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The World Bank

THE SCOPE OF FOSSIL-FUEL SUBSIDIES IN 2009 AND A ROADMAP FOR PHASING OUT FOSSIL-FUEL SUBSIDIES

An IEA, OECD and World Bank Joint Report[1]

Prepared for the G-20 Summit, Seoul (Republic of Korea)

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[1] This Joint Report does not express the positions of the G20 Member Countries. Nothing in this Joint Report shall be construed as interpreting or modifying any legal obligations under the WTO Agreements, treaty, law or other texts, or as expressing any legal opinions or having probative legal value in any proceedings.

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Executive Summary

This report, prepared for the G-20 by the International Energy Agency (IEA), the Organisation for Economic Co-operation and Development (OECD) and the World Bank, estimates the scope of fossil-fuel subsidies in 2009 and provides a roadmap for phasing-out fossil-fuel subsides.

The IEA estimates that direct subsidies that encourage wasteful consumption by artificially lowering end-user prices for fossil fuels amounted to $312 billion in 2009. In addition, a number of mechanisms can be identified, also in advanced economies, which effectively support fossil-fuel production or consumption, such as tax expenditures, under-priced access to scarce resources under government control (e.g. land) and the transfer of risks to governments (e.g. via concessional loans or guarantees). These subsidies are more difficult to identify and estimate compared with direct consumer subsidies.[2]

Phasing-out fossil-fuel subsidies represents a triple-win solution. It would enhance energy security, reduce emissions of greenhouse gases and bring immediate economic gains. This is highlighted by estimates from the IEA that indicate that if fossil-fuel subsidies were completely phased-out by 2020, it would cut expected growth in global energy demand by 5%. This amounts to the current consumption of Japan, Korea and New Zealand combined. In terms of oil demand, the savings amount to 4.7 mb/d, or around one-quarter of current US demand. It would also represent an integral building block for tackling climate change as expected growth in carbon-dioxide emissions would be cut by 2 gigatonnes.

Furthermore, OECD and IEA analyses suggest that subsidy reform would bring about immediate economic gains as in many cases they are creating market distortions, imposing an unsupportable fiscal burden on government budgets and are weakening trade balances. For example, the IEA estimates that, in the absence of reform, spending on fossil-fuel subsidies is likely to reach almost $600 billion in 2015, or 0.6 percent of global gross domestic product. As countries emerge from the economic crisis, the revenues that can be saved from removing inefficient fossil fuel subsidies, or redirected to more directly tackle pressing priorities such as poverty alleviation, health and education, will be important.

Since the commitment taken at the Pittsburgh Summit in 2009, many countries both within and outside the G-20 are moving ahead with reforms. While this is a very encouraging start, the full extent of the potential gains will only be realised if more countries raise the level of ambition in the reforms they are pursuing.

The World Bank's contribution provides a road map for implementing fossil fuel subsidy removal, revisited through the poverty lens. Such a roadmap may help policy makers in deriving some quick diagnostics of the key problems and the required policy response:

- Who has been benefitting from an existing subsidy? If it is primarily the rich in absolute terms and for wasteful consumption, as is often the case, then there is a strong case for removing the subsidy on equity grounds as well as for improved economic efficiency. Subsidy removal will, however, have a negative impact on the poor, if the subsidy was used to satisfy basic needs, rather than to encourage wasteful consumption. Schemes

[2] An OECD expert workshop on 18-19 November 2010 will examine methods for estimating the different types of fossil-fuel subsidies.

assisting households with only the portion of residential energy costs that goes for home heating (such as the US LIHEAP, successfully replicated in some Eastern European countries) are described. Alternative schemes supporting new gas connection as well as providing incentives for demand side management are discussed.

- Assuming that there is an impact on the poor, what are the options for ameliorating those? The answer will depend in part on what the intended effect of the subsidy was. If it was to make the existing use of energy more affordable, then income-based support programs or (second best) lifeline tariffs can be considered. If it was to make energy access available to new households, then switching the subsidy to access (e.g. connection costs) with full payment of incremental consumption costs is recommended.
- After the implementation of subsidy phasing out, the report discusses socially or environmentally welfare enhancing ways to reallocate the savings to mitigate and offset eventual adverse social impacts.

Lessons drawn from recent experience also suggest more effective alternatives to regressive fuel subsidies that largely benefit higher income households, including the following:

- Well designed rural electrification subsidies to make energy services affordable to the poor
- Better-targeted compensation packages for poorest households or broader reforms aimed at protecting the most vulnerable.
- Moves towards automatic price adjustments mechanisms and fully liberalized system for fossil fuels.

1. The scope of fossil-fuel subsidies in 2009

1.1 Introduction

1.1.1 Background to the report

In September 2009, G-20 leaders took a key step towards reforming energy subsidies at their summit in Pittsburgh, United States. Together, they committed to "rationalize and phase out over the medium term inefficient fossil fuel subsidies that encourage wasteful consumption". This move was closely mirrored by Asia-Pacific Economic Cooperation (APEC) leaders in November 2009. These commitments were made in recognition that inefficient fossil-fuel subsidies distort markets, impede investment in clean energy sources and undermine efforts to deal with climate change.

During the Pittsburgh Summit, the G-20 also requested a Joint Report on the scope of energy subsidies and suggestions for the implementation of their phase-out initiative. The Joint Report was presented to the G-20 Toronto Summit in June 2010, during which country-specific implementation strategies and timetables were tabled.

The IEA, OECD, and World Bank were subsequently requested to prepare this second report for the November 2010 G-20 summit meeting to be held in Seoul, Republic of Korea. This work extends the analysis presented in Toronto in June 2010, in particular by updating the quantitative findings to include data for the year 2009 and providing a road map for phasing out fossil fuel subsidies. The report covers:

- motivations for introducing energy subsidies;
- the case for reforming energy subsidies;
- estimates of energy subsidies;
- modelling-based analysis of the implications of phasing-out energy subsidies;
- recent action taken to phase out subsidies;
- a road map for phasing out subsidies, revisited through the poverty lens; and
- lessons drawn from recent experience of subsidy reforms.

1.1.2 Defining energy subsidies

Finding a commonly agreed definition of subsidies has proven a major challenge in the G-20 context and countries have decided to adopt their own definition of energy subsidies. However, for the purpose of this report, an energy subsidy is defined as any government action that lowers the cost of energy production, raises the revenues of energy producers or lowers the price paid by energy consumers. Many energy subsidies are difficult to measure, so for practical reasons much narrower definitions are often adopted that include only those subsidies that can be quantified and for which data are readily available. The broad definition used in this report is

designed to capture all of the diverse and non-transparent types of energy subsidies that commonly exist.

Energy subsidies are frequently differentiated according to whether they confer a benefit to producers or consumers, or whether they support traditional fossil fuels or cleaner forms of energy. Fossil-fuel consumption subsidies lower prices to end-users. These types of subsidies have been phased out by most economies in the developed world, but are still prevalent in many emerging and developing economies. Production subsidies, by contrast, involve measures that seek to maintain or to expand domestic supply. They remain an important form of subsidisation, particularly in advanced economies, though many subsidies in this category have also been phased out, with the shift towards more market-oriented economic and energy policies and liberalisation of international trade. Both production and consumption subsidies, by encouraging excessive production or consumption, can lead to an inefficient allocation of resources and market distortions. Within this report a particular focus is given to inefficient fossil fuel subsidies that lead to wasteful consumption.

1.1.3 Mechanisms of government support to energy

Subsides can be further distinguished according to the channels through which they are administered; these include budgetary payments, regulations, taxes and trade instruments (Table 1). They can be grouped as either direct transfers, such as grants to expedite the deployment of fledgling energy technologies, or indirect transfers, such as the regulation of end-use prices.

Subsidies to energy *consumption* are provided through several common channels: price controls intended to regulate the cost of energy to consumers, direct financial transfers, schemes designed to provide consumers with rebates on purchases of energy products and tax relief. Government interventions supporting energy consumption often involve the regulation or direct subsidization of domestic prices. However, many economies also support energy consumption through direct budgetary transfers that do not alter the observable market price for the fuels or electricity thus supported. In developing countries, a common form of such a transfer is a fuel voucher, which allows low-income recipients to purchase fuel at a discounted price. In advanced market economies, direct budgetary transfers include heating-energy grants for low-income households, and subsidies to help particular sectors, such as agriculture, meet the cost of fuel purchases when prices rise unexpectedly.

Similarly, a wide array of tax expenditures often target consumers. These mostly take the form of excise-tax concessions on fuel designed to benefit particular users or areas. A preliminary survey of practices in OECD countries suggests that these could be quite important in value terms. For example, OECD estimates that fuel tax concessions are worth some $8 billion per year to the agricultural sector in OECD countries, and at least $1.4 billion per year to the fisheries sector. Finally, tax regimes in a number of advanced market economies inadvertently encourage the provision by employers of company-owned or leased vehicles for employees, and of company-paid fuel for those vehicles.

Governments provide support to energy *production* in a variety of ways: by intervening in markets in such a way as to affect costs or prices, by transferring funds to recipients directly, by assuming part of their risk, by selectively reducing the taxes they would otherwise have to pay, and by undercharging for the use of government-supplied goods or assets. Often, more than one transfer mechanism is involved. For example, a government may fund research at a

national laboratory on how to convert coal into a liquid transport fuel, provide grants and loan guarantees to companies investing in synthetic fuels from coal, provide a tax credit linked to the production of such fuels, and exempt such producers from paying royalties on coal mined from state-owned lands. The national government may, in turn, pay the producer a higher price for the fuel than it could have paid for an imported, petroleum-derived fuel.

Table 1: Common types of energy subsidies

	Description	Examples
Trade instruments	Quotas. Technical restrictions. Tariffs.	Tariffs on imports of crude oil and petroleum products, making domestic fossil fuel production more lucrative.
Regulations	Price controls. Demand guarantees and mandated deployment rates. Market-access restrictions. Preferential planning consent. Preferential resource access.	Gasoline prices regulated at below international market levels. Regulations that prioritise use of domestic coal for power generation.
Tax breaks	Rebates or exemption on royalties, producer levies and income taxes. Tax credits and accelerated depreciation allowances. Rebates, refunds or exemptions on energy duties and CO_2 taxes or for energy in general consumption taxes.	Favourable tax deductions for depletion or investments in oil and gas fields and coal deposits. Excise exemptions for fuel used in international air, rail, or water transport.
Credit	Low-interest or preferential rates on loans to producers.	Loan guarantees to finance energy infrastructure.
Direct financial transfer	Grants to producers or consumers.	Social payment programmes conditioned on or earmarked for heat and electricity consumption.
Risk transfer	Limitation of financial liability.	Insurance or indemnification provided to fossil fuel producers at below-market levels.
Energy-related services provided by government at less than full cost	Direct investment in energy infrastructure. Public research and development.	Provision of seismic data for oil and gas exploration. Government finance of activities relating to environmental health and safety in coal mines.

Direct budgetary transfers are the most straight-forward types of subsidies to measure, although the complexity of the task depends on how well they are reported in government budget documents. In the case of European countries, the bulk of direct budgetary transfers have traditionally benefited the coal industry.

