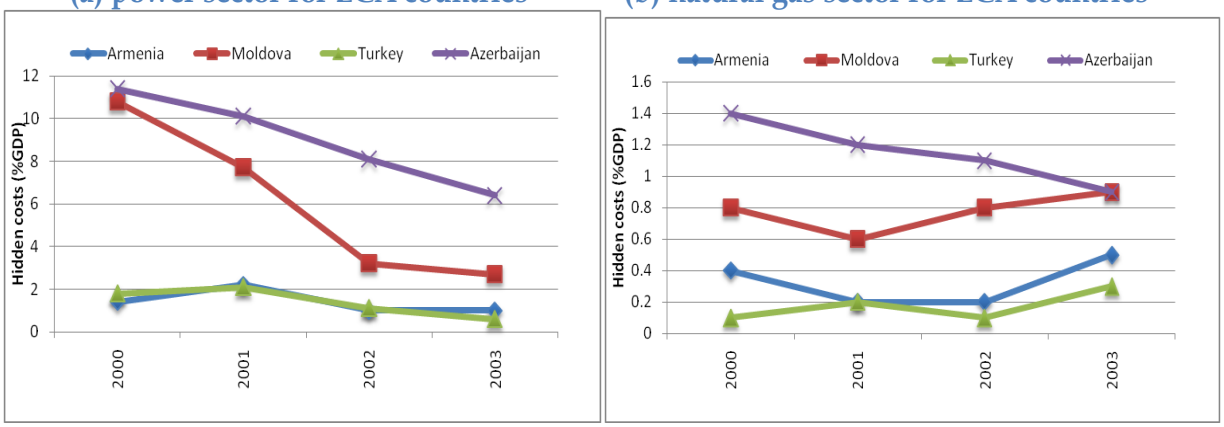
Source: World Bank

In addition to explicit budgetary subsidies, developing countries are using a myriad of implicit subsidies both in the energy and oil sectors. To estimate such subsidies, Fig. 3 below reports the hidden costs coming from the difference between actual receipts and the revenue that the energy company (e.g. a utility involved in the distribution of electric and natural gas) would receive were it to be in operation with cost-recovery tariffs based on efficient operation, with normal losses and with full bill collection. The first two graphs in Fig. 3 reports the early trends for the selected countries in the ECA region, which includes countries belonging to low-income and energy net importer (such as Armenia and Moldova, Group A), higher income and energy net importers (such as Turkey, Group B), and low income energy net exporters (such as Turkey, Group C). There were dramatic decreases in hidden costs in the power sector as a result of broader reforms in the power sectors for countries belonging to different groups, such as Moldova and Azerbaijan, which have embraced different reforms. Hidden costs in the power sector were substantially reduced, dropping from about 11% of GDP in 2000 to below 3% of GDP in 2003. The largest component of hidden cost comes from unaccounted losses, which were also reduced substantially from more than 7% of GDP to 2.7%of GDP in the same period as a result of major reforms entailing unbundling, privatization and establishment of a sound regulatory framework. An independent energy regulatory agency (ANRE) was established in 1998 for the purpose of regulating the electricity, natural gas, and district heating sub-sectors. ANRE adopted cost-recovery tariffs using a rate-of-return methodology. However, until recently the municipalities remained in charge of setting the tariffs for district heating and remained heavily subsidized. It is not surprising that natural gas hidden costs remained constant over time, mainly due to collection failures. Historically, a number of subsidies were embedded in electricity tariffs in Azerbaijan, as a result of both non-payment problems in the sector as well as below cost pricing. In 2003, it is estimated that the shortfall in payments accounted for about 3.2% of GDP. The under recovery of the true economic value of the fuels supplied to Azerenergy was equal to 2.5%. These are the two largest

components of hidden costs. Since 2003, the government started to reflect these underpayments as subsidies in the budget.

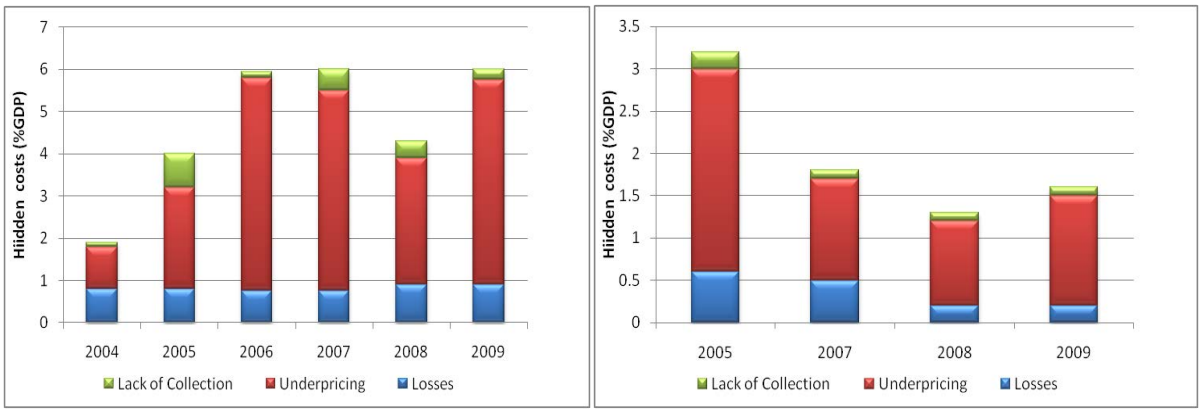
Fig. 3
Energy Sector Hidden Costs

(a) power sector for ECA countries **(b) natural gas sector for ECA countries**



Source: Ebinger (2006)

(c) power sector for Ghana **(d) power sector for Nigeria**



Source: AICD (2010)

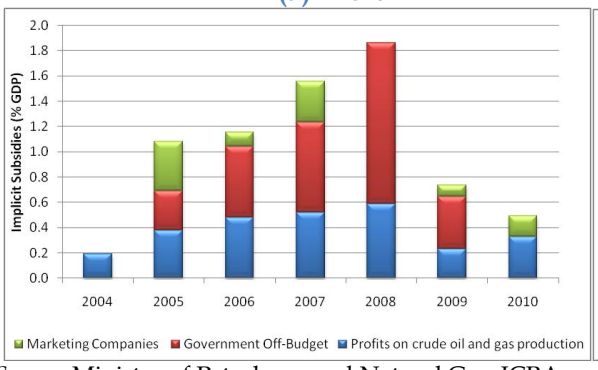
Different trends in hidden cost of subsidies are displayed for the two Sub-Saharan African low-income countries that we included in our sample (last two graphs of Fig. 3). In the case of Ghana, until recently a net energy importer country, the hidden cost of energy subsidies escalated substantially due to the heavy reliance on oil whose price fluctuates and the absence of an automatic adjustment mechanism. A significant price increase was implemented in June 2010 to improve the situation. By contrast, in the case of Nigeria, a net energy exporter, tariff reforms with the introduction of a multi-year tariff order in 2005 implied a significant reduction of hidden costs due to underpricing from about 2.5% in 2005 to half of such value since 2007.

The magnitude of implicit subsidies is even higher in the oil and gas sectors. In the case of India (Fig. 4a) the subsidy can be measured by the difference between oil marketing companies' (OMGs) costs and their revenues (under-recovery). To finance under-recovery of oil marketing companies (OMGs) the Indian government employs a number of different mechanisms. The majority of financing takes place off budget. An important source of financing was until 2007 the issuance of

oil bonds to OMGs. Another portion of under-recoveries is financed by oil and gas producers that are required by the government to transfer share of their profits to OMGs. The implicit subsidies through such off budget mechanisms reached a peak of about 1.3% of GDP in 2008 (Fig. 4a). In the 2011 budget, the government announced the plans to stop issuing oil bonds and switch to directly subsidizing OMGs instead. Excessive gasoline consumption has turned Iran into a net gasoline importer, with a negative impact on the fiscal balance (IMF, 2009). The predictable results were rising subsidy bills for the state. Most of this burden was carried as an implicit subsidy to domestic energy consumers, with the price of diesel fuel, for example, set at the equivalent of two US$ cents a litre, and petrol selling for less than bottled water. Iran's fuel prices were among the very lowest in the world, only ahead of Venezuela. This has encouraged excessive use of energy (both in per capita terms and per unit of GDP), as reflected by Iran's move from being one of the lowest energy intensity users in the world in 1980 to one of the highest in 2009. Low fuel prices have not only caused consumption inefficiency in the country, but have also presented an opportunity for fuel smuggling in neighboring countries such as Iraq, Turkey, Pakistan and Afghanistan. The price of gasoline in Turkey used to be 20 times higher than in Iran while that of diesel more than 50 times higher. According to IMF estimates, implicit oil subsidy costs the government around 10% of GDP annually (Fig. 4b).

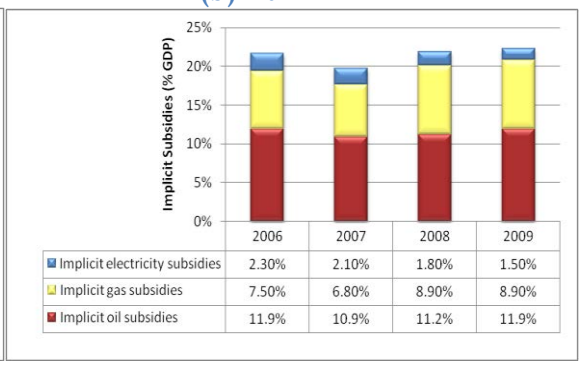
Fig. 4 Implicit Subsidies in the oil, gas and electricity sector

(a) India



Source: Ministry of Petroleum and Natural Gas, ICRA

(b) Iran



	2006	2007	2008	2009
Implicit electricity subsidies	2.30%	2.10%	1.80%	1.50%
Implicit gas subsidies	7.50%	6.80%	8.90%	8.90%
Implicit oil subsidies	11.9%	10.9%	11.2%	11.9%

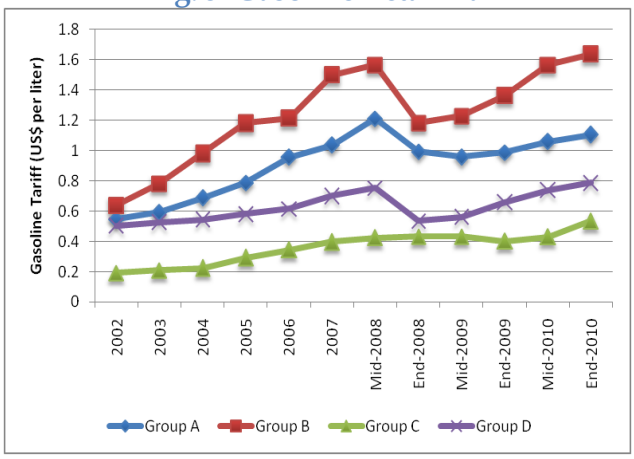
Source: IMF

(b) Have energy subsidy reforms succeeded in restraining energy consumption?