Tax expenditures relating to the production of energy in industrialised countries most often stem from favourable tax treatment for capital or intermediate inputs. These can encourage higher levels of production than would otherwise be demanded by the market. In the case of capital, special rules that allow businesses to deduct depreciation faster than the actual speed at which equipment becomes economically obsolete can in some cases imply large indirect subsidies. Immediate deduction (expensing) of exploration and development costs is also a case

in point although the issue is complicated by the special nature of tax and royalty regimes targeted at natural-resource rents. For cash-flow based natural resource tax system where there is no deduction for interest expenditure, neutrality would require immediate deduction (expensing) of investment outlays. Provisions for expensing or accelerated depreciation does therefore not necessarily imply subsidies, but for many countries it would be relevant to review if all the existing expensing and accelerated depreciation provisions are warranted or if some go too far. Meanwhile, other inputs can also attract subsidies. For instance, workers in particular industries may be allowed to deduct part of their wage from their personal income-tax base, or intermediate goods, such as raw materials may be acquired free of excise duty by refiners.

Governments also forego revenue by offering the use of scarce resources (e.g. land or fossil-fuel resources) under their control. This can reduce costs and thereby encourage more production than otherwise. The most direct cases relate to the conditions under which governments provide access to domestic resources of fossil fuels that a private company (or individuals) then exploits for their own use or for sale. This sometimes takes the form of a royalty exemption for a particular type of coal or a given project of oil and gas extraction. But many governments also provide access to intermediate inputs, like water or electricity, at below market prices, and access to government land for, e.g. the construction of roads or buildings.

Transfers of risk to governments are much less transparent and, as such, hard to gauge even in the case of industrialised countries. They include measures related to capital like concessional loans but also security guarantees as in the case of government-funded oil stockpiling. Equally important are the transfers of environmental and health liabilities from producers to the public which often result in governments acting as insurers of last resort. An example would be the amounts disbursed by governments to compensate residents affected by subsidence associated with abandoned coal mines.

Another area of government involvement in energy production is investment in research and development (R&D). In 2008, IEA data suggest that total government expenditure on R&D related to fossil fuels amounted to almost $1.7 billion. Included under this category of expenditure is R&D related to enhanced oil and gas production; un-conventional oil and gas production; refining, transport and storage of oil and gas; oil, gas and coal combustion; and oil, coal and gas conversion.

1.1.4 Motivations for introducing energy subsidies

The rationale for the introduction of energy subsidies has often been to advance particular political, economic, social and environmental objectives, or to address problems in the way markets operate. In practice, however, they have rarely proven to be a successful or efficient means of achieving their stated goal. The most common justifications for the introduction of energy subsidies include:

- **Alleviating energy poverty:** Consumption subsidies have been used to improve the living conditions of the poor by making cleaner, more efficient, fuels affordable and accessible (Box 1). For example, liquefied petroleum gas (LPG) in place of traditional biomass.
- **Boosting domestic energy supply:** Production subsidies have been used to support indigenous fuel production in a bid to reduce import dependency. They have also been

used at times to support a country's foreign and strategic economic policies by helping the overseas activities of national energy companies.

- **Supporting industrial development and employment**: Energy subsidies to industrial users are a source of competitive advantage. They are sometimes used to encourage investment in energy-intensive industries, such as aluminium smelting, which would otherwise not be profitable. Further, production subsidies, usually in the form of tariffs or trade restrictions, are often used to maintain regional employment, especially in periods of economic downturn or transition.

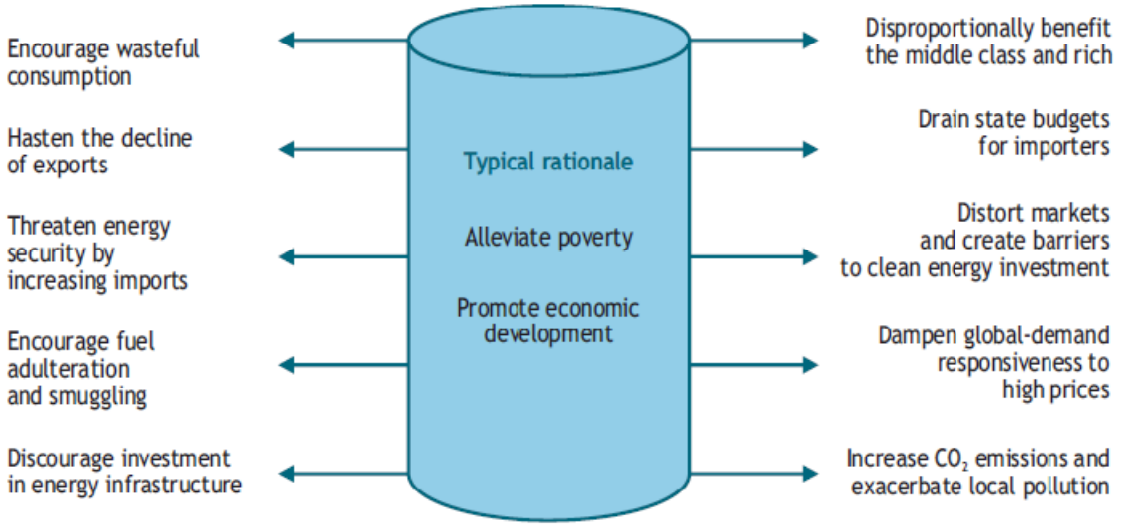
- **Redistributing national resource wealth:** In major energy-producing countries, consumption subsidies that artificially lower energy prices are often seen as a means of sharing the value of indigenous natural resources. They are also used in an effort to encourage economic diversification and employment by improving the competitiveness of energy-intensive industries, such as petrochemicals and aluminium.

- **Protecting the environment:** Developed countries and several emerging economies have introduced support programmes to aid the development of renewable energy, nuclear power and carbon capture and storage (CCS). In some cases, transitional incentives to move cleaner technologies quickly towards market competitiveness can help to cost-effectively reduce greenhouse-gas emissions and pollution.

1.1.5 The case for reforming energy subsidies

In recent years there has been increasing momentum to phase out certain types of fossil-fuel subsidies as many were seen to be resulting in an economically inefficient allocation of resources and to be distorting markets, while often failing to meet their intended objectives (Figure 1). Subsidies have been shown to encourage wasteful consumption, exacerbate energy-price volatility by blurring market signals, incentivise fuel adulteration and smuggling, and undermine the competitiveness of renewables and more efficient energy technologies. For importing countries, subsidies often impose a significant fiscal burden on state budgets, while for producers they quicken the depletion of resources and can thereby reduce export earnings over the long term.

Figure 1: Potential unintended effects of fossil-fuel subsidies



Source: IEA *World Energy Outlook 2010* (forthcoming)

Among the key unintended effects of subsidies that have proved to be drivers of reform in recent years are that they:

- **Create fiscal burden on state budgets:** In some cases, high energy prices have imposed unsupportable financial burdens on countries that import energy at world prices and sell it domestically at lower, regulated prices. As a share of GDP at market exchange rates, spending on oil and gas imports in many economies spiked in 2008, reaching levels well above those seen during the first and second oil shocks. Some countries seized the opportunity presented by the fall in prices after mid-2008 to reduce subsidies without having a major impact on inflation (since the fall in world prices cushioned consumers from the upward pressure on prices resulting from subsidy removal) and without provoking consumer wrath.

- **Encourage wasteful consumption:** Subsidies can encourage wasteful consumption, thereby leading to faster depletion of finite energy resources, and can also discourage rationalisation and efficiency improvements in energy-intensive industries. Eliminating subsidies would provide consumers with an incentive to conserve energy by improving proper price signals. For example, a power company burning oil to produce electricity may not have the choice of switching to a less costly alternative overnight, but could decide to build new, non-oil capacity if it expects higher input prices to persist as a permanent feature of the market. Similarly, a rise in the price of gasoline might encourage a motorist to alter her driving habits and/or buy a more fuel-efficient car when her existing vehicle is traded or scrapped.

- **Exacerbate energy price-volatility:** The price controls that give rise to fossil-fuel subsidies exacerbate energy price-volatility on global markets by dampening normal

demand responses to changes in international prices. Many market analysts were surprised by the robustness of global oil demand, despite the dramatic increases in crude-oil prices, during the first half of 2008. This has now been attributed in part to artificially low energy prices in many countries, which blunted market signals. A survey of 131 countries carried out by the International Monetary Fund (IMF) found that in 2008 around two-thirds of countries failed to fully pass through the sharp rise in international prices for gasoline and half failed to pass through the full increase in the cost of diesel (Coady *et al.*, 2010). Cutting subsidies, by shifting the burden of high prices from government budgets to individual consumers, would lead to a much faster and stronger demand response to future changes in energy prices and free up government revenues for other urgent needs.

- **Distort markets:** Subsidies for fossil-fuel production can hinder competition and create market distortions by propping up less efficient producers. For example, several countries still retain subsidies for hard coal mining. In some cases, a significant share of the subsidy is directed at covering the cost of closing down mines and compensating workers who had lost their jobs as a result of earlier rationalisation of the industry, so is unlikely to alter demand and supply patterns. However, in other cases, subsidies maintain production that would otherwise be uneconomic, for example, by enabling high-cost local coal producers to compete against imports. Similarly, countries also offer subsidies for oil and gas production such as through reduced royalties for leases in certain areas. Removing production subsidies such as these would typically have the effect of making domestic production less competitive compared with imports and would, therefore, tend to lower indigenous production. The extent to which investment and production would be shifted to other parts of the world, and the extent to which prices would rise or fall as a result, would depend on the shape of the global supply curve. In practice, the effect of one country no longer subsidising fossil fuels on world energy prices and consumption is likely to be small. However, when many countries engage in similar policies, world prices are likely to be higher than otherwise. There are other reasons that support a close review of the efficiency and effectiveness of fossil-fuel production subsidies. For example, if the removal of coal subsidies in an economy leads to greater imports of higher-quality coal, it would clearly benefit the environment (Steenblik and Coroyannakis, 1995). Furthermore, by propping up less efficient producers, they can create barriers to the introduction of cleaner technologies and fuels and discourage the uptake of more efficient production practices. Their removal could also free up budgetary resources that could be better used elsewhere in the economy. Lastly, lower energy prices can result in energy being substituted for labour and capital. Depending on the degree of inter-factor substitution, removing energy subsidies to producers could boost employment and investment.

- **Adverse impact on the environment:** Energy subsidies can have varying environmental effects. Subsidies that enable poor communities to switch from the traditional use of biomass to modern fuels can minimise deforestation and reduce household air pollution. Subsidies for low-carbon technologies can help to accelerate learning, causing unit production costs to decline, and reducing the overall cost of climate change mitigation in the long term. However, the vast majority of fossil-fuel subsides are counterproductive in reaching local and global environmental goals. Subsidised energy prices dampen incentives for consumers to use energy more efficiently, resulting in

higher consumption and greenhouse-gas emissions than would otherwise occur. Furthermore, fossil-fuel subsidies undermine the development and commercialisation of renewable energy and other technologies that could become more economically attractive.

- **Encourage fuel adulteration:** Energy subsidies can encourage fuel adulteration, and the substitution of subsidised fuels for more expensive fuels. In some countries, subsidised kerosene intended for household cooking and lighting is diverted for unauthorised use as diesel fuel due to wide price differentials. Smuggling can also arise, since an incentive is created to sell subsidised products in neighbouring countries where prices are unsubsidised and, therefore, higher. This has been an issue for years in many parts of the world, particularly in Southeast Asia, Africa and the Middle East. The effect in subsidising countries is a substantial financial transfer to smugglers, while recipient countries experience losses from uncollected taxes and excise duties, due to reduced sales in the legitimate market. Removing subsidies would eliminate incentives both to adulterate fuels and to smuggle them across borders.