1. Evidence across Groups

Considering the trends in gasoline retail prices, net energy importers (Group A and Group B) have been the most successful in phasing out subsidies. For both groups of countries prices increased substantially from a level of about US$ 0.6 per liter in 2002 to a value of about US$ 1.1 per liter in 2010 for Group A and US$ 1.6 per liter for Group B during the same period. Retail gasoline tariffs remained substantially lower for net energy exporters (Group C and D). However, tariff increased substantially for lower income countries, more than doubling from US$ 0.2 per liter in 2002 to US$ 0.5 per liter in 2010. The lowest tariff increase was recorded for higher income countries, whose average level raised from US$ 0.5 per liter to US$ 0.8 per liter in the same period (Fig. 5).

Fig. 5 Gasoline Retail Tariff



Source: World Bank

Lower income countries (Group A and C) continued to increase gasoline consumption by an annualized rate of 4%, and so did richer net exporters (Group D) even if at the reduced annualized rate of 2% (Fig. 6a). This suggests that the income effect more than outweighs the price effect. Only higher-income net importing countries (Group B) are characterized by a reduction in the consumption of gasoline per capita in the road sector, which can be explained both by the substantial increase in the level of tariffs.

The real impact of tariff reforms on consumption is shown by the considerable decrease in gasoline consumption (per unit of GDP) in the road sector. As shown in Fig. 6b, however, the most notable decline in intensity of consumption is recorded in the low and lower middle income countries (Group A and C). This reflects the much higher rate of growth in GDP in this group of countries and underlines the opportunities to influence future consumption behaviour rather than modifying the existing consumption patterns, overcoming inertia and vested interests.

Fig. 6.a Road Gasoline Consumption per capita

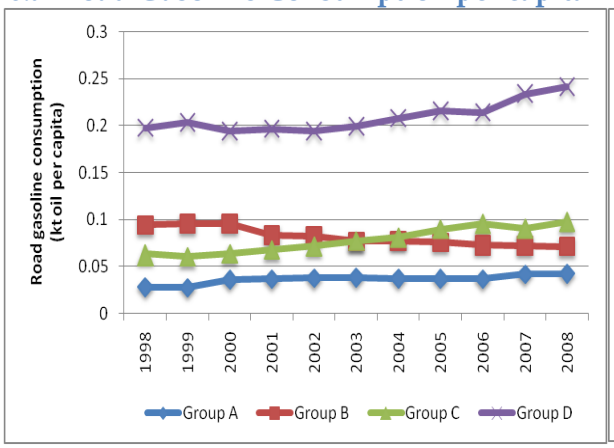
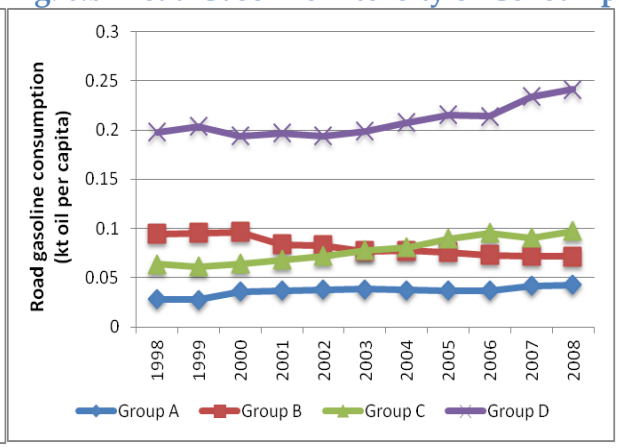


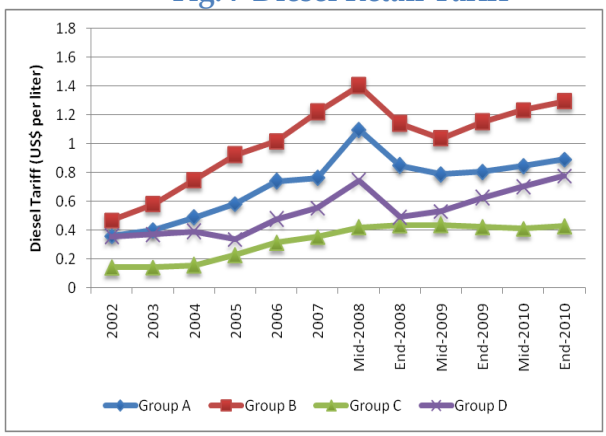
Fig. 6.b Road Gasoline Intensity of Consumption



Source: World Bank

As in the case of gasoline, energy net importers (Group A and Group B) have been the most successful in phasing out subsidies by increasing the price of diesel. For both group of countries prices increased substantially from a level of about US$ 0.4 per liter in 2002 to a value of about US$ 0.9 per liter in 2010 for Group A and US$ 1.3 per liter for Group B during the same period. Retail diesel tariffs remained lower for net energy exporters (Group C and D). However, also for net energy exporters, tariff increased substantially for lower income countries, from US$ 0.1 per liter in 2002 to US$ 0.4 per liter in 2010, but also for richer countries, whose average level raised from US$ 0.4 per liter to US$ 0.8 per liter in the same period (Fig. 7).

Fig. 7 Diesel Retail Tariff



Source: World Bank

Differently from the case of gasoline, all groups of countries are characterized by a much lower but steady increase in diesel consumption by an annualized rate of 2%, with only low income net energy exports displaying a rate of growth of about 4%. Fossil fuel consumption in the road sector (per unit of GDP), however, declined substantially. As shown in Fig. 8b, the most notable decline in consumption was recorded in the low and lower middle income countries (Group A and C).

Fig. 8.a Road Diesel Consumption per capita

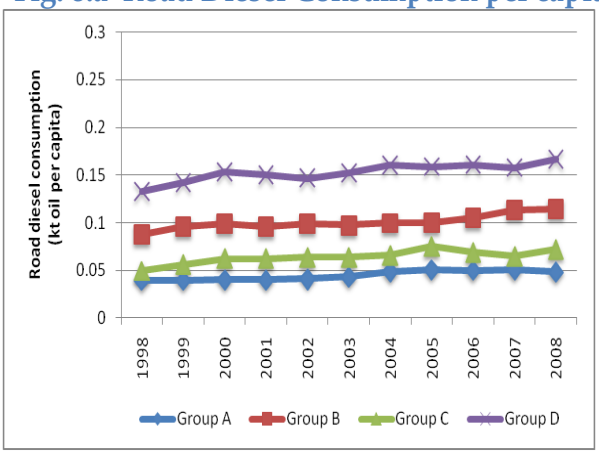
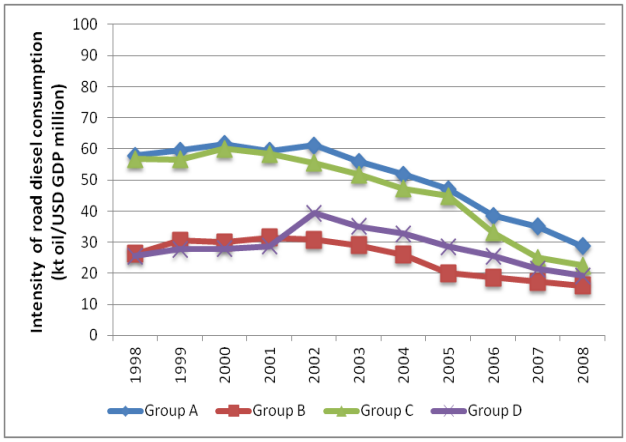


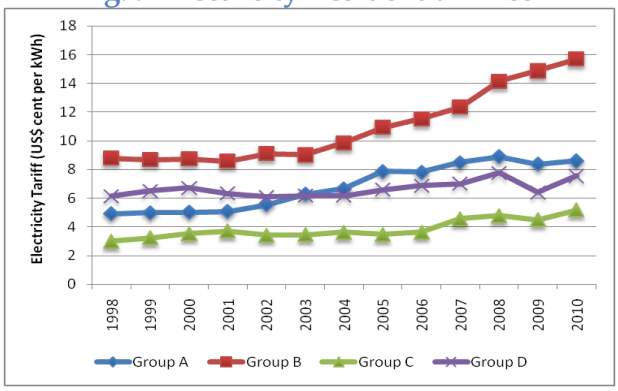
Fig. 8.b Road Diesel Intensity of Consumption



Source: World Bank

Considering the trends in electricity prices, net energy importers (Group A and Group B) have been the most successful in phasing out subsidies by increasing the price of electricity. Among energy importers, higher income countries raised tariffs from US$ 9 cent per kWh in 1998 to US$ 16 cent per kWh in 2010 and lower income from US$ 5 cent per kWh to US$ 9 cent per kWh during the same period. Notable progress has been recorded for lower income net energy exporters whose average electricity prices increased from US$ 3 cent per kWh to US$ 5 cent per kWh, whereas higher income countries have kept electricity tariffs relatively low with increases from US$ 6 cent to US$ 7.5 cent per kWh.

Fig. 9 Electricity Residential Price



Source: World Bank

All groups of countries are characterized by a steady increase in power consumption per capita by an annualized rate of 3%. The only group for which power consumption is increasing at a much faster rate (equal to 5%) is Group B, the same group for which electricity tariffs have been substantially increased. As already noted, there is, however, a dramatic reduction in power consumption (per unit of GDP. As shown in Fig. 10b, the most notable decline in consumption was recorded in the low and lower middle income countries (Group A and C). This reflects the much higher rate of growth in GDP in this group of countries and underlines the opportunities to influence future consumption behaviour rather than modifying the existing consumption patterns, overcoming inertia and vested interests.