- **Disproportionally benefit the middle class and the rich:** Although energy subsidies are often intended to help redistribute income to the poor, the greatest benefit typically goes to those who consume the most energy, i.e. who can afford to own motor vehicles, electrical appliances, etc. The Co-ordinating Ministry of Economic Affairs of Indonesia, for example, reported that the top 40% of high-income families absorb 70% of energy subsidies, while the bottom 40% of low-income families reap only 15% of the benefits (IEA, 2008a).

- **Threaten investment in energy infrastructure**: Subsidies can have an adverse impact on investment resources. Where fossil-fuel consumption is subsidised through consumer price controls, the effect – in the absence of offsetting compensation payments to companies – is to reduce energy companies' revenues. This limits their ability to invest in, maintain and expand energy infrastructure. For example, many state-owned electricity companies are obliged to provide electricity at heavily subsidised rates (or, in certain cases, for free) to certain sections of the community. This has made many of them financially weak, harming their capacity to invest in building new generating plant and in maintaining and extending the network. Although this problem is particularly prevalent within the electricity sector, it also exists in the oil, natural gas and coal sectors.

- **Hasten the decline of exports:** Several energy-rich exporting countries have also moved to phase out subsidies, or expressed interest in doing so, concerned not only by the high cost of the subsidies but also the resulting low efficiency in domestic energy use. Over time, such subsidies may even threaten to curtail the exports that earn vital state revenue streams, with implications for global energy security. A number of significant oil exporters, including Angola, Iran, Kazakhstan and Nigeria, rely on imports of refined petroleum products, partly because low regulated prices preserve artificially high demand and undermine investment in adequate refining capacity. This problem is particularly acute if refiners are not reimbursed by governments for their losses.

The gains from phasing out fossil-fuel subsidies can be enhanced if combined with broader energy taxation reforms. Rising world market prices have greatly enhanced the profits from fossil fuel production and in some cases, the royalty and tax regimes for natural resource rents may warrant review to assess if they are well balanced. Some middle-income countries have also found higher excise taxes on energy consumption to be an attractive route in a context of difficulties controlling income tax evasion. Wider reforms can therefore raise considerable revenues that can help financing the measures needed to ensure a social balance when fossil-fuel subsidies are phased out and, as emphasised by OECD work on Tax and Development, contribute to state building and administrative development.

Box 1: Subsidies and energy poverty

The IEA's *World Energy Outlook 2010* highlights the alarming fact that today 1.4 billion people (over 20% of the global population) lack access to electricity and 2.7 billion people (some 40% of the global population) rely on the traditional use of biomass for cooking. Although energy subsidies are one means of alleviating energy poverty, by making energy services more affordable and accessible for the poor, studies have repeatedly shown them to be an inefficient and often ineffective means of doing so. The cost of these subsidies falls on the entire economy, but benefits are conditional upon the purchase of subsidised goods and thus tend to accrue disproportionately to middle and higher-income groups.

Poor households may be unable to afford even subsidised energy or related services, or may have no physical access to them (for example, rural communities lacking a public transport network or a connection to an electricity grid). In general, subsidies for liquid fuels are particularly difficult to target, given the ease with which such fuels can be sold on the black market. In comparison, the distribution of electricity and piped natural gas is more easily monitored and controlled. We estimate that subsidies in the residential sector to kerosene, LPG and electricity in countries with limited household access to modern energy (defined as countries with electrification rates of under 90% or modern fuels access under 75%) represented just 15% of consumption subsidies in 2009. There is considerable evidence that most of these subsidies in any case go to richer households. The IMF has estimated that 80% of the total benefits from petroleum subsidies in 2009 accrued to the richest 40% of households (Coady, *et al.*, 2010).

Nonetheless, the removal of even poorly targeted energy subsidies needs to be carefully implemented, since low-income households are likely to be disproportionately affected by their removal, as they spend a higher percentage of their household income on energy. Similarly, subsidies can bring considerable benefits to the poor when they encourage switching to cleaner and more efficient fuels or enhance access to electricity. Therefore, any moves to phase-out subsidies must be carefully designed so as not to restrict access to essential energy services or increase poverty. Providing financial support for economic restructuring or poverty alleviation is essential to smoothing the path for fossil-fuel subsidy reform. In most successful cases of energy-subsidy reform, the remaining support has been well-targeted, temporary and transparent. In undertaking major changes, assessments should be made regarding the extent to which the economy and society can absorb the impacts of the reform. Furthermore, the phase-out of fossil-fuel subsidies should be considered as a package, particularly if broader structural reforms are underway or being contemplated. Pre-announcing a strategy and

timeframe for phasing in subsidy reform can help households and businesses to adjust to these reforms (UNEP, 2008).

1.2 Measuring fossil-fuel subsidies

Measuring both energy consumption and production subsidies is a complex undertaking due to the varying definitions of what constitutes a subsidy and the availability of adequate data. Although measuring consumption subsidies requires an extensive array of energy pricing data, enough information is published to enable a reasonable estimate, as is done in this report for 2009. Estimating subsidies to fossil-fuel production is particularly challenging. Even within a single country there are typically several different sources, recipients and categories of producer support. Many subsidies are administered via indirect mechanisms, such as complex tax concessions. And the data necessary to estimate producer support are in many cases of poor quality or not reported.[3]

Developing a comprehensive and internationally comparable set of estimates of producer subsidies is hindered by data constraints and methodological and conceptual issues. Even at the national level, few countries have produced comprehensive estimates of support for their fossil-fuel industries, and even fewer have included support provided by sub-national jurisdictions. Data are often reported only at broad, programmatic levels, requiring analysts to allocate a given expenditure to the various fuels covered by the programmes. This can prove quite complex when lacking sufficient details on subsidy recipients. Meanwhile, quantifying tax expenditures requires having a proper benchmark against which to assess them. This, in turn, raises numerous issues having to do with definitions and comparability of tax regimes across countries.

Despite these challenges, numerous government agencies, academic researchers, and non-governmental organizations have recently turned their attention to subsidies benefitting fossil-fuel production, resulting in a clearer picture of their nature and scope (see, e.g., Koplow *et al.*, 2010). The OECD Secretariat is currently working with OECD Member countries to compile estimates of support to fossil-fuel production and consumption, and will be organizing expert workshops on issues relating to the identification, estimation and reporting of fossil-fuel support.[4]

Given the incomplete state of information on other types of subsidies to fossil fuels, in this report only estimates of support to fossil-fuel consumption that are revealed through price-gap measurements are provided. While representing only a subset of total subsidies to fossil fuels, they have a particularly important impact on global energy trends affecting economic growth, energy security and the environment.

[3] The Global Subsidies Initiative (GSI), a Geneva-based program of the International Institute for Sustainable Development (IISD), has estimated that worldwide fossil-fuel production subsidies may be of the order of $100 billion per year (GSI, 2010).

[4] An Expert Workshop on Estimating Support to Fossil Fuels will be held at the OECD's Headquarters, in Paris, on 18-19 November 2010.

1.2.1 The price-gap approach

This report provides estimates of energy-consumption subsidies using a price-gap approach. This approach compares final consumer prices with reference prices, which correspond to the full cost of supply or, where appropriate, the international market price, adjusted for the costs of transportation and distribution. The estimates cover subsidies to fossil fuels consumed by end-users and subsidies to fossil-fuel inputs to electric power generation. Simple as the approach may be conceptually, compiling the necessary price data across different fuels and sectors and computing reference prices are formidable tasks.

The price-gap approach is the most commonly applied method for quantifying consumer subsidies.[5] It is designed to capture the net effect of all subsidies that reduce final prices below those that would prevail in a competitive market. However, estimates produced using the price-gap approach do not capture all types of intervention known to exist. They, therefore, tend to be understated as a basis for assessing the impact of subsidies on economic efficiency and trade. For example, the method does not take account of revenue losses in countries where under-collection of energy bills (particularly for electricity) is prevalent, or where energy theft is rife. Despite these limitations, the price-gap approach is a valuable tool for estimating subsides and for undertaking comparative analysis of subsidy levels across countries to support policy development (Koplow, 2009).

For countries that import a given product, subsidy estimates derived through the price-gap approach are explicit. That is, they represent net expenditures resulting from the domestic sale of imported energy (purchased at world prices in hard currency), at lower, regulated prices. In contrast, for countries that export a given product — and therefore do not pay world prices — subsidy estimates are implicit and usually have no direct budgetary impact. Rather, they represent the opportunity cost of pricing domestic energy below market levels, *i.e.* the rent that could be recovered if consumers paid world prices. For countries that produce a portion of their consumption themselves and import the remainder (such as Iran), the estimates presented here represent a combination of opportunity costs and direct government expenditures.

1.2.2 Reference prices

For net importing countries, reference prices have been calculated based on the import parity price: the price of a product at the nearest international hub, adjusted for quality differences, plus the cost of freight and insurance to the importing country, plus the cost of internal distribution and marketing and any value-added tax (VAT). Other taxes, including excise duties, are not included in the reference price. Therefore, in the case of gasoline, even if the pre-tax pump price in a given country is set by the government below the reference price, there would be no net subsidy if an excise duty large enough to make up the difference is levied. For net exporting countries, reference prices were based on the export parity price: the price of a product at the nearest international hub adjusted for quality differences, minus the cost of freight and insurance back to the exporting country, plus the cost of internal distribution and marketing and any VAT.

For oil products, average distribution and marketing costs for all countries were based on costs in the United States. The assumed costs for shipping refined products, by contrast, vary

[5] Kosmo (1987), Larsen and Shah (1992) and Coady et al., (2010) among others, for example, have used this approach.

according to the distance of the country from its nearest hub and have been taken from average costs as reported in industry data. For natural gas and coal, transportation and internal distribution costs have been estimated based on available shipping data. All calculations have been carried out using local prices and the results have been converted to dollars at market exchange rates.

Reference prices have been adjusted for quality differences, which affect the market value of a fuel. For example, for countries that rely heavily on relatively low-quality domestic coal but also import small volumes of higher quality coal, such as India and China, reference prices are set below observed import prices.

Unlike oil, gas and coal, electricity is not extensively traded over national borders, so there is no reliable international benchmark price. Therefore, electricity reference prices were based on annual average-cost pricing for electricity in each country (weighted according to output levels from each generating option). In other words, electricity reference prices were set to account for the cost of production, transmission and distribution, but no other costs, such as allowances for building new capacity, were included. They were determined using reference prices for fossil fuels and annual average fuel efficiencies for power generation. An allowance of $15/MWh and $40/MWh was added to account for transmission and distribution costs for industrial and residential uses, respectively. To avoid over-estimation, electricity reference prices were capped at the levelised cost of a combined-cycle gas turbine (CCGT) plant.

Some experts suggest that the above method of determining reference prices has limitations. In particular, some are of the opinion that the reference price in countries that are net exporters should be based on their cost of production, rather than prices on international markets as applied within this analysis. The basis for this view typically is that these countries are using their natural resources in a way that effectively promotes their general economic development, and that this approach more than offsets the notional loss of value by selling the resource internally at a price below the international price. The counter-argument is that such an approach results in an economically inefficient allocation of resources and reduces economic growth in the longer term.