Fig. 10.a Electricity Consumption per capita

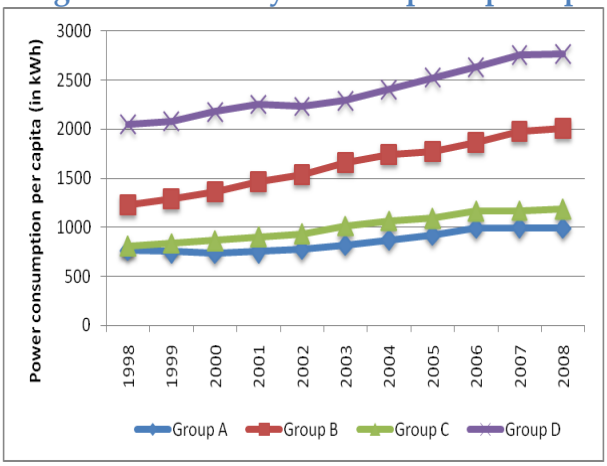
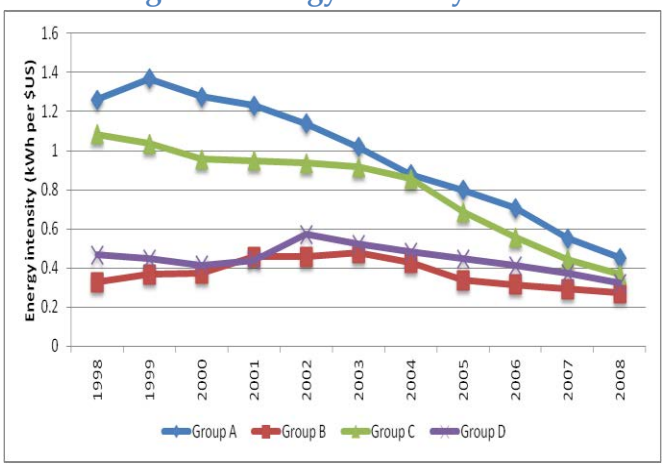


Fig. 10.b Energy Intensity



Source: World Bank

2. Cross Country Evidence

In the effort to phase out fossil fuel subsidies, substantial increases in the prices of gasoline and diesel have been recorded over time. Figures 11a and 12a show the domestic retail price for gasoline and diesel from 2002 to 2010. Countries are ranked according to the level of tariff (in US$ per liter) in 2010. The annualized rate of growth of tariffs (the blue bubbles) is measured on the right hand axis. In our sample of countries, gasoline prices more than doubled from US$ 0.4 per liter in 2002 to US$ 0.9 in 2010 (see Fig. 11a). Diesel prices almost tripled from US$ 0.3 per liter to US$ 0.8 per liter (see Fig. 12.a).

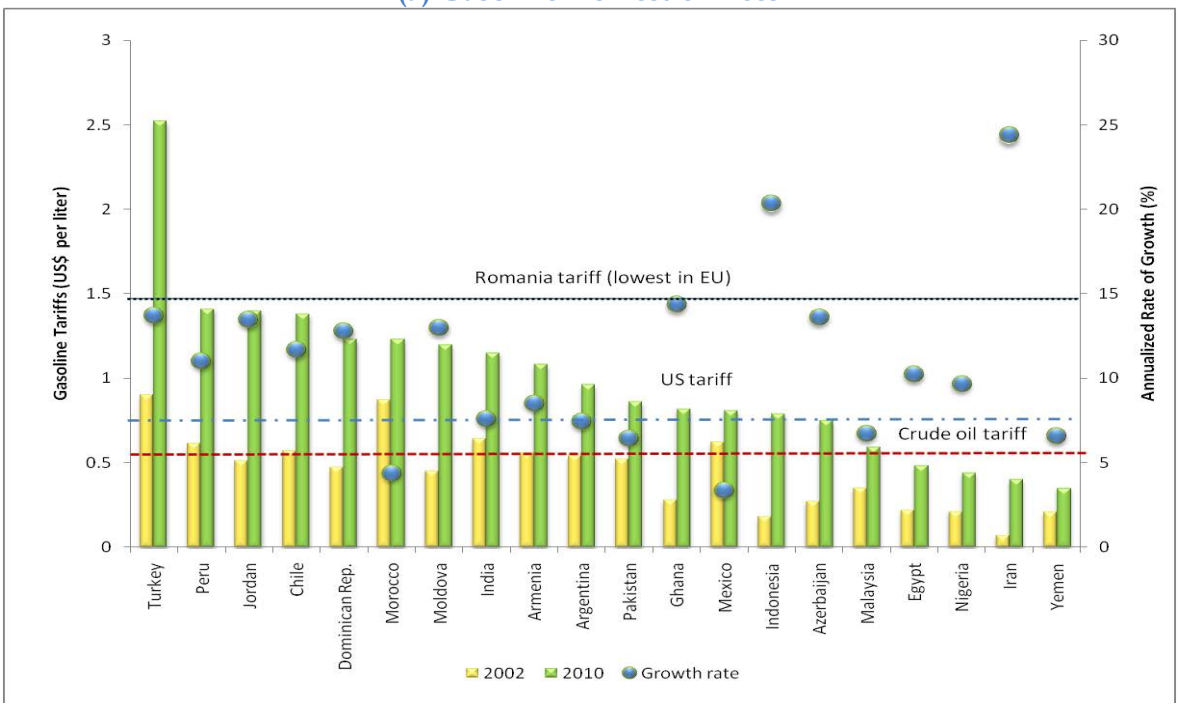
As noted earlier, in our sample of countries, gasoline (and diesel) road consumption per capita increased slightly from 0.08 (0.07) kt oil equivalent in 1998 to above 0.09 kt in 2008. The intensity of road consumption of gasoline (and diesel) in terms of unit of GDP, however, declined dramatically from 44 (53) kt oil equivalent to 23 kt oil equivalent (Fig. 11b and 12b), confirming the much higher income than price elasticity. Our results confirm the result of the economic literature estimating price and income elasticities of gasoline and diesel (Box. 1).

Box 1
Evidence from estimations of fossil fuel and price and income elasticity

Based on a review of 124 developed and developing countries, including the majority of countries which are covered in this report, Dahl (2011a) estimates a range of values for the price elasticity between -0.11 and -0.33 in the case of gasoline and between -0.13 and -0.38 in the case of diesel. Price elasticity tends to be higher the higher the level of price and GDP per capita particularly in the case of gasoline. A possible explanation is that in low income countries it is only rich people who can afford personal vehicles and they tend be less responsive to changes in prices. Income elasticity ranges between 0.66 and 1.26 for gasoline and are estimated to be around 1.3 for diesel. In addition, income elasticity for fossil fuels tends to be lower the higher the level of GDP per capita.

Based on a review of developed countries, Goodwin et al. (2004) also found that income elasticity is greater than the price elasticity, mostly by factors of 1.5-3. The mean of price elasticity for fuel consumption from dynamic estimations is equal to -0.25 (in the short run) and -0.64 (in the long run), and -0.43 from static estimations. The mean of income elasticity of fuel consumption from dynamic estimations is 0.39 (in the short run) and 1.08 (in the long run), and 0.49 from static estimations.

Figure 11
(a) Gasoline Domestic Prices



(b) Road Sector Gasoline Intensity of Consumption

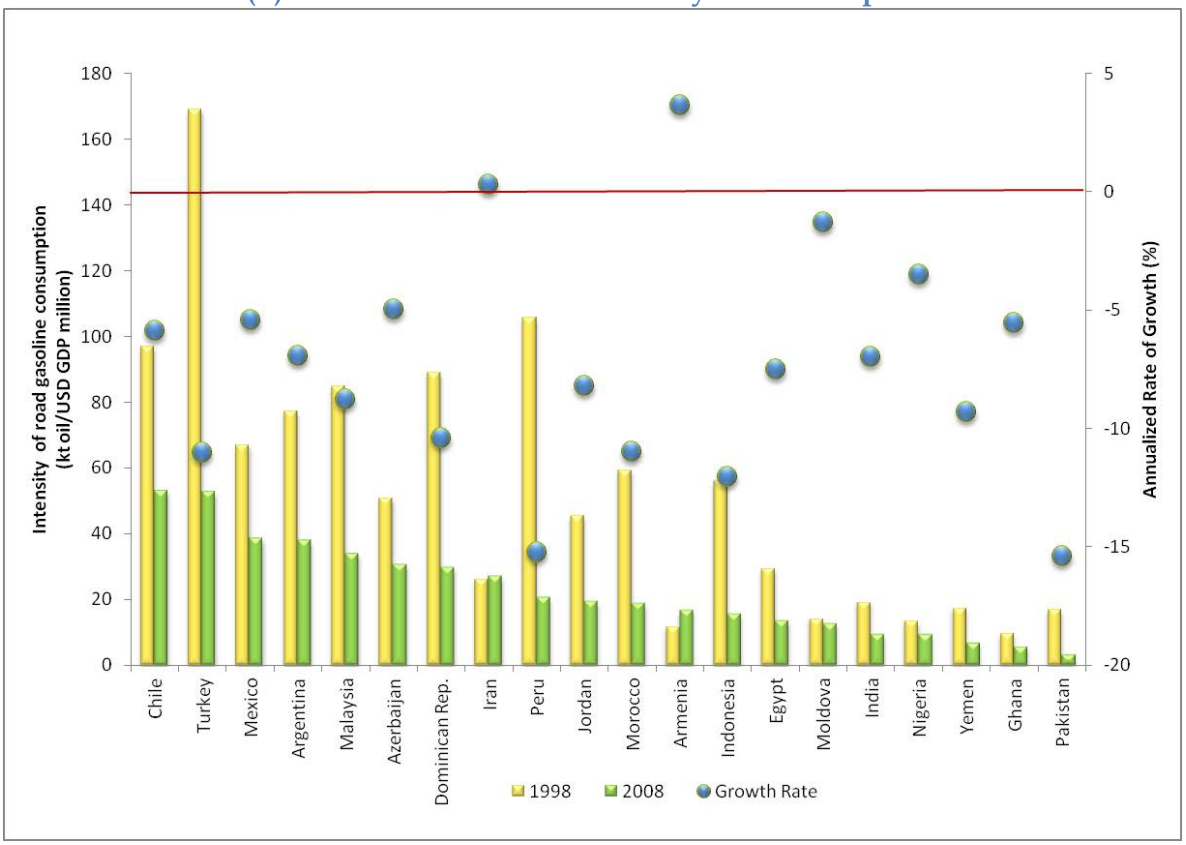
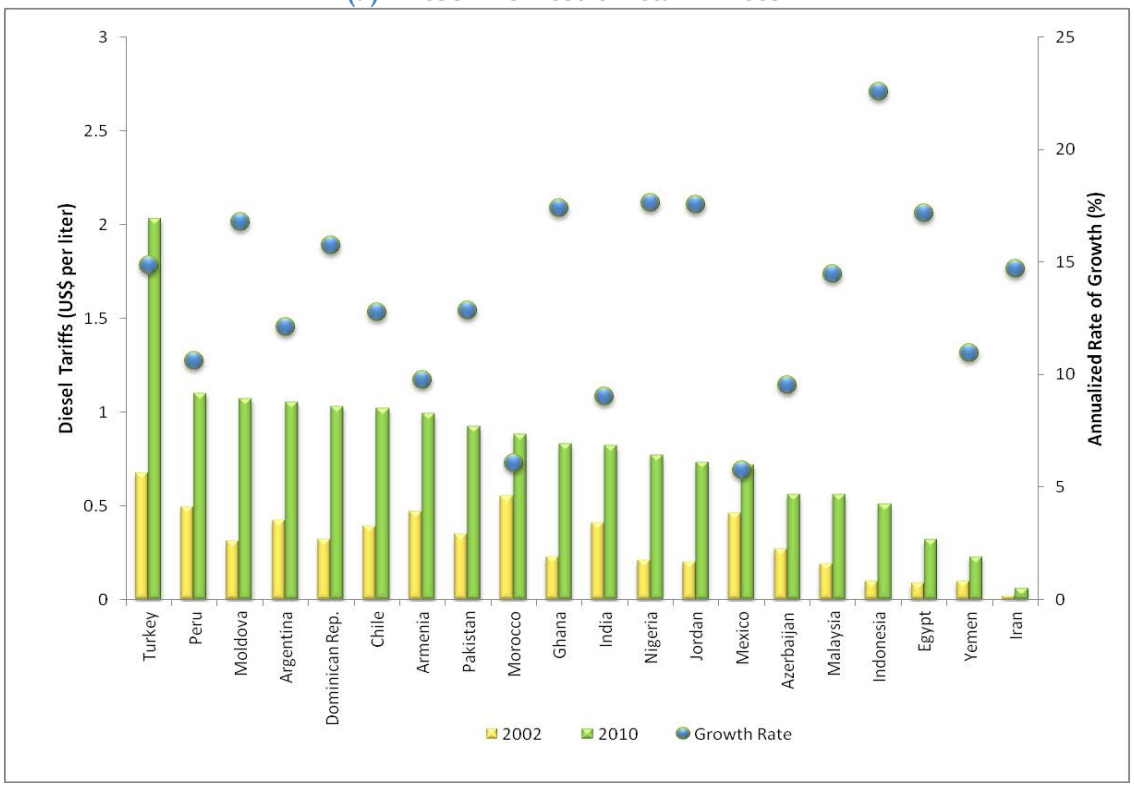
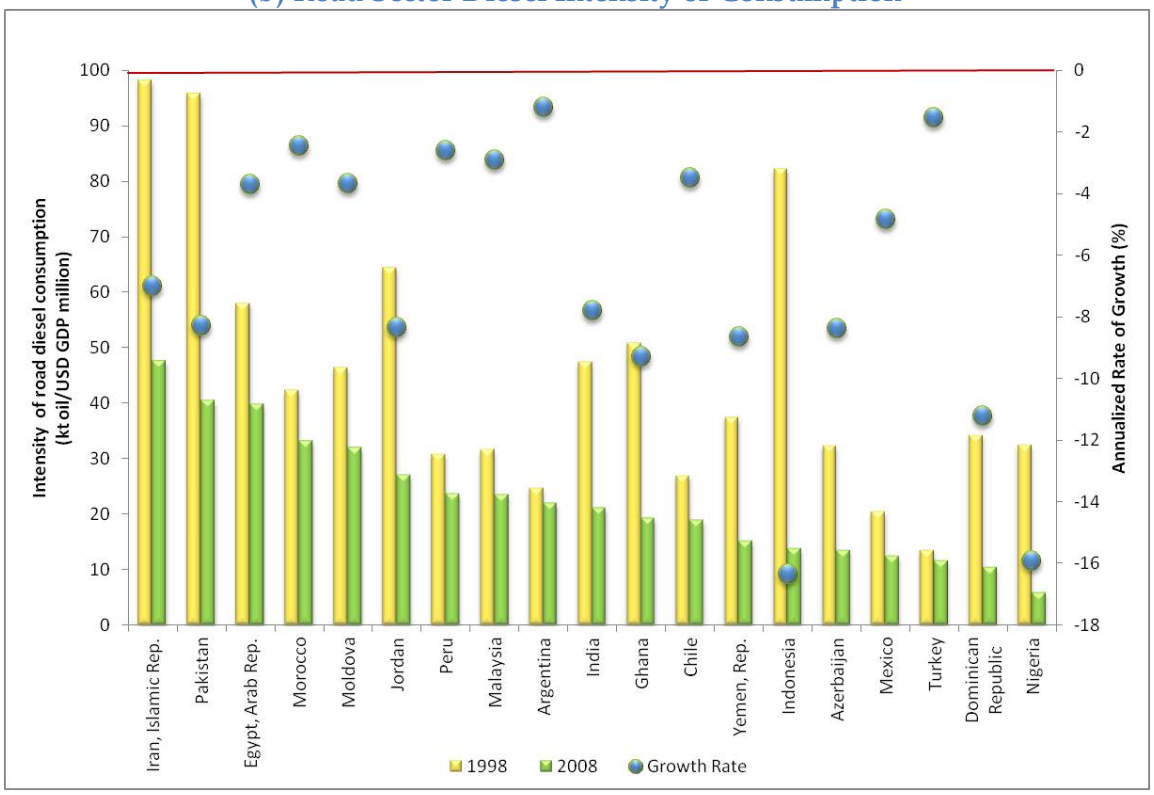


Fig. 12

(a) Diesel Domestic Retail Prices



(b) Road Sector Diesel Intensity of Consumption



Source: World Bank

Evidence of phasing out electricity subsidies is also strong. Fig. 13a shows the domestic retail price for electricity from 2002 to 2010. Countries are ranked according to the level of tariff (in US$ cent per kWh) in 2010. The annualized rate of growth of tariffs (the blue bubbles) is measured on the right hand axis. For our sample of countries the average electricity tariffs increased by 50% from US$ 6 cent in 2002 to US$ 9 cent per kWh in 2010. Net importer countries, including Chile, Dominican Republic and Turkey display the highest electricity tariffs. Net energy exporters, including Egypt, Yemen and Iran but also Argentina charge the lowest electricity tariffs. Only Yemen and Argentina recorded a decrease in tariffs. Among the countries that recorded the most dramatic increase in gasoline and diesel tariffs are both net energy exporters, such as Azerbaijan, Indonesia, Iran and Egypt, and net energy importers, such as Chile, Turkey, Moldova, and Dominican Republic.

In our sample of countries, power consumption per capita increased from 1000 kWh in 1998 to above 1500 kWh in 2008 despite price increases. Energy intensity in 2008, however, became less than half of the 1998 level, declining from 0.9 kWh to 0.4 kWh (in unit of GDP). These results are in line with the majority of the estimates found in the literature that indicate that income elasticity is higher than price elasticity for electricity. Also, in general, demand for electricity is more responsive to changes in price and income in the long run than in the short run (see Box 2).

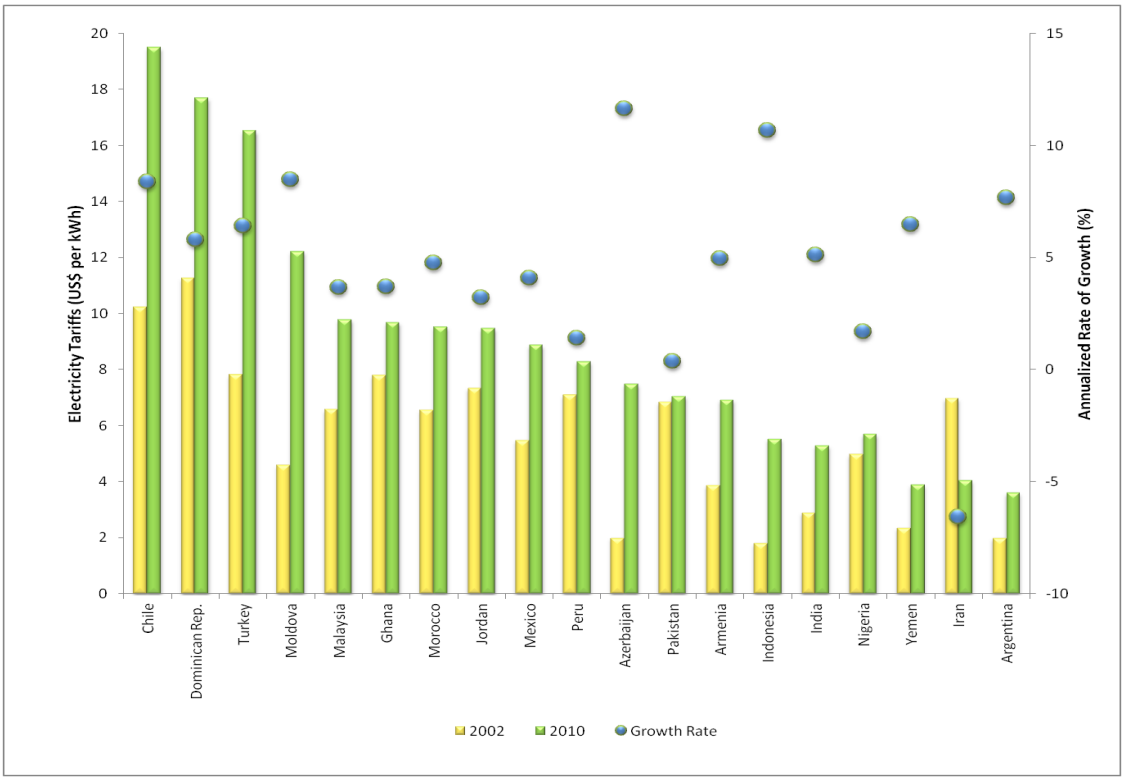
Box 2
Evidence from estimation of electricity price and income elasticity

The results of Dahl (2011b), based on a global survey of electricity demand including more than 450 studies for about 60 countries for the period from 1951 to the present, indicate that the mean price elasticity in the short run is -0.21 and -0.48 in the long run, and that the mean income elasticity is 0.32 (in the short run) and 1.08 (in the long run). The earlier results by Espey and Espey (2004) based on a meta-analysis of residential electricity demand elasticities from 36 studies (mostly from developed countries) found the mean price elasticity equal to -0.35 and -0.85 respectively in the short and long run and the mean income elasticity equal to 0.28 and 0.97 respectively in the short and long run.