Cross-subsidies between sectors, *i.e.* where some consumers are charged a price above cost so as to offset lower prices for other consumers, have not been taken into account in this analysis. For example, in many countries commercial and industrial consumers often pay a price above cost so as to finance lower prices for the agriculture and residential sectors, while the opposite situation can also be found in other countries (for example, where aluminium producers are able to negotiate special low electricity rates). Furthermore, as the price-gap method measures an average variance in prices, it does not capture the variability in prices by time-of-day or region that are often vitally important in giving new technologies entry points into energy markets. Similarly, it does not pick up direct subsidies to consumers that are tied to fuel purchases, such as the discounted fuel coupons used by some developing countries or heating-fuel rebate schemes.

Box 2: Sample calculation – estimating gasoline subsidies in Venezuela in 2009

The first step is to calculate the appropriate reference price. Venezuela was a net exporter of gasoline in 2009 and therefore we start with the free-on-board (fob) price, or the price of a product at the border. Taking the average spot price of gasoline in 2009 at the nearest hub, the United States, the fob price is calculated by subtracting the average cost of freight and

insurance to transport gasoline between Venezuela and the United States. Given a spot price of 0.89 bolívares fuertes (VEF) ($0.41) per litre and a shipping cost of VEF 0.02 ($0.01) per litre, the fob price is VEF 0.87 per litre. To complete the calculation of reference prices and arrive at the price consumers would see at their local pump, retail and distribution cost are added as well as any VAT. Assuming distribution and retail costs equal to those in the United States, VEF 0.17 ($0.08) per litre, the final reference price for gasoline in 2009 was VEF 1.04 ($0.48) per litre. No VAT is applied to gasoline sales in Venezuela.

As average end-use prices for gasoline in 2009 were reported as VEF 0.06 ($0.03) per litre, the price gap then amounts to VEF 0.98 per litre. To estimate the total value of the subsidy to gasoline, we take the price gap multiplied by total final consumption (estimated at 15.9 billion litres), arriving at a gasoline subsidy of approximately VEF 15.6 billion ($7.3 billion).

1.3 Estimate of global fossil fuel consumption subsidies

The value of fossil-fuel consumption subsidies (including subsidies to electricity generated from fossil fuels) is estimated to amount to $312 billion in 2009. These estimates are made by the International Energy Agency and do not represent the official positions of G-20 countries. The IEA's finding is based on an extensive survey to identify those economies that subsidise fossil-fuel consumption, as identified using the price-gap method outlined above. In total, 37 such economies were identified, estimated to represent over 95% of global subsidised fossil-fuel consumption. Remaining subsidised consumption occurs in economies where reliable data on energy consumption and prices are unavailable. The vast majority of the economies where energy is identified as being sold below a world reference price were outside the OECD. However, production subsidies are prevalent in both OECD and non-OECD economies. By implication, the figures for consumption subsidies may under-represent the relative contribution of OECD countries to the total of production and consumption subsidies.

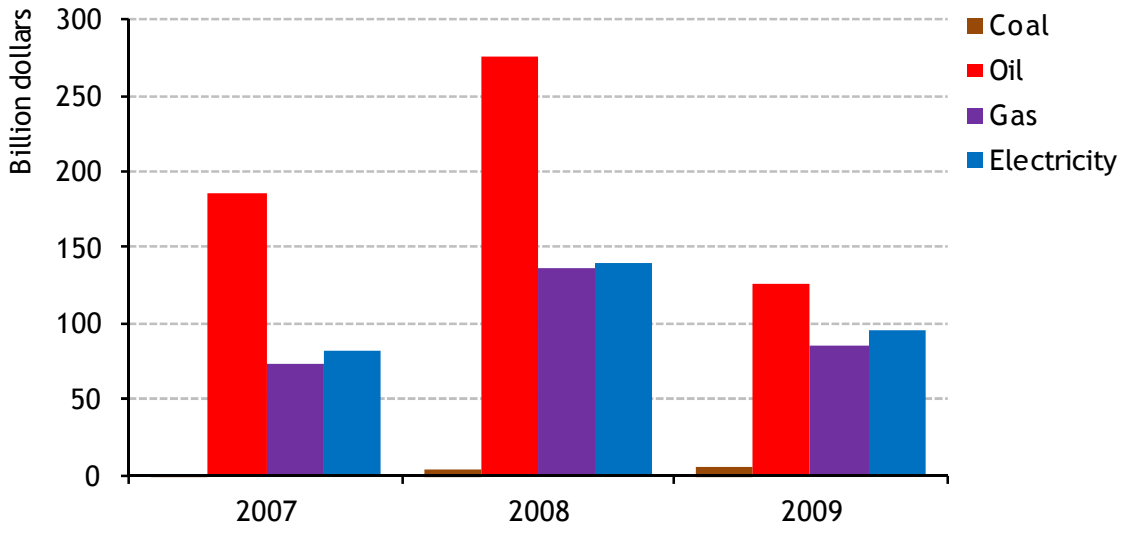
In absolute terms, the biggest subsidies are in those economies with the largest resource endowments. For a given fuel, net-exporting economies do not incur hard-currency expenditures by pricing domestic energy products below their value in international markets, as long as prices are set above the cost of production. Iran's subsidies reached $66 billion (the highest of any economy), with most of this sum going to oil products and natural gas. It is worth highlighting that estimates for certain economies may appear high in dollar terms, but less high when viewed on a per-capita basis or as a percentage of GDP. Fossil-fuel subsidisation rates, expressed as a proportion of the full cost of supply, vary considerably by fuel as well as by economy. The $312 billion estimate comprises subsidies to fossil fuels used in final consumption and to fossil-fuel inputs to electric power generation. In 2009, oil products and natural gas were the most heavily subsidised fuels, attracting subsidies totalling $126 billion and $85 billion, respectively. Subsidies to electricity consumption were also significant, reaching $95 billion in 2009. At only $6 billion, coal subsidies were comparatively small.

For the economies surveyed here, fossil fuels were subsidised at a weighted-average rate of 22%, meaning consumers paid roughly 78% of competitive market reference prices. Natural gas was the most highly subsidised fuel, at an average rate of 51% in 2009. Subsidisation rates for natural gas are comparatively high since many supplies are still priced within limited domestic markets, even as the global market for liquefied natural gas continues to grow. Oil products were subsidised at an average rate of 19%, electricity at 18% and coal at 7%.

The magnitude of energy subsides fluctuates from year-to-year with changes in world prices, domestic pricing policy, exchange rates and demand. Of these factors, movements in world prices typically have by far the greatest impact on variations in subsidy levels. In 2008, when fossil-fuel prices surged in international markets during the first half of the year, the value of energy consumption subsidies was estimated at $558 billion, a dramatic increase from 2007, when the total was $343 billion. Declining world prices were the main reason for the sharp drop in the value of subsidies between 2008 and 2009. However, some of the observed drop can also be attributed to deliberate interventions to raise consumer prices (thereby, shrinking the price-gap) in order to reduce the burden on government finances.

Some economies manage price volatility by regulating domestic prices for certain energy products. Although the intent may not be to hold average prices over a period below market levels, rising international energy prices can inadvertently lead to market transfers to consumers (an effect picked-up by the price-gap approach). Conversely, when world prices fall, the situation can lead to unexpected revenues. For example, the fall in oil prices in 2009 meant that the subsidies arising from Mexico's fuel-excise mechanism all but vanished. Experience has shown that governments often find it hard to increase domestic prices when international prices are increasing and not to immediately pass through the full extent of any subsequent price falls. During the rapid run-up in world oil prices in early 2008, many economies abandoned automatic price adjustments in order to shield consumers, but they subsequently faced criticism for being slow to adjust downward after prices fell sharply later in the year.

Figure 2: Economic value of fossil-fuel consumption subsidies by type



Source: IEA *World Energy Outlook 2010* (forthcoming).

Note: Subsidy estimates are made by the International Energy Agency and do not represent the official position of G20 countries.

1.4 Implications of phasing out fossil-fuel consumption subsidies

1.4.1 Method and assumptions

This section quantifies the energy savings that would result from the phase-out of fossil-fuel consumption subsidies and the implications for CO_2 emissions. The comparison is with a baseline case in which subsidy rates from 2010 remain unchanged relative to their average level in 2007-2009. Because subsidies tend to fluctuate as a result of market volatility, this provides a reasonable basis for estimating the impact of the subsidy phase-out, even though the magnitude of subsidies may rise or fall sharply in a given year. The analysis is based on the premise that subsidies to consumers lower the end-user prices of energy products and thus lead to higher levels of consumption than would occur in their absence. The unsubsidised, or reference, prices are calculated using the price-gap analysis described above.

To illustrate the magnitude of the gains possible by eliminating subsidies, the analysis assumes a gradual phase-out of all subsidies to fossil-fuel consumption, globally, over the period 2011-2020.[6] A growing number of economies have already announced plans that, if fully implemented, would eliminate or reduce their subsidies well before 2020 (see Section 1.5). It is important to emphasise that social and equity impacts resulting from energy subsidy removal need to be a central consideration in the design of any phase-out programme (see Section 2.2).

Box 3: The IEA energy-subsidy online database

As highlighted by the G-20, increasing the availability and transparency of energy subsidy data is an essential step in building momentum for global fossil-fuel subsidy reform. Improved access to data on fossil-fuel subsidies will raise awareness about their magnitude and incidence and encourage informed debate on whether the subsidy represents an economically efficient allocation of resources or whether it would be possible to achieve the same objectives by alternative means. Transparency of subsidy data can also encourage consistent presentation and provide a useful baseline from which progress to phase out subsides can be monitored (Hale, 2008; Laan, 2010).

As a contribution to the process of increasing transparency of energy-subsidy data, the IEA is establishing an online database to allow public access to data on fossil-fuel subsidies, including breakdowns by economy, by fuel and by year. This new database represents an extension of the systematic analysis of energy subsidies that the IEA has been undertaking through the World Energy Outlook series since 1999. It will be updated annually as a means of tracking the progress being made by economies to phase-out fossil fuel subsidies. The IEA is constructing the database on an independent basis, not at the request of the G20. It has been constructed on the basis of the IEA's own survey and the energy-subsidy data has not been agreed by the economies concerned. The database will be available at www.worldenergyoutlook.org/subsidy.asp. The database has been constructed following an extensive survey of end-use price data. A key source of data was the IEA's quarterly publication,

[6] Although the analysis assumes the complete phase out of consumption subsidies in all economies between 2011 to 2020, the commitment among G-20 countries is to "rationalize and phase out over the medium term inefficient fossil fuel subsidies."

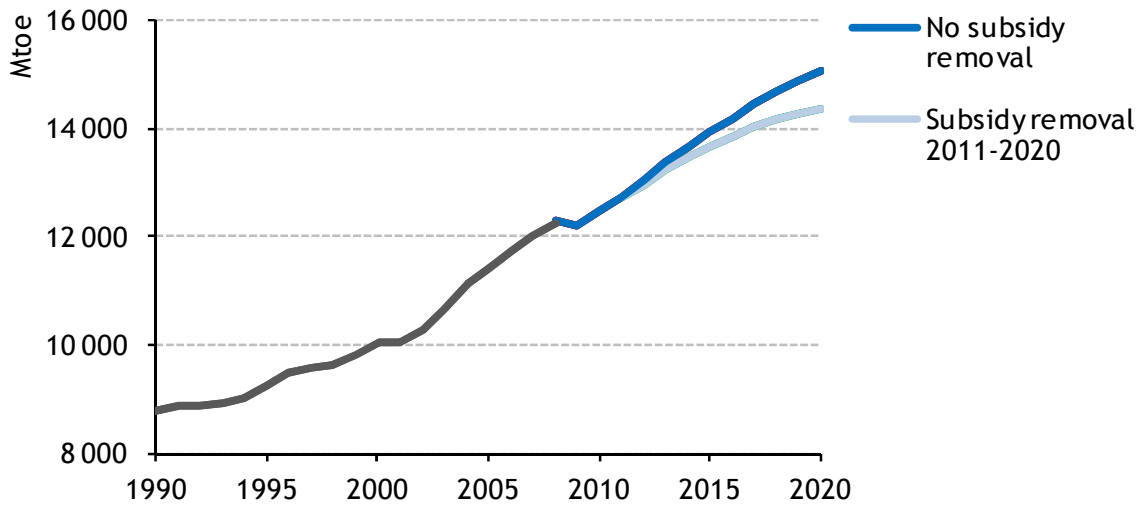
Energy Prices and Taxes. Other sources include official statistics, international and national energy companies, consulting firms and investment banks' research reports. The IEA's network of energy and country experts and their local energy contacts have also contributed substantially to the identification and verification of end-user prices. Additional data were extracted from databases, reports and personal communications with various organisations, including the Asian Development Bank, IMF, Latin American Energy Organization and the European Bank for Reconstruction and Development.