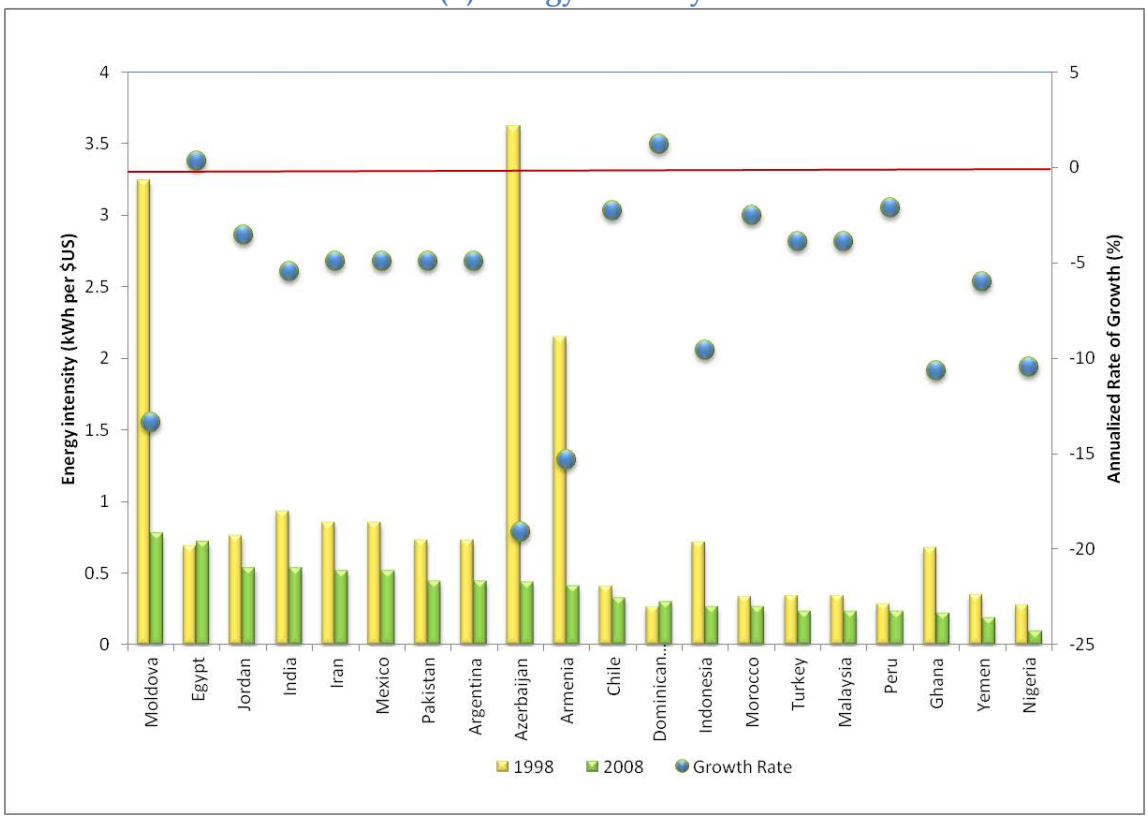
Estimates of income elasticity for countries with lower income than the US are higher. As income increases in developing countries, electrification, ownership of appliances, and demand for electricity increase at a fast rate. However, as the access to electricity reaches 100% and ownership of appliances approaches saturation, increases in income have a smaller effect on demand for electricity.

Figure 13

(a) Electricity Prices over time



(b) Energy Intensity



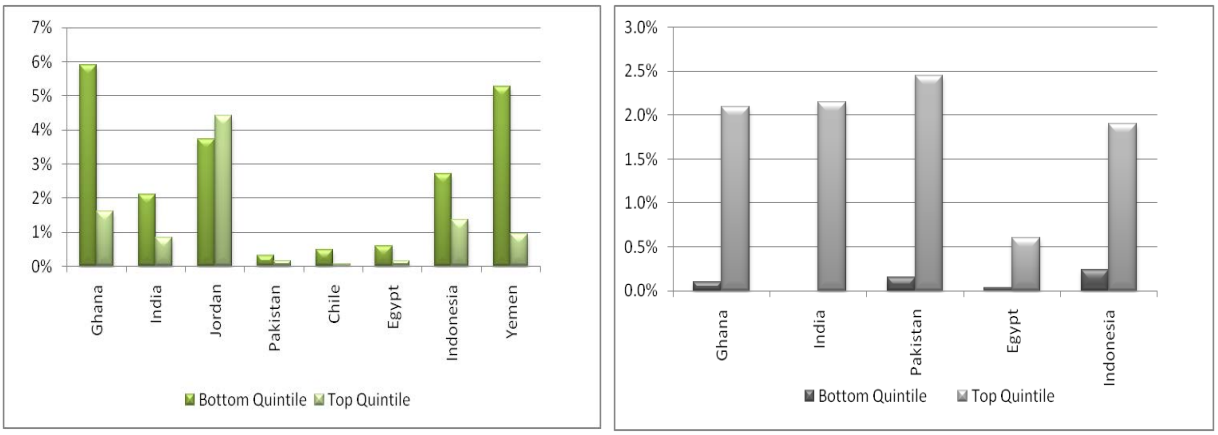
Source: World Bank's elaboration

(c) Have energy subsidy reforms managed to avoid adverse social impacts?

Household surveys show interesting patterns in the consumption of fuel and electricity. Kerosene, which is used for lighting and heating in low-income countries where households do not have access to electricity, shows in most of the cases a regressive pattern, with the bottom quintile consuming up to 6 times their income for such fuel, compared with the top quintile (Fig. 14a). Gasoline, which is used in internal combustion engines such as motor vehicles, shows a progressive pattern, with the richer quintile consuming from 10 to 20 times their income for such fuel, compared with the top quintile (Fig. 14b).

Fig. 14
Fuel Expenditure (% income), by top and bottom quintile

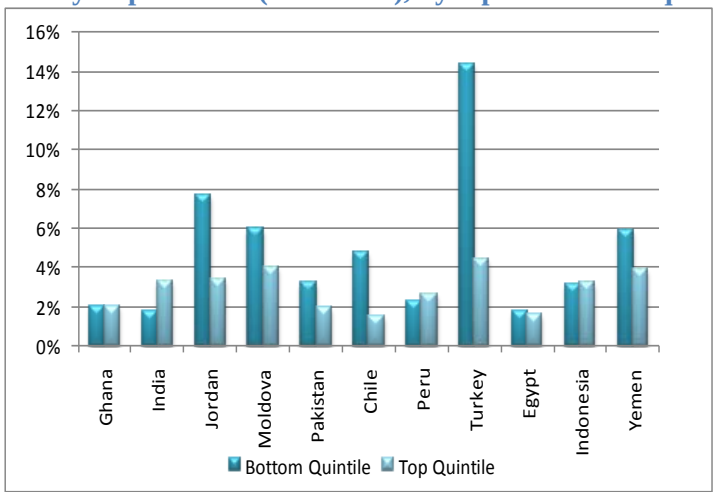
a) Kerosene **b) Gasoline**



Source: Household Surveys results reported in Vagliasindi (2012)

Electricity in most of the cases displays a regressive pattern, with the bottom quintile consuming up to 3 times their income compared with the top quintile (Fig. 15).

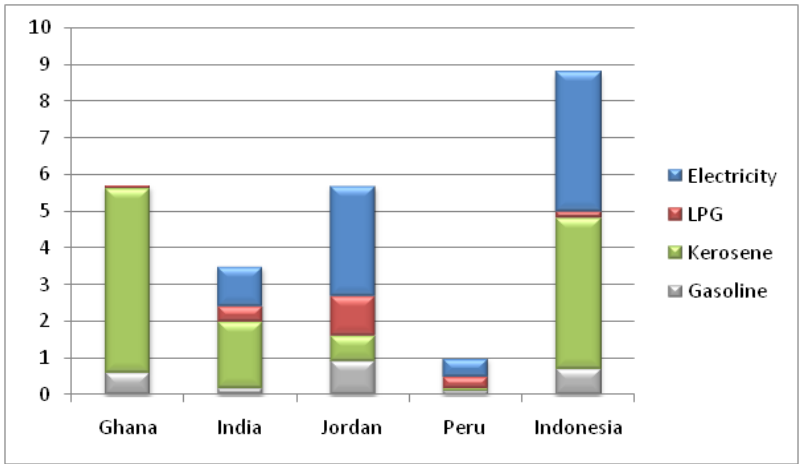
Fig. 15
Electricity Expenditure (% income), by top and bottom quintile



Source: Household Surveys results reported in Vagliasindi (2012)

Such a consumption pattern has important implications for the impact of the removal of subsidies. Del Granado *et al.* (2010) consider the direct impact of an US$ 0.25 per liter increase in fuel prices in the case of a number of countries, including Ghana, India and Jordan (Group A), Peru (Group B) and Indonesia (Group C). The *direct* impact of phasing out subsidies, considering the impact for the consumption of fuels for cooking, heating, lighting, and private transport and its composition vary substantial across these countries, as shown in Fig. 16.

Fig. 16
Welfare Impact of Removing Fuel Subsidies (% loss in real income)



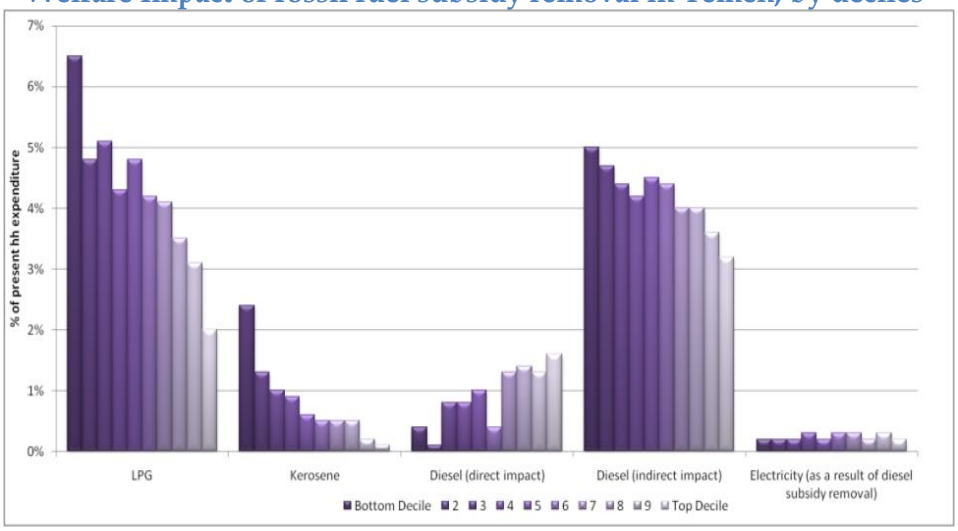
Source: Del Granado et al (2010)

For all low income countries, where kerosene represents an important source of fuels particularly for the poor, with the exception of Jordan where the rate of electrification is very high, the lion's share of the loss of real income comes from the reduced consumption of kerosene. The kerosene component that contributes to the loss of real income ranges from almost 90% in the case of Ghana to 50% in India and slightly less than 50% in the case of Indonesia. On the other hand, for higher income countries with a higher rate of electrification (such as Peru and Jordan) the most substantial welfare impact comes from the reduced consumption in electricity.

More detailed simulations of the impact of removal of different fossil fuel subsidies on the real income of consumers confirm the differential impact we would expect on the poorer and richer quintiles in light of the pattern of consumption by quintiles described above.

In the case of Yemen, a low income country, if prices of all petroleum products were raised to their economic levels, low income households would bear a relatively higher burden in the case of kerosene, compared to higher income households (Fig. 17). On the contrary, the direct impact of the removal of subsidies for diesel fuels would be more costly to high-income households. Again – this is due to the fact that richer deciles tend to consume more diesel than poorer deciles do. The aggregate effects of eliminating subsidies on most of the fuels are regressive, i.e. the poor's energy expenditures would rise by a greater proportion than the non-poor's (World Bank, 2005).

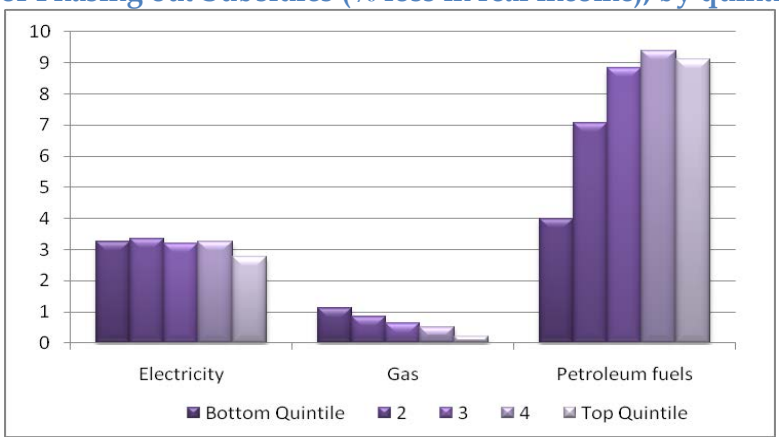
Fig. 17
Welfare Impact of fossil fuel subsidy removal in Yemen, by deciles



Source: World Bank (2005) based on 2003 Household Energy Survey

Similar results were found for a higher income country such as Malaysia. Modadkhani et al. (2010) model the direct welfare effects of doubling the prices of all sources of energy. For petroleum fuels the most adversely affected group is the top quintile for which the loss of real income is above 9%. This is more than twice the loss of real income of the lowest quintile which was estimated at around 4%. No significant difference of loss of real income between different quintiles was found for electricity. In the case of natural gas instead, the loss of real income for the bottom quintile amounts to 1.1%, more than 5 times the real loss of income for the top quintile (Fig. 18).

Fig. 18
Welfare Impact of Phasing out Subsidies (% loss in real income), by quintiles in Malaysia

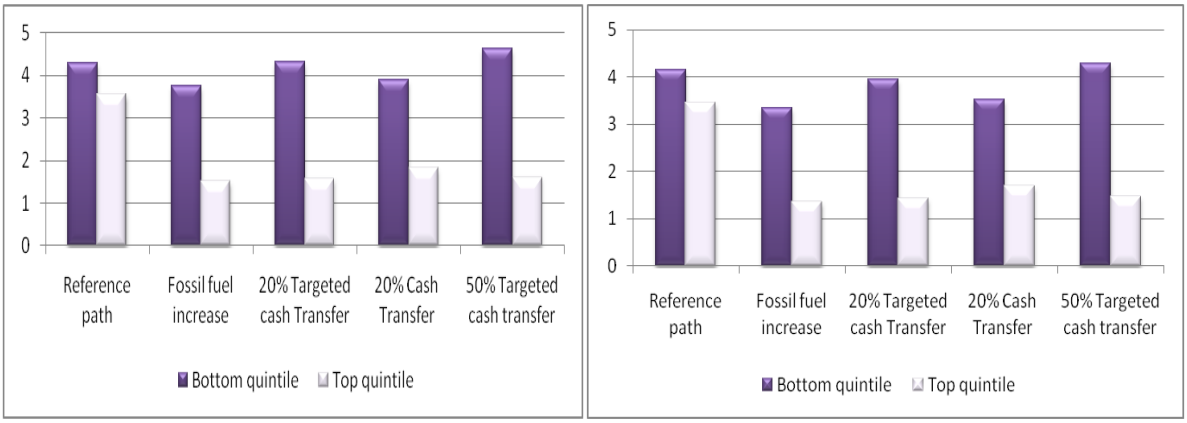


Source: Moradkani et al. (2010) based on Household Expenditure Survey 2005

The studies we considered above look exclusively at the impact of removal of subsidies without considering the reallocation of the savings of such reforms towards more welfare enhancing activities.

We now turn to consider few studies which indeed also considered alternative scenarios where the savings are used to provide cash transfers towards the poor. In the case of Egypt, Abouleinein et al. (2009) and World Bank (2009) analyze the impact of the gradual phasing out fuel subsidies in Egypt over a five-year period from 2008 to 2013. In the first year of simulation the increases implemented in May 2008, including increases in the price of natural gas, heavy oil, diesel, and gasoline respectively by 58.33%, 100%, 46.7% and 28.2%. Using a CGE model, the study shows that the elimination of energy subsidies, without any offsetting policy actions, would reduce average annual GDP growth by 1.4 percentage points over the reference period and depress the welfare levels of households at all levels of the income distribution. Inequality is reduced, however, reflecting the larger welfare impact on households in the richest quintile of the distribution (Fig. 19).

Fig. 19
Welfare Impact of Removing Energy Subsidies (% loss in real income) in Egypt
(a) Rural **(b) Urban**

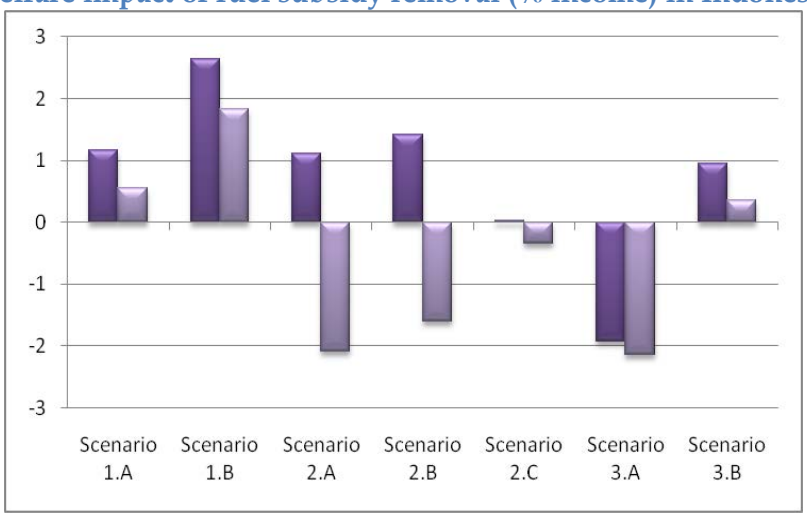


Source: 2005 Household Survey (reported in World Bank, 2009)

The authors also examine alternative scenarios involving either targeted or untargeted transfers that redistribute 50% of the energy subsidy savings. Untargeted transfers of this magnitude still result in income losses to households at all levels of the income distribution. However, transfers targeted to the poorest two quintiles of the income distribution increase their welfare relative to what it would have been in the presence of energy subsidies, generating a large improvement in income distribution measures. Economic growth is higher with targeted transfers compared to untargeted transfers, as a greater portion of the funds are recycled into higher consumption (although growth is still lower than what it would have been in the absence of the reforms).

In the case of Indonesia, Yusuf (2008) used a Computable General Equilibrium (CGE) model to simulate the economic and distributional impact of the package of subsidy removal implemented by the Indonesian authorities in October 2005, which entailed the increase in the price of gasoline by 87.5%, diesel by 104.7% and kerosene by 185.7%. The 2005 package is simulated through different scenarios. The first one is without the increase in the price of kerosene. Three scenarios consider together with the package the introduction of a compensation offered through the Unconditional Cash Transfer (UCT) to the poor. As there is no consensus on the degree of effectiveness of the UCT scheme (though it has been recognized as very successful), two alternative assumptions on the degree of its effectiveness are made (100% and 75%, the latter scenario assuming that the amount of cash given to every target group of household is reduced by 25%).

Fig. 20
Welfare impact of fuel subsidy removal (% income) in Indonesia

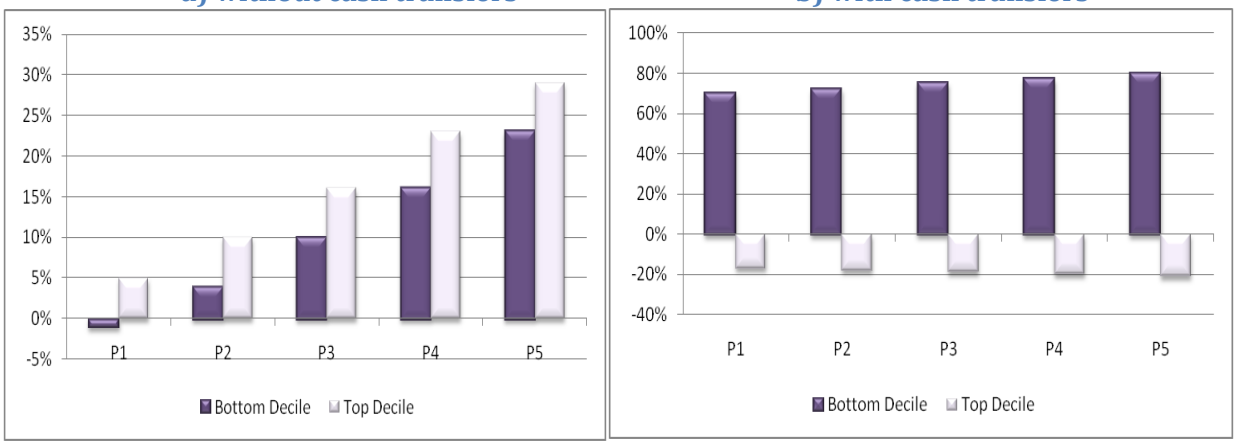


Source: Yusuf (2008)

The two final simulations introduce a subsidy to targeted household for spending on education and health (in the same amount of the UCT) with and without the 2005 package of reform. The distributional impact of alternative scenarios shows interesting results (Fig. 20). Incidence of both urban and rural poverty is significantly lower where the subsidy removal does not include kerosene, supporting the evidence reported in the previous section that among petroleum fuels they are the most "progressive". Overall national poverty incidence decreases for all UCT schemes, but urban poverty incidence is shown to increase even with a 100% effective UCT scheme. Adjusting somewhat the scheme providing more support to urban poor is shown to prevent the increase in urban poverty, while not negatively affecting poverty incidence in rural areas. In contrast with UCT schemes, subsidizing education and health expenditure when combined with the 2005 package would increase both urban and rural poverty incidence, respectively, by 0.9 and 0.35%. This result may be interpreted as investment in human capital is a longer term strategy rather than a short term measure. Hence it is less effective in minimizing the impact of energy pricing reforms.