1.4.2 Energy demand

Compared with a baseline case in which subsidy rates remain unchanged, the complete phase-out of consumption-related fossil-fuel subsidies between 2011 and 2020 would cut global primary energy demand by 5%, or 738 Mtoe, by 2020 (Figure 3).[7] This reduction is equivalent to the current energy consumption of Japan, Korea, and New Zealand combined. Furthermore, reductions in energy demand (relative to the baseline) would continue to be realised after 2020 as consumers continue to change their behaviour over time.

Where consumption is subsidised, eliminating energy subsidies would reduce dependence on imports and lead to an immediate improvement in the fiscal position of many governments. Moreover, exposing consumers to market-driven price signals would strengthen and accelerate the demand response, which in turn would contribute to reducing volatility in global markets. The phase-out of energy subsidies would have several other positive effects on long-term energy security by encouraging diversification of the energy mix and slowing down the depletion of finite fossil-fuel resources.

Figure 3: Impact of fossil-fuel consumption subsidy phase-out on global primary energy demand



Source: IEA *World Energy Outlook 2010* (forthcoming)

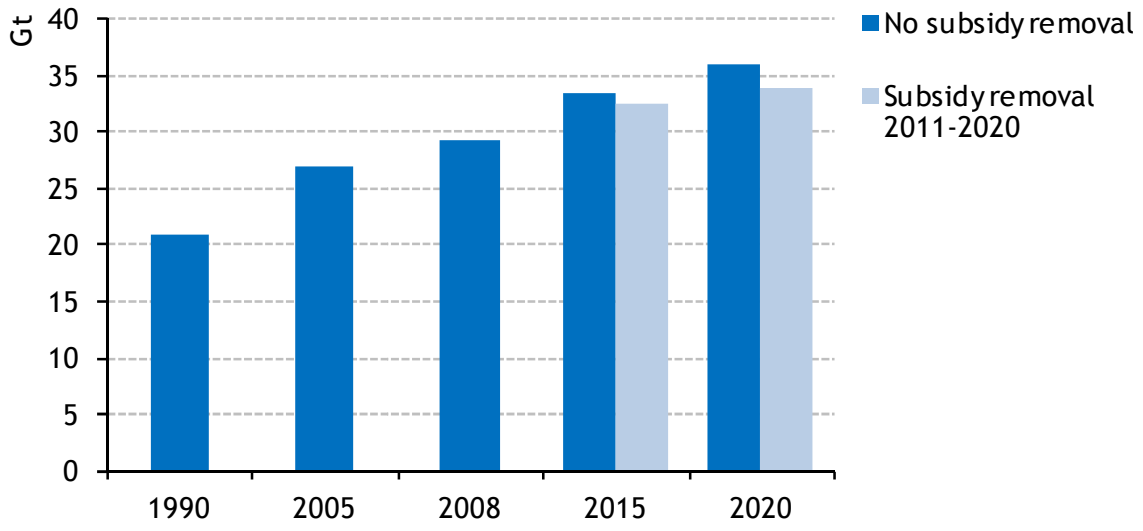
[7] Although the analysis assumes the complete phase out of consumption subsidies in all economies between 2011 to 2020, the commitment among G-20 countries is to "rationalize and phase out over the medium term inefficient fossil fuel subsidies."

1.4.3 CO_2 emissions

The phase-out of fossil-fuel consumption subsidies over 2011-2020 would reduce global energy-related CO_2 emissions by 5.8% by 2020 compared with a baseline case in which subsidy rates remain unchanged (Figure 4). This amounts to savings of 2 gigatonnes (Gt) of CO_2 by 2020, equivalent to the current combined emissions of Germany, France, the United Kingdom and Italy. Reduced demand growth for fossil fuels would also lead to lower emissions of particulate matter and other air pollutants.

Our analysis illustrates the importance of the G-20 commitment to phase out inefficient fossil-fuel subsidies in addressing climate change and the role it could play in implementing the commitments under the Copenhagen Accord. According to climate experts there is a reasonable chance of limiting the global temperature increase to 2°C if the concentration of greenhouse gases in the atmosphere is limited to around 450 parts per million of carbon-dioxide equivalent (ppm CO_2-eq). Based on IEA estimates, fossil-fuel consumption subsidies in 2009 amounted to 45% of the additional yearly investment in low-carbon technologies and energy efficiency required to meet the 2°C goal. However, a portion of the funds liberated through a subsidy phase-out programme would be need to be directed towards the costs involved with subsidy removal, such as creating a comprehensive social welfare net, in order to ensure that other policy objectives, including the reduction of energy poverty, are also achieved.

Figure 4: Impact of fossil-fuel consumption subsidy phase-out on global energy-related CO_2 emissions



Source: IEA *World Energy Outlook 2010* (forthcoming)

Box 4: Subsidies for low-carbon energy sources

Policy support for low-carbon energy has increased considerably over the past decade. Two drivers underpin this trend: first, the effort to constrain growth in greenhouse-gas emissions and, second, a desire to diversify the supply mix (prompted particularly by high oil prices, especially in 2005-2008). Job creation has been another factor in government support, especially as a contribution to reducing unemployment following the economic crisis.

In the context of this growing policy support, some forms of low-carbon generation have grown significantly during the last decade. Renewables-based electricity output increased by nearly a third from 2000 to 2008; wind power expanded seven-fold and photovoltaic generation grew 16-fold during the same period. At the same time, global consumption of biofuels quadrupled. Along with this growth in deployment, renewable technologies have experienced a fall in costs. Cost reductions are essential to large scale development of renewable energy. Most renewable energy technologies are capital-intensive, requiring significant upfront investments, and most cannot currently compete on price with conventional sources.

Government support for emerging low-carbon technologies can lead to design improvements and the widespread deployment that is necessary to make them cost-competitive. The scope for further cost reductions for these emerging technologies is generally greater than for the more mature fossil fuel technologies. By contrast, fossil fuel prices are expected to increase in the future. Subsidies for low-carbon energy can take the form of consumption or production subsidies. A wide variety of mechanisms can be used to deliver the support, including portfolio standards, green certificates, feed-in-tariffs, premiums, and production, consumption and investment tax incentives.

The IEA estimates that worldwide government support to renewable electricity and biofuels amounted to $57 billion in 2009 — up from $44 billion in 2008 and $41 billion in 2007. These estimates do not include subsidies for renewable heat technologies or other emerging low-carbon energy technologies such as CCS.

While subsidies for renewable energy can yield benefits, they can also be ineffective or inefficient if not well-designed. Good policy design for renewable energy subsidies involves paying close attention to non-market barriers, ensuring that support is predictable and transparent in order to attract investors, reflecting improvements in technology over time by reducing subsidies in line with declining costs, matching support to the needs of individual technologies at differing stages of development, and considering the wider effects of new technologies on the energy system as a whole (IEA 2008b).

In addition to providing support as defined above, governments are engaged in the substantial continuing effort in research and development (R&D) to bring down the costs of renewable energy technologies and improve their performance. Some renewable technologies are mature or almost mature and do not require significant additional R&D, while others depend on further supportive R&D policy measures for their widespread diffusion. Total spending on R&D for renewable electricity technologies and biofuels reached $5.6 billion in 2009, with 45% of this amount provided by governments.

See Annex 4 for more discussion on mechanisms to support low-carbon energy technologies.

1.5 Recent action taken and plans to phase out subsidies

Following the commitment made by the G-20 countries to “rationalize and phase out over the medium term inefficient fossil fuel subsidies that encourage wasteful consumption”, each G-20

member has submitted implementation strategies and timetables to implement this phase-out.[8] In addition to the implementation strategies planned by G-20 members in response to the Pittsburgh agreement many economies both within and outside the G-20 have in recent years implemented or proposed reforms to bring their domestic energy prices into line with the levels that would prevail in an undistorted market or to rationalise support given to fossil-fuel producers (Table 2).

These efforts contributed to a small but meaningful reduction in the IEA estimates for energy-consumption subsidies in 2009 relative to 2008. Preliminary data also suggest that they have also had a more noticeable impact on estimated subsidy levels in 2010. The key drivers behind the moves have varied from economy to economy, as have expectations over the likelihood that lasting reform will take hold, in view of the political and social barriers that first need to be overcome.

In October, 2010, **Angola** made the first of a series of planned cuts to gasoline and diesel subsidies as part of its plans to attract foreign investment into the downstream segment of the country's oil sector. The first cuts led to immediate increases in gasoline prices by 50% and diesel prices by 38%. Angola is currently dependent on imports for around 70% of its refined product demand, but is seeking to build new refining capacity to enable the country to become self sufficient in refined products.

In **Canada**, the oil and gas sector has traditionally benefited from certain favourable tax provisions. Changes at the federal level, however, have moved toward the gradual removal of these preferences. In the 2003 federal budget, the government introduced a number of income tax changes to be phased in over a five-year period, including the replacement of the 25% resource allowance with a deduction for actual provincial royalties and mining taxes paid. These measures were intended to improve the neutrality of the resource tax system. A special remission order which had allowed deduction of both royalties and the resource allowance in respect of the Syncrude oil sands project expired at the end of 2003. In the 2007 federal budget, Canada announced that the accelerated depreciation allowance for oil sands would be phased out over the 2011-2015 period, although it still exists for mines extracting conventional minerals. Draft regulations to implement the phase-out were released on May 3, 2010.

In less than a generation, **China**, which was a largely self-sufficient energy consumer, has become the world's fastest-growing energy consumer (and importer) and a major player in global energy markets. China has made significant progress in bringing domestic energy prices closer to global market levels and is continuing to push ahead with new reforms. These efforts have contributed to the significant reduction in energy intensity experienced since 1980. Prices for crude oil produced in China are already determined on the basis of the price for comparable grades of oil sold in international markets. Prices for many refined oil products also now generally match the international levels. In 2007, China lifted its remaining price controls for coal and began to introduce a market-based pricing system. Coal prices for power generation are now largely set by direct negotiations between coal producers and power companies. In the natural gas market, prices remain relatively low compared to those on international markets. In May 2010, the government announced a 25% increase in onshore natural gas benchmark prices following an increase in gas transmission fees. The increase should induce consumers to use gas more efficiently, and should accelerate investment by China's national oil companies in domestic exploration and production and development of LNG and long-distance pipeline gas

[8] Details of these subsidy reforms are available at http://www.g20.org/Documents2010/expert-/Annexes_of_Report_to_Leaders_G20_Inefficient_Fossil_Fuel_Subsidies.pdf

import projects. After launching a programme to eliminate the preferential tariff arrangements for certain energy-intensive industries and increase the electricity prices for non-residential users in 2009, the government has recently released a proposal to introduce a tiered electricity pricing mechanism for residents (under which prices would increase with consumption).