Fig. 21
Welfare impact of Removal of Electricity and Natural Gas Subsidies (% loss in real income), by deciles and over time in Argentina

a) without cash transfers **b) with cash transfers**



Source: Benitez and Chisari (2010)
Note: P1-P5 refers to the 5 years period after the simulation of the tariff increase in 2006

In the case of Argentina, Benitez and Chisari (2010) provide estimates using a dynamic CGE model that simulates the economic and social impact of removing residential consumer electricity and natural gas subsidies. The model uses a social accounting matrix for the Argentinean economy in 2006 where household subsidies accounted for around 0.4% of GDP. Fig. 21 reports the results of the welfare impact of subsidy removal as loss in consumer real income under difference scenarios: without any mitigating policy to protect the poor and with cash transfers targeted to the poorest decile of the population. All incremental changes in percent for the period 2007-2011 with respect to the benchmark are reported. The results show how cash transfers help to mitigate the social impact of subsidy removal on the poor, with substantial incremental increases in real income for all periods. It is also worth noting that in the absence of mitigating policies welfare losses are experienced by the poorest decile only the first year following the reforms.

iv. Lessons Learned

The review of the experience highlights some lessons that may help other countries to engage in such reforms:

1. Strengthening social safety nets and improving the targeting mechanisms for subsidies

An important condition for successful reforms is the credibility of the government commitment to compensate vulnerable groups and to use the funds freed from subsidy reform for more welfare enhancing activities. Policy tools to protect the poor include and lifeline rates, which generally perform better than universal subsidies as well as cash transfers. Use of transitional arrangements and short term measures to alleviate the impact of tariff increases on the poor can act to protect low-income groups at the time of the policy change.

- Improving design and use of Household Expenditure Surveys: Using a household expenditure survey to provide information on those benefiting from the existing subsidy and the impacts on the various groups from subsidy removal provides an important reference for assessing the adequacy of compensation measures that are planned. Prior to

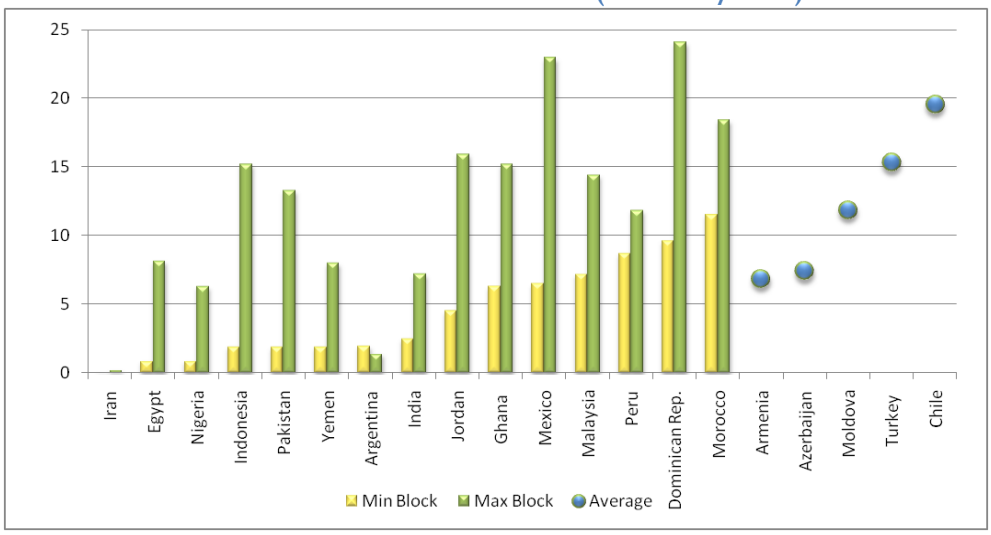
designing a strategy, a Poverty and Social Impact Analysis (PSIA) can be helpful in determining what budget shares are spent on energy vis-à-vis household income levels and total household expenditures.

- Enhancing Targeting: Targeting mechanisms and methods for identifying those eligible for the subsidy program can vary, depending on the degree of coverage as well as the extent to which different programs are progressive, determining trade-offs between different solutions, as highlighted below. Moreover, policy makers should also be careful in avoiding that programs to ensure energy affordability contribute to the fragmentation of safety nets programs, leading to small, complex and ineffective policy measures. To be effective, subsidy programs should adopt simple and transparent targeting criteria consistent with those adopted by the social assistance system, ideally within the context of a unified registry.

A. Lifeline tariffs

❖ Lifeline electricity tariffs, despite being widespread in developing countries (as Fig. 22 shows for our sampled countries), are usually a second best option, as experience shows that they have been regressive and they did not reach the poor where access is an issue. For countries with high connection rates lifeline tariffs offer the advantage of much higher coverage of the poor than other existing targeted programs, even if at a high cost.

Fig. 22
Lifeline tariff across countries (cents US/kWh)



Source: World Bank

❖ The impact of the introduction of direct cash transfers is illustrated by the Armenian case. To soften the impact of the tariff increase, a direct cash transfer of 1,450 Armenian drams (approximately $2.70 using 1999 conversion rates) was provided to approximately 30% of households (230,000 households) eligible for the family benefit, plus an additional 9% (70,000) to those expected to have difficulty meeting their electricity payments. A significantly higher percentage of the poor (as compared to the

non poor) regularly consuming in the first two blocks of the 1998 electricity tariff were receiving the income transfer in 1999.

B. Improving targeting performance

- To improve the targeting performance of electricity subsidies is to move from traditionally used Inverted Block Tariff to Volume Differentiated Tariff (VDT) structures, where the lowest price for the lowest block is only available to those consuming within the first block (usually the lower-income households). In countries characterized by high connection rates a move from IBT to VDT and the use of means-tested discounts substantially increases the targeting performance of subsidies.
- Angel-Urdinola and Wodon (2005) simulated in the case of Cape Verde the effect of replacing an increasing block tariff with a volume differentiated tariff, where the threshold and the price of those receiving the volume differentiated tariff was the same as that of the first block (40 kWh per month), while all others paid the full cost, namely the price of the second block. In this case the targeting performance increased to 1.06, showing slight progressivity. Komives *et al.* (2009) simulated various alternative subsidy schemes for electricity in the case of Mexico and found that a volume differentiated tariff (as well as the use of means-tested discounts) would increase the value of the targeting performance. The high rate of connections in this case ensured that exclusion rates would be low under any alternative schemes. It should be noted that the results of Cape Verde where electrification rates are high do not apply to other Sub Saharan countries, where instead in most of the cases such a change would have only a limited impact on targeting performance. However, even in the most pessimistic scenario this re-targeting would help in reducing the overall price tag of subsidies, as well as to help to achieve the original poverty objective of subsidies in reaching the poor.
- Where possible, the use of geographical or socio-economic targeting variables substantially improves the targeting performance of subsidies in the case of electricity. Apart from the United States' Low Income Home Energy Assistance Program's (LIHEAP described in Box 3), examples include geographically defined subsidies in Colombia, average of provincial means-test subsidies in Argentina and winter heating allowance scheme in Georgia (Tbilisi) are all reaching the poorest quintiles (Fig. 23). Geographical targeting may be more problematic for petroleum fuels, as they may be more difficult to be implemented and more vulnerable to smuggling and fuel adulteration.

Box 3
The US Low Income Home Energy Assistance Program's (LIHEAP)

The Low Income Home Energy Assistance Program's (LIHEAP) administered by the U.S. Administration for Children and Families (ACF) is a block grant program that aims to assist low-income households, particularly those with the lowest income that pay a high proportion of their household income for home energy, in meeting their immediate household energy needs. LIHEAP was launched in 1982 and resulted from earlier programs introduced in response to the energy crisis of the 70s. Under LIHEAP, the federal funds are allocated to individual states and disbursed under programs designed by the states. The vast majority of LIHEAP disbursed funds (more than 80%) used to assist eligible households in meeting the costs of home energy, which is defined as a heating or cooling in residential dwellings.

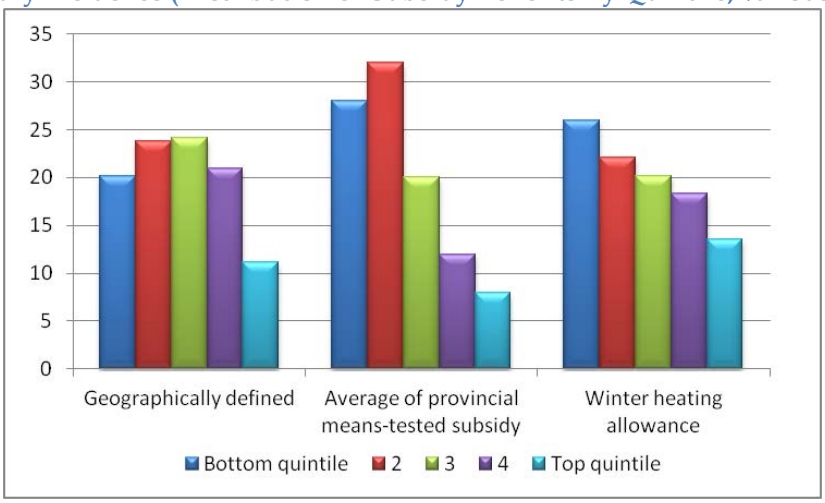
i. Eligibility and Coverage:

- **Households are eligible for LIHEAP under federal standards when incomes do not exceed 150 percent of the poverty level for their state or 60 percent of the state median income**. However, states may set income limits as low as 110 percent of the poverty level. The law requires benefits to be targeted to households with the highest energy costs in relation to income and household size.
- **LIHEAP is targeted in that it assists households with only that portion of residential energy costs that goes for home heating and home cooling.** Funds are available for payment of heating or cooling bills, Low-cost weatherization projects (e.g., window replacement or other home-energy related repair; limited to 15% of allotment unless a grantee has a waiver for up to 25%); services to reduce need for energy assistance (e.g., needs assessment counseling on how to reduce energy consumption; limited to 5% of allotment) Assistance with energy-related emergencies (winter or summer crisis aid)
- **The LIHEAP statute requires the highest level of assistance to be provided to those households that have the lowest incomes and the highest energy costs or needs in relation to income, taking into account family size**.

ii. Targeting:

- **As of 2008 LIHEAP recipient households had average energy expenditures of US$ 2,104, about 12 percent higher than the average for low income households**. The mean individual energy burden for LIHEAP recipients was about 17 percent, more 9 percentage points higher than the mean individual energy burden for all households and about 3 percentage points higher than the mean individual energy burden for low income households.
- **LIHEAP recipients spent a higher proportion of their annual residential expenditures for space heating and a lower proportion for space cooling than did other groups**. LIHEAP recipient households spent 40 percent of their annual residential expenditures for space heating, 8 percentage points more than did the average low income household.
- **The performance indicators used to measure the achievement of the program goals include recipiency targeting index, benefit targeting index and burden reduction targeting indexes. Recipiency targeting index can be used to examine the effectiveness of the outreach initiatives to households with vulnerable members and households with high energy burdens**. The recipiency targeting index is computed by dividing the percent of LIHEAP recipient households that are members of a target group by the percent of all LIHEAP income eligible households that are members of the target group and then multiplying by 100. Benefit and burden reduction targeting indexes are used to examine the effectiveness of benefit determination procedures in serving households with vulnerable members and households with high energy burdens.