Earnings from energy taxes in **India**, which go predominantly to the state governments, far outweigh the cost of subsidies, which is borne by the central government. Nonetheless, the country is in the process of energy price and tax reform (Government of India, 2010). In June 2010, the federal government announced that gasoline prices would henceforth be market-driven and the intention to later apply market-driven pricing for diesel. It also announced immediate price increases for diesel, LPG and kerosene. Natural gas pricing reform was also implemented in mid-2010, allowing state-run Oil & Natural Gas Corp. (ONGC) and Oil India Ltd. (OIL) to sell gas from new fields at market rates instead of regulated prices. Furthermore, the price of natural gas more than doubled under the regulated price regime in 2010. Reforms in India's steam coal industry are expected to slowly bring domestic coal prices in line with import parity levels, with due allowance for quality differences. In June 2010, state-owned Coal India Ltd, which is responsible for almost 90% of the country's coal production, announced that it would move to price its premium grades on an import parity basis. As more than 80% of India's electricity is generated from coal, the implementation of the coal pricing reforms can be expected to impact power prices.

Indonesia has a long history of directly subsidising energy as a means of supporting the incomes of poor households. The size of energy subsidies has fluctuated widely over the past decade, following movements in international prices and the exchange rate and adjustments to the subsidy schemes. Previously, subsidies were available for industry and all segments of the population, but coverage has become increasingly targeted and the number of subsidised fuels has declined. In 2010, Indonesia announced plans to eliminate energy subsidies by 2014. The gap between international and domestic prices is to be progressively reduced, in an effort to minimise the impact on the poor. According to Indonesia's 2011 state budget, 11% of government expenditure in 2011 will be devoted to energy-consumption subsidies, compared with 13% in 2010 and 19% in 2008. Indonesia has an ongoing programme to phase out the use of kerosene in favour of LPG. The energy ministry is considering a new plan to restrict the use of subsidised fuel to motorcycle, public transportation vehicles and cars purchased before 2005. In June 2010, the Indonesian government raised power tariffs by an average of 10%. This will reduce the overall burden of electricity subsidies on the state budget and boost revenues for Indonesia's state power company.

With vast reserves, **Iran** is one of the world's largest oil and natural gas producers. Oil and gas activities play a central role in supporting Iran's economy, generating about 80% of its export revenues in 2008. Heavily-subsidised energy consumption has left a legacy of inefficient energy use, environmental degradation, inadequate investment and fuel import dependence. In early 2010, a law outlining far-reaching subsidy reform was enacted in Iran. The subsidy reform law calls for gradual implementation (over 2010-2015) of market-based energy pricing and the replacement of subsidies by targeted assistance to lower income groups. Among the key objectives of the law are to increase the prices of oil derivatives to 90% of the Persian Gulf export price, the price of household gas tariffs to 75% of the Persian Gulf export price, and the price of electricity to a level that reflects the full cost of production. To compensate for higher prices and the impact on low-income groups, 50% of the fiscal benefit resulting from increased prices would be redistributed to low-income consumers via direct cash and non-cash payments.

Despite **Mexico** being the world's seventh-largest crude-oil producer, subsidised energy prices have represented a serious economic strain on the government budget and contributed to increasing reliance on refined product imports. Subsidies for electricity, gasoline, diesel and liquefied petroleum gas were equivalent to more than one and a half per cent of GDP over the period 2005 to 2009 (National Energy Strategy). Mexico is currently reforming its excise arrangements for refined products and, contingent on international market conditions, it is estimated that gasoline and diesel subsidies could be eliminated by late 2010 and those for LPG by late 2012. As part of the process, retail prices for gasoline, diesel and LPG – set by the government – have been increasing on a monthly basis since December 2009 while protecting poor customers with better targeted subsidies. Starting in 2008 the government implemented a cash transfer connected to *Oportunidades* that is intended to help very low-income households cover their energy needs. This is preferable to price subsidies, as it is better targeted at the poor and avoids creating incentives for environmentally harmful increases in energy consumption.

Substantial progress has been made in **Russia** to introduce more market-based gas and electricity pricing, especially in the industrial sector. Gas tariffs for Russian industry (in rouble terms) have been increased consistently since 2000, by approximately 15% to 25% each year. In 2007, the government adopted the goal of achieving equal profitability from sales to domestic and export markets by 2011. The target date for full parity was extended to 2014-2015, following the surge in oil prices during 2008 and the subsequent economic downturn. Electricity market restructuring began in 2006, and full liberalisation of the wholesale market is currently scheduled for 2011. A process of scaling back retail electricity price subsidies for the residential sector is due to commence in 2011.

In **South Africa**, subsidised electricity pricing, coupled with non-payment by customers and an inability of utilities to enforce property rights, has led to a lack of investment and a shortage of electricity capacity. Rolling blackouts have provided strong impetus for recent price increases and plans to further raise tariffs in coming years. In 2010, the National Energy Regulator of South Africa (NERSA) granted Eskom, the state utility, permission to raise average rates by approximately 25% per year over 2010-2013. Through cross-subsidies, it will maintain its Free Basic Electricity programme, which provides targeted subsidies to the poor through a minimum amount of free electricity for essential services.

The **United Arab Emirates** commenced a series of planned increases to gasoline prices in April 2010 which are aimed at bringing prices in line with international market levels and stemming the losses state-run fuel retailers had been incurring on gasoline sales. To date, prices have risen by 26%. There have been reports, however, that the moves have pushed up sales of gasoline in neighbouring Oman (where prices are now much lower) by United Arab Emirates nationals who cross the border specifically to purchase fuel. Unlike gasoline, prices for most of the diesel sold in the United Arab Emirates have already been deregulated and fluctuate in line with international market levels.

Table 2: Selected plans for subsidy phase-out

Country	Description of announced plans
Angola	Cut gasoline and diesel subsidies in September, 2010, leading to a price increase of 50% and 38% for gasoline and diesel respectively.
Argentina	Proposes to reduce household subsidy for propane gas as natural gas access is expanded.
China	Oil product prices were indexed to a weighted basket of international crude prices in 2008. Natural gas prices increased by 25% in May 2010. China has already removed preferential power tariffs for energy-intensive industries.
Egypt	Plans to eliminate energy subsidies to all industries by the end of 2011.
India	Abolished gasoline price regulation in June 2010 and plans to do the same for diesel. The price of natural gas paid to producers under the regulated price regime was increased by 230% in May 2010. State-owned Coal India Ltd. announced that it would benchmark its premium grade coal to world prices.
Indonesia	Plans to reduce spending on energy subsidies by 40% by 2013 and fully eliminate fuel subsidies by 2014. Electricity tariffs were raised by 10% in July 2010. Has an ongoing programme to phase out the use of kerosene in favour of LPG.
Iran	Plans to replace subsidised energy pricing with targeted assistance to low-income groups over the period 2010-2015. Reforms call for the prices of oil products, natural gas and electricity to rise to market-based levels.
Malaysia	In July 2010, announced reductions in subsidies for petrol, diesel and LPG as the first step in a gradual subsidy-reform programme.
Mexico	Subsidies to gasoline and diesel are expected to disappear by the end of 2010, and the gap of LPG prices is expected to close in 2012.
Nigeria	Plans to remove subsidies on petroleum products by December 2010, or latest end of 2011.
Pakistan	Plans to phase out electricity subsidies and has implemented a tariff increase of around 20% in 2010.
Russia	Natural gas prices for industrial users are to continue increasing toward international levels through 2014 based on the balancing of revenues from domestic and export sales. Pricing in the wholesale electricity market is scheduled to be fully liberalised in 2011.
South Africa	Plans to increase electricity tariffs by approximately 25% per year over 2010-2013.
UAE	Commenced reducing gasoline subsidies in April 2010 and plans to bring them in line with international market levels. Diesel prices are already largely deregulated.
Ukraine	Raised gas price for households and electricity generation plants by 50% in August 2010 and plans to raise them by another 50% from April 2011.

Sources: IEA *World Energy Outlook 2010* (forthcoming)

2. A roadmap for phasing out fossil fuel subsidies

The World Bank's contribution to the Joint Report with the IEA and OECD is organized as follows. A simple analytical framework is discussed, through a step by step decision tree already proposed in the first Joint Report here revisited through the poverty lens (Section 2.1). It also derives the lessons drawn from recent experience of energy reforms, focusing on recycling the savings from the reduction of subsidies in reaching the poor through rural electrification projects and cash transfers. Other elements of reforms, including the introduction of automatic price adjustments and oil funds are also considered as ways to mitigate the impact of fossil fuel subsidy removal on the poor (Section 2.2).

2.1. Analytical Framework

A necessary first step in implementing the reform of fossil-fuel subsidies is identifying those subsidies that should be phased out because they are inefficient and lead to wasteful consumption. Identifying which specific fossil-fuel subsidies are "inefficient" and "encourage wasteful consumption" from among the universe of fossil fuel subsidies that are provided by individual countries requires understanding the circumstances of each country, and analysis of the impact of the subsidy on consumption.

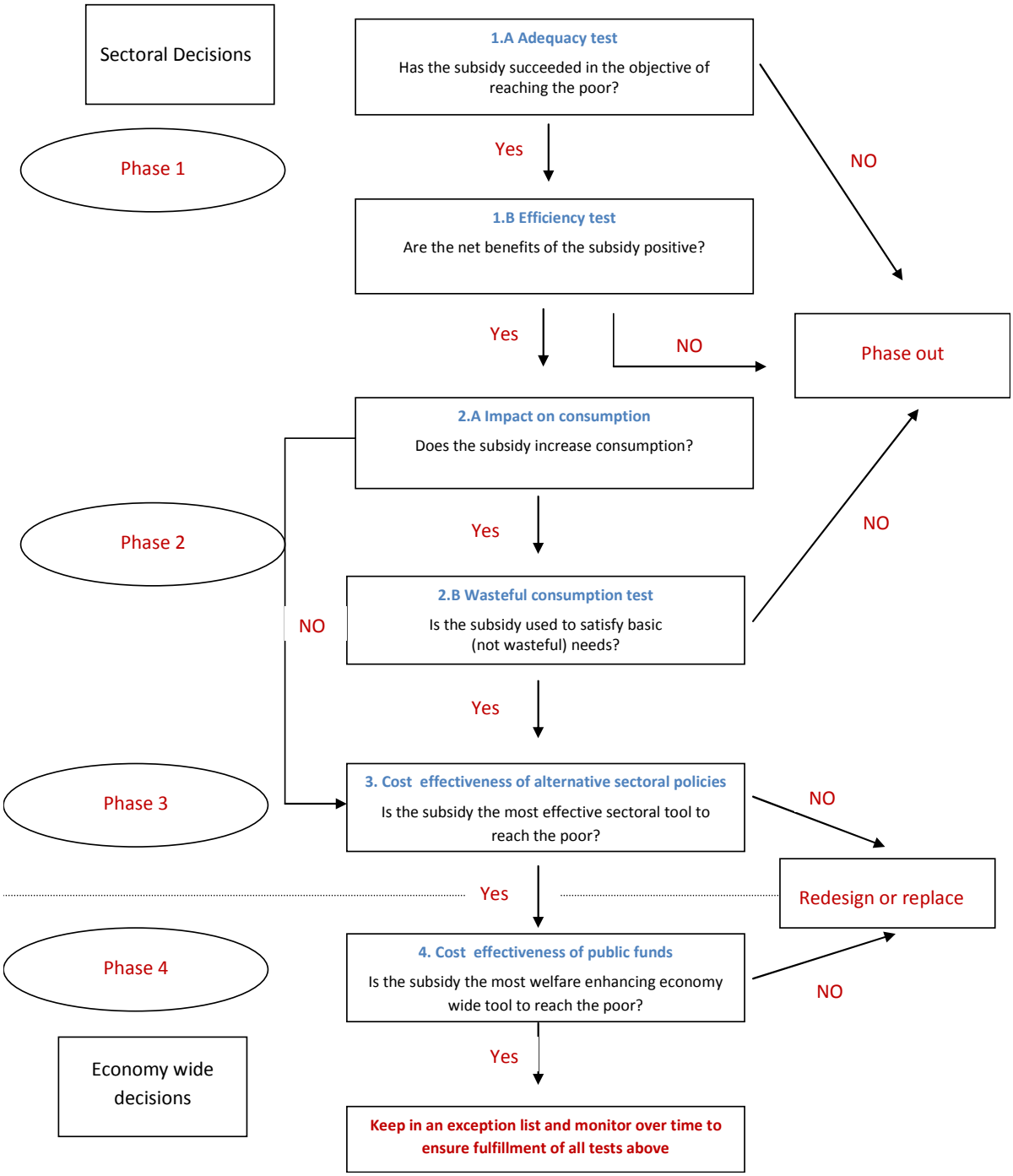
A simple decision tree could be used by individual countries to rationalize and phase-out selected subsidies over the medium term, focusing on the impact on the poor. In this section we will tailor the decision tree to allow individual countries to assess whether to retain, redesign or remove an energy subsidy, focusing on the impact on the poor. Using a poverty lens, the following tests can be used to assess whether to retain, redesign or remove an energy subsidy at each phase of the decision tree (Figure 5).

The first two phases consider the impact of existing subsidies in order to help policy makers identify those inefficient subsidies that lead to wasteful consumption, considering both efficiency and equity issues.

The third phase assesses the cost effectiveness of the subsidy tools compared with alternative sectoral instruments. It should also be highlighted that even in the case of subsidies that passed all the tests above further scrutiny, periodic review and monitoring is needed.

Finally, it is necessary to consider the subsidies in the context of broader policy objectives. In a broader perspective it is important to consider whether the same amount of money can be reallocated to other more socially or environmental desirable activities. Even if the issue is to some extent beyond the scope of energy subsidy reforms, and move the analysis from a sectoral to an economy wide perspective for policy makers, we made some reference to it. This final phase (referred to in Figure 5) covers both the cost effectiveness of other economy wide mechanisms for addressing the needs of the poor (e.g. cash transfers).

Figure 5: Decision tree



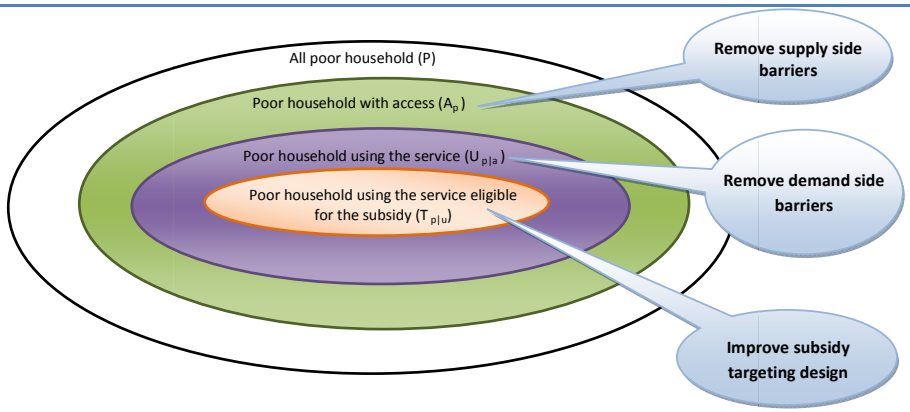
Source: Adapted from IEA, OPEC, OECD and World Bank (2010)

2.1.1 Phase 1 Questions: Has the subsidy succeeded in reaching the poor? If yes, at positive net benefits?

2.1.1.A What share of the poor is reached by the subsidy?

To measure the performance of a subsidy in reaching the poor, policy makers may find it helpful to define the probability that the targeted group (i.e. the poor) will receive the subsidy. This index is known as the beneficiary incidence (Figure 6).

Figure 6: Poor beneficiary incidence – what share of the poor is reached by the subsidy?



Source: Adapted from Wodon *et al.* (2009)

Among the overall poor population, policy makers may find helpful to decompose the beneficiary incidence into three components. Such a decomposition, reported below for the case of electricity, enables some quick diagnostics of the key problems and the required policy responses to be derived (for more details see Annex 1):

- The share of households with potential access to the energy source (A). This is determined by the coverage of the electricity grid among the population which is in turn influenced by the development of the infrastructure grid network and its geographical reach (within a reachable distance from where households live). If A is low, which is often the case in rural areas, the best policy response is to develop the most suitable infrastructure (including off grid and rural electrification solutions) to reach the poor.
- The take-up rate amongst households with potential access – meaning the share of households with potential access that actually use the energy source (U). This second component captures both supply and demand side variables. A low value of U can result from affordability constraints, due to the expensive connection rates, and/or from the presence of cheaper but dirtier substitutes, which can in turn cause environmental problems.
- The share of households that are connected that are eligible for the subsidy (T). Finally, the third factor is determined by eligibility criteria included in the subsidy design. More sophisticated schemes, such as the United States' Low Income Home Energy Assistance Program's (LIHEAP), the reports specific criteria for eligibility, based on socioeconomic variables (see Annex 2 for a short description of LIHEAP).

The framework above has been originally designed for electricity but can be extended to all primary energy sources. Specific recommendations to reach the poor in rural areas are considered in section 2.2.1A.

What information is needed to assess this set of indicators?

A unifying framework, including indicators of inequality (including the Gini Index) and of poverty (such as Sen's index and the members of the Foster-Gree-Thorbecke family) can be used to measure social and poverty impacts.

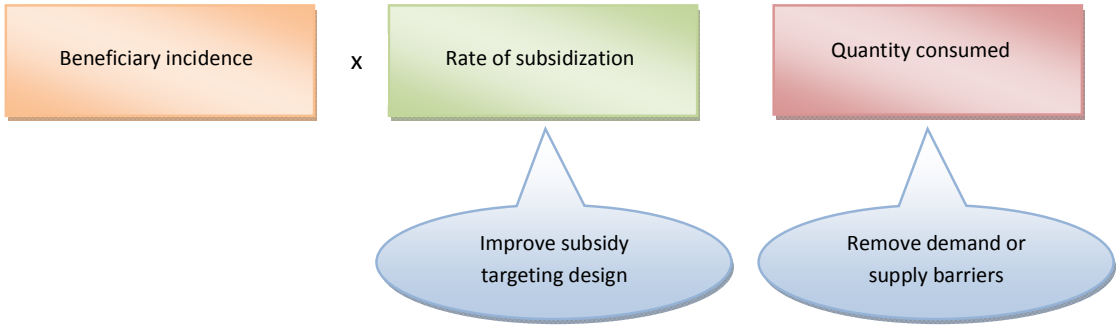
In the case of electricity (and natural gas) it is usually possible to determine whether a household lives in an area where a grid connection is available and used and from household survey information.[9]

In the case of petroleum products the only information available from household surveys is often limited to whether a household uses a specific fuel.

2.1.1.B. What share of the benefits of the subsidies goes to the poor vis-à-vis the non poor?

To further refine the indicator above one may want to look at the benefit incidence (I), namely what share of the subsidy is received by the poor (Figure 7)**.**

Figure 7: Benefit incidence of the subsidies



Source: Adapted from Wodon *et al.* (2009)

The additional components, beyond the beneficiary incidence defined above, to be considered are:

- The rate of subsidization, calculated from the ratio between household consumption valued at cost-recovery prices and the actual payment, among those who benefit from the subsidy. This component can be improved by better targeting of the subsidy design.
- The quantity consumed among those who benefit from the subsidy, which depends mainly on income. Jacobson *et al.* (2005) show how electricity consumption is far more evenly distributed in developed than in developing countries, suggesting that the distributional pattern of electricity consumption depends heavily on a combination of wealth, income distribution and quality of infrastructure provision. Metrics relating

[9] Limitations of household surveys, including lack of information on illegal connections should be kept in mind.

energy access to income provide a quantitative basis to evaluate the effectiveness of pricing reforms in meeting economic efficiency, social equity, and environmental goals (Jacobson *et al.*, 2005).

What information is needed to assess this set of indicators?

The rate by which households are subsidized depends on the specific design of the subsidy scheme.

The quantities consumed can be determined from household surveys and combined with information on the tariff or price charged to end-users. For electricity this requires knowledge of the tariff scheme at which different prices may apply to different blocks of consumption. Evidence from a large sample of countries shows that the lowest quintile consumes less than a third of the electricity that is used by the highest quintile (Komives *et al.* 2007) and in many cases less than the first block generally covered by the tariff structures.

In the case of fossil fuels, universal subsidies are most common. More sophisticated programs, such as the US LIHEAP allow to reach a subsample of the low income household population that may most need subsidies through a careful targeting of recipients. As shown in Annex 2, LIHEAP recipients spend on average a more than 10 percent higher percentage of bill than low income households and their individual and group burden (in terms of income) is also higher.

Among fossil fuels, the share of the subsidy that accrues to the poor is usually the highest for kerosene, making it the least regressive fossil fuel. However, f diesel prices are higher, then kerosene is most likely to be diverted to the transport sector and added to diesel fuel. When diversion is taken into account, a kerosene subsidy can became regressive.

Results based on simulations suggest that subsidies on electricity, gasoline and LPG are likely to be strongly regressive for 20 countries from Sub Saharan Africa, Latin America, Middle East and South and East Asia (Arze del Granado *et al.*, 2010).[10] Figure 8 presents the shares of the total benefits from subsidized fuel prices captured by each income group. On average, the top income quintile receives about six times more in subsidies than the bottom quintile (Figure 8a). The indirect impact through higher prices for goods and services (other than cooking, heating, lighting, and private transport) consumed by households shows similar regressivity patterns (Figure 8b).

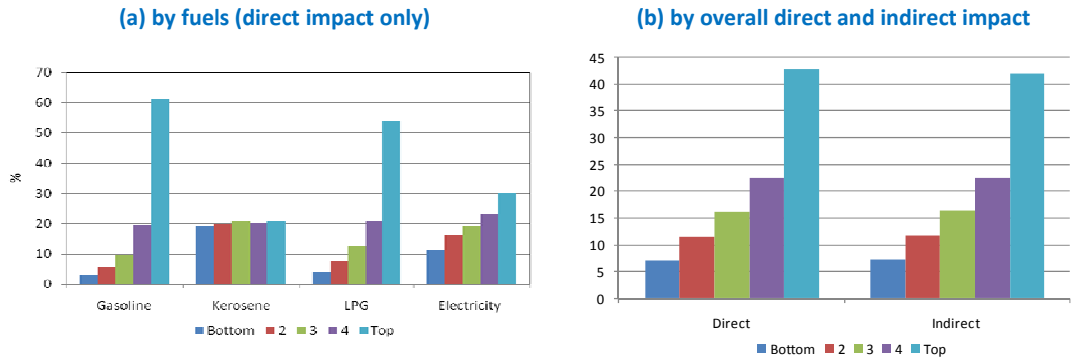
Summing up, where subsidies do not reach the poor and/or its benefits are mostly directed to the richest, there is a strong case for phasing out subsidies. Alternatives to subsidization of energy consumption can be more effective and more efficient for providing benefits related to energy access and affordability to the poor (see Phase 3). Even if subsidies are retained, a regressive pattern of distribution indicates a clear need for changing targeting.

Even if subsidies are progressive, they can be further distinguished into the two categories below, after undertaking a cost-benefit analysis. If net benefits are positive (e.g. benefits more

[10] Arze del Granado et al (2010) consider the impact of a $0.25 per liter increase in fuel prices. The direct impact on households faced with higher prices for fuels consumed for cooking, heating, lighting, and private transport is considered in Fig. 4a. The indirect impact through higher prices for other goods and services consumed by households as higher fuel costs are reflected in increased production costs and consumer prices is considered in Fig. 4b.

than outweigh the costs, including local environmental damages), subsidies may not need to be phased out. However, they need to be subject to the test of phase 2 to ensure that they do not encourage wasteful consumption.

Figure 8: Distribution of Subsidy Benefits By Quintile



Source: Arze del Granado *et al.* (2010)

2.1.2 Phase 2 Questions: Have subsidies resulted in wasteful consumption?

The increased consumption due to the subsidies must be further analyzed to disentangle to what extent it is not wasteful. For example, if consumption has been used to satisfy basic needs (basic heating in cold seasons) this is surely a non wasteful purpose. The appropriate threshold by income or consumption must be defined at the national level, depending on countries' circumstances (for households the level of subsistence can represent a useful point of reference). Subsidies that lead to excessive energy consumption can be further distinguished into the two categories, after comparing actual consumption related with basic need levels. If the increase of consumption is not wasteful in that it satisfies basic needs, subsidies can be kept, subject to continuous monitoring. If the increase in consumption does not relate to basic needs and is wasteful then energy subsidies need to be phased out.

If the poor does not have connection to the energy sources for basic needs, subsidies on connection may be needed.

Finally, wasteful consumption may depend from lack of demand side management.

Different policy responses may be needed as highlighted in the following section.

2.1.2.A. Do fossil fuel subsidies support only or mainly basic needs (non wasteful consumption)?

Some schemes assist households with only that portion of residential energy costs that goes for home heating. Funds are available to eligible households for assistance with energy-related emergencies (winter or summer crisis aid).

Alternative schemes have been used to support new connections. The Global Partnership on Output Based Aid (GPOBA) and the World Bank funded a scheme in several countries including

Armenia providing grants to poor households for individual heating solutions based on gas heaters and in some cases boilers. The funds were disbursed only after the predetermined outputs were met, which provided an incentive for the utility providers to complete the installation in a timely and effective manner. A similar approach was used in Colombia where 35,000 new natural gas connections were made to poor households.

Pricing and rate design can also be used to reduce wasteful consumption. In middle and higher income countries, low-cost weatherization projects have also been subsidized. Decoupling has also been used to break the one-for-one linkage between utility profits/revenues and gross unit sales and generate a price incentive for energy efficiency (see Annex 4). The policy was developed in California in the 1980s, and is now implemented in 22 U.S. states for natural gas, and 13 for electricity (Cavanagh 2009).

2.1.2.B Do fossil fuel subsidies encourage fuel switching to modern energy sources for the poor?

The links between energy poverty and the use of biomass has been well documented. Fuel switching from biomass to other fuels allow labor (by women and children) to be redirected from biomass collection towards more productive purposes and helps reduce deforestation. Household use of biomass is not only associated with high levels of indoor air pollution (with causes the death of some 1.6 million people per year) but also increase substantially time and effort to collect the biomass restricting time available for other activities—particularly education for children.

In low income countries biomass (in the form of charcoal, coal, fuel wood and dung) remains the main consumption fuels for households. The vast majority of Sub Saharan Africa population – a staggering 95 percent of the rural population and above 90 percent of the lowest quintile -- use traditional biomass for cooking. Similar statistics apply to the case of kerosene for lighting. Data from other countries in other regions, including India, confirms the rural urban dichotomy with biomass making up the lion's share of rural fuel consumption for cooking. In contrast, LPG is the dominant fuel for this purpose in urban areas (see Annex 3 for more details).

Sometimes subsidies have been justified to bring the poor further up the "energy" ladder. However, fossil fuel subsidies may not always induce a move away from biomass. Heltbert (2004) shows effects of displacement of biomass use only in urban areas, based on analysis of comparable household survey data from Brazil, Ghana, Guatemala, India, Nepal, Nicaragua, South Africa and Vietnam. The findings vary substantially in rural areas with no fuel switching in rural areas of Ghana and Nepal and partial switching in the rural areas of South Africa and Brazil. The result suggests that fossil fuel subsidies may not always encourage the poor to move away from biomass, as hoped for.

Natural gas has an increasing potential among urban households, where it is mainly used for cooking and heating. Natural gas burns more cleanly than other fossil fuels, such as oil and coal, and produces less carbon dioxide per unit of energy released. Some evidence of switching from electricity to natural gas providing more affordable services to the poor has been found (see Annex 3).

Even if subsidies do not encourage switches to modern sources of energy, this would not necessarily require phasing out in rural areas, as changes in ways traditional fuels are used can bring substantial benefits to the poor.

To summarize the first two phases, policy makers may want to address the question below: who has been benefitting from an existing subsidy? If it is primarily the rich in absolute terms, as is often the case, then there is that much stronger a case for removing the subsidy on equity grounds as well as for improved economic efficiency. Either way, however, there will be an impact on the poor coming from subsidy removal, unless the subsidy really is only used to satisfy basic needs.

2.1.3 Phase 3 Questions: Can protection of the poor be reached by alternative sectoral policy tools in a more cost-effective way?

Further redesign or fine tuning of energy subsidies may be needed to ensure that they are cost-effective. The subsidy re-design may include, for example, better targeting or the introduction of alternative or complementary sectoral policies.

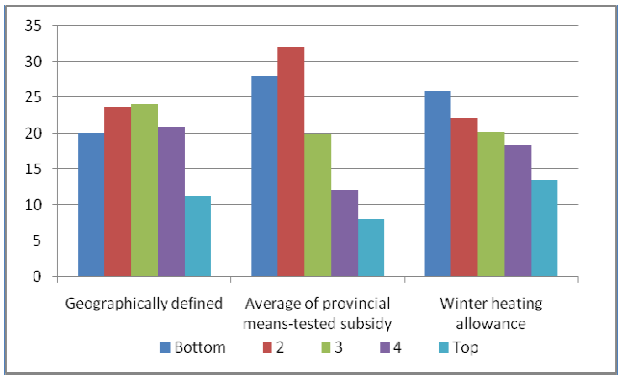
Assuming there is an impact on the poor, what are the options for ameliorating those? The answer will depend in part on what the intended effect of the subsidy was. If it was to just make energy existing use more affordable, then incomes based support programs or (second best) lifeline tariffs can be considered. If it was to make energy access more viable, then switching the subsidy to access (e.g. connection costs) with full payment of incremental consumption costs would make sense.

2.1.3.A How to improve the targeting performance of existing subsidies?

One approach to improve the targeting performance of electricity subsidies is to move from traditionally used Inverted Block Tariff (IBT) to Volume Differentiated Tariff (VDT) structures, where the lowest price for the lowest block is only available to the poor. This is a feasible option only where metering exist. 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. However, for low-income countries, such a change would only have a limited impact on targeting performance.

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 US LIHEAP, 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 (Figure 9). 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.

Figure 9: Distribution of Subsidy Benefits By Quintile



Source: Komives *et al.* (2007)

2.1.3.B What alternative sectoral instruments can be used to reach the poor by increasing access?

An alternative approach is to replace consumption subsidies with connection subsidies. Simulations show that connection subsidies designed to reach a majority of unserved population living in areas connected to the grid are superior to consumption subsidies and in most of the cases are also progressive (Wodon, *et al.*, 2009). If connections subsidies are distributed in the same way as the existing consumption subsidies the targeting performance of the subsidy would improve but not significantly. Nevertheless, the efficiency performance of the connection subsidy will be larger and that would provide a compelling reason for considering it over the consumption subsidy.

2.1.4 Phase 4 Questions: Can the same amount of money be reallocated to other more socially and environmentally desirable activities?

For those fossil fuel subsidies that remain, it is then necessary for policymakers to consider the subsidies in the context of broader policy objectives. That is, whether the opportunity cost of energy subsidies is too high, particularly in the presence of alternative policy priorities. The analysis would require comparing at the margin the welfare impact of a unity reduction of energy subsidy compared with an increase in expenditure on health, education or infrastructure. In addition, the net benefit of subsidies must be higher than the marginal cost of public funds.

Reforms of fossil fuel subsidies reduce expenditures on financing such policies. If these are cross-subsidies among users, then the net effect may be revenue neutral or not, depending on whether the supplier has run an overall deficit. If that is the case, or the government has been directly financing the subsidy, then public funds that would have been used for the consumption of energy is available for other uses.

Once fossil fuel subsidies have been removed, there is still need to consider how to recycle the free funds for addressing the needs of the poor, but that issue is beyond the scope of energy subsidy reform. One can consider for example how much of the overall "economic efficiency

dividend" obtained from fossil fuel reform might be applied to such social goals, or should go back to general revenues.

2.1.4.A What alternative economy wide instruments can be used to reach the poor?

Policy makers can compare the mean targeting performance of utility subsidies versus other targeting instruments. 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 impact of the introduction of direct cash transfer is illustrated by the Armenian case. To soften the impact of the tariff increase, a direct cash transfer of 1,450 AMD (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 non poor) regularly consuming in the first two blocks of the 1998 electricity tariff were receiving the income transfer in 1999.

2.1.4.B How to reallocate the savings from subsidy removal to other more productive activities?

A number of empirical studies have used computable general equilibrium models (CGE) to model the welfare impact of removal of energy subsidies. The benchmark dataset needed for a CGE model is generally specified in the form of a "social accounting matrix" or SAM. The construction of an accurate SAM is challenging. The raw materials take the form of the National Accounts, input-output tables, household surveys, and a variety of other data. A number of cautionary remarks need to be made. Concepts and definitions differ between data sources. And even after adjustments have been made to make definitions consistent, the estimates for what are conceptually the same totals coming from different sources will generally differ.

In what follows we summarize the results of "recycling" at least some of the savings coming from reduction of subsidies through alternative policies and explore the likely economic, social and environmental impact, through the most recent CGE literature. Recent studies simulate the distributional impact of subsidies removal and the introduction of alternative policies, including the introduction of carbon cap and dividend policies in the case of California (Kunkel and Kammen, forthcoming), Indonesia (Yusuf, 2008, Yusuf and Ramayandi, 2008), Egypt (Abouleinein *et al.*, 2009), Argentina (Benitez and Chisari, 2010) and China (Lin and Jiang, 2010). Annex 5 reports more details on the results of the models summarized below:

- In most of the cases, fossil fuel subsidy removal has adverse economic and social impacts.
  - Incidence of poverty is significantly lower where the subsidy removal does not include kerosene, supporting the evidence reported in the previous sections