Fig. 23
Beneficiary Incidence (Distribution of Subsidy Benefits By Quintile, % households)



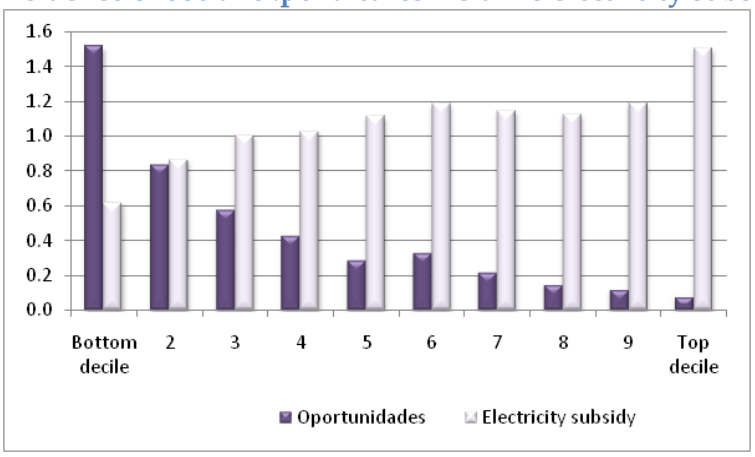
Source: Komives *et al.* (2007)

- In many countries particularly in the case of middle income countries, a close coordination between different stakeholders is needed, since electricity tariffs are set either by sectoral regulators or by the forces of the market, through auctions in the wholesale market, while programs that refund energy expenditures might be run by either energy providers or the social assistance systems. This entails significant implications (a) for the feasibility of some targeted programs; (b) for the effectiveness of some of targeted programs. With regard to the former issue, in liberalized energy sector regulators may oppose the introduction of compensatory measures managed by energy providers. With regard to the latter point, measures such as Volume Differentiated tariffs would require close coordination around targeting between energy regulators and providers and the social assistance system.

C. Cash Transfer Programs

- As Komives *et al.* (2007) show that cash transfers and near-cash transfers (food stamps, etc.) were progressive in the great majority of cases studied. In contrast, consumption subsidy for electricity is regressive, and only one in five of the 37 cases studied was progressive. However, the implementation of targeted transfers can be challenging. Their effectiveness and efficiency depend on the targeting method and administrative capacity.
- The case of Mexico where cash transfers have been provided in parallel with subsidies accruing to lower consumption customers through increasing block tariff is quite revealing. *Oportunidades*, Mexico's main anti-poverty government program involving the geographic selection of poor areas and proxy-means tests to select beneficiaries, has been quite successful in targeting the poor and in contrast to electricity subsidies shows a high degree of progressivity (see Fig. 24).

Fig. 24
Benefit Incidence of social expenditures vis-à-vis electricity subsidy (% income)



Source: Encuesta Nacional de Ingresos y Gastos de los Hogares (ENIGH), 2008

- To be effective, the cash transfer component should be enough to compensate for the increases in energy prices. Ways to distribute cash to households can vary and different methods have been used by different countries with experience with such programs. Some have set up bank accounts for beneficiaries while others, such as Malaysia, have used smart cards. The Indian authorities are implementing an ambitious unique identification project. The program started with pilot projects in a number of states before the implementation of the program scheduled for 2012.

2. *Informing the public and announcing one off compensatory measures*

Governments need to ensure public trust in the reform agenda through broad communication, appropriate timing of subsidy removal, and implementation of compensatory social policies. Explaining the need for change and the compensating measures that will be undertaken, before the changes are introduced, reduces uncertainty and can make the case for reform stronger. Planning careful communication strategies including media and public campaigns in order to reach out to the poor and those who will be most affected by the subsidy reform can help minimize public opposition to energy subsidy reforms (See Box 4).

- It is essential for the information campaign to communicate to consumers that what they pay is often only a fraction of the full cost of the service. Experience shows that the in some countries those who receive subsidized energy are often not even aware that government in fact subsidizes their consumption.
- The campaigns ought to also explain the imperfect nature of subsidies and their leakage to higher income groups, for which the subsidy is not intended. Reviewing the lessons learned from the experience is often more persuasive than ex ante analysis.
- Public campaigns are also most useful to document the benefits from reallocation of the savings by removing fuel subsidies, which the government will determine as part of its safety net strategy prior to undertaking such reforms.
- While developing social safety nets is important in ensuring consumers cope with higher prices successfully in the long run, tariff and fuel price increases should be accompanied with immediate short term measures.

Box 4
The Importance of Communicating Subsidy Reforms

Careful communication strategies including media and public campaigns in order to reach out to the poor and those who will be most affected by the subsidy reform has represented a pivotal element of reforms (World Bank, 2010).

i. Ghana

- In 2004, the government launched a poverty and social impact assessment (PSIA) for fuel. Guided by a steering committee of stakeholders from ministries, academia, and the national oil company, the PSIA was completed in less than a year. By the time the government announced the 50% price increases in February 2005, it could use the PSIA findings to make its case to the public for liberalizing fuel prices (Coady et al., 2006). The Government of Ghana used budgetary savings to expand the existing rural electrification scheme. This was a prominent component of the expenditure package introduced simultaneously with fuel price increases. The incidence of the benefits from these expenditures was found to be strongly progressive (Coady et al., 2006). The mitigation measures, transparent and easily monitored by society, included an immediate elimination of fees at government-run primary and junior secondary schools and a program to improve public transport. Extra funds were made available to an existing program, the Community Health Compound Scheme, to enhance primary health care in the poorest areas (Bacon et al., 2006). The minister of finance launched a public relations campaign via broadcast explaining the need for the price increases and announcing measures to mitigate their impact. In November 2007, prices were increased again by 35%.

ii. Indonesia

- Indonesia has a history of violent protests against attempts to implement fuel price increases like the time when President Megawati was forced to roll back the prices in 2003. However, an important lesson that emerges from the case of Indonesia is that decisive leadership and government popularity along with appropriate compensation measures and an effective informational campaign works to counteract citizen disenchantment and prevent any impending riots. Current President Yudhoyono's credibility helped successfully increase fuel prices, the savings from which he then directed toward the UCT program in 2006. Additionally, before introducing UCT the government initiated an extensive nationwide information campaign about the benefits of the program, which helped citizens learn about the value of the program and prevented possible unrest.

iii. Jordan

- Jordan is the one of the few countries in the MENA region to have succeeded in implementing fuel subsidy reforms. Price regulation was replaced with automatic monthly adjustments of the domestic price to reflect changes in international prices, which have generated significant savings for the government. The transition has been relatively smooth and peaceful. One of the key elements in the reform was the large public communication campaign undertaken in order to inform the people and appease them to prevent protests. A wide-ranging compensation package was introduced to prevent increases in poverty, and to secure the consent of the non-poor. In absolute terms, energy subsidies were highly regressive, but the poor spent a higher proportion of their income on fuel. Reforms were also successful because they were coordinated with various stakeholders and preceded by consultations with parliament, the local NGOs, the business community and labor representatives. The political will and determination to phase out subsidies and not backtrack on reform was there, as the emphasis was placed on the regressive nature of the subsidy and the leakage to higher income groups.

3. *Ensuring the Sustainability of Subsidy Policy through Broader Sectoral Reforms*

- Efforts aimed at reducing the burden of subsidies can be affected by situations of crises, posing formidable challenges to the sustainability of such reforms. For instance, both Argentina and Mexico were severely affected, respectively, by the global crisis of 2008 and the domestic crisis of 2001. In the case of Argentina, despite important market reforms were made in the 80s and the 90s after the 2001 crisis tariffs were frozen as a way of cushioning the social costs of the devaluation of the peso. In the case of Mexico, the government abandoned the gradual adjustment of the price of gasoline (taking into account inflation and taxes) and in 2009 it froze its price.
- In the power sector engaging in broader reforms to improve service ahead of reforming energy subsidies, particularly where the quality of electricity services is low, lends credibility and improves consumer willingness to pay. Steps such as improving metering, billing and payment collection bill collection and quality of the service to make tariff increases more acceptable once subsidies are removed (see Box 5).
- Reforming the power sector by engaging in regulatory reforms, vertical and horizontal unbundling, and introduction of private sector participation should not be seen as an end in itself but to the extent to which it delivers improvements in access, quality, operational and financial efficiency of the services (Vagliasindi and Besant-Jones, 2012).
- Improving energy efficiency will also help to reduce the costs of removing subsidies both for energy suppliers and consumers.
  - ❖ Cost based tariffs in line with actual costs will serve as effective price signals to reduce energy wasteful consumption
  - ❖ Better insulation in household buildings where energy is used for heating will reduce the energy bill
  - ❖ Providing discounts for energy saving equipment will help reduce energy use. In line with technology improvements, use of smart meters will help households keep track of expenditures and manage their energy bills more effectively
- More generally, rationalizing the fuel mix for electricity and transport, discouraging private transport in favor of public transport may help supporting reforms, as it would the prioritization of structural expenses that benefit the poor (including sectoral road and rural electrification schemes, but also social expenditure, including health and education).

Box 5
Lessons from broader sectoral reforms in Eastern Europe and Central Asia

Engaging in broader reforms including improving metering, billing and payment collection bill collection and quality of the service to make tariff increases more acceptable once subsidies are removed. The selected examples provide an excellent illustration.

i. Turkey:

- The impetus behind electricity sector reforms, among other factors, has been Turkey's longstanding ambition to join the EU. A reform program to harmonize its electricity sector with EU Energy Acquis became especially prominent after 2001 with Turkey's announcement of the Electricity Market Law As part of the gas and electricity markets reform, Turkey has moved towards a fully cost-reflective tariff structure (Bagdadioglu et al. 2007, World Bank, 2009b). Hidden costs coming from underpricing, lack of collection and unaccounted losses were substantially reduced as the results of such reforms, from the peak of 2.1% of GDP in 2001 to 0.6% of GDP in 2003. Natural gas hidden costs have remained a challenge, as natural gas is mainly used for heating and has been subsidized to protect consumers.

ii. Armenia:

- Privatization brought several benefits through a reduction in the need for government implicit and explicit subsidies. The decline of the once sizeable quasi-fiscal subsidies showed direct improvements in the performance of the energy sector. Collections rates increased to close to 100% by the end of 2004 while commercial losses decreased to 4% of total production. Armenia's electricity reform is touted as a success story in part because of the timely execution of the reform and the commendable results that it has delivered. The case of Armenia is especially applicable to countries reforming their electricity sectors once part of larger and more integrated systems such as that of the Soviet Union as well as countries seeking to curb electricity demand growth and increase efficiency.

iii. Moldova:

- The overall results of the restructuring of the Moldovan energy sector were positive, with payment collections increasing, especially for electricity in both privatized and state-owned electricity distribution companies. Privatization of the distribution had a positive impact on both the service quality and the government budget. The poor benefited more than the non-poor from the reforms, having increased their consumption more than the non-poor despite rising costs (Lampietti *et al.*, 2007). During the reforms, between 1998 and 2003, energy efficiency improved, as high volume consumers reduced consumption following the price increases.

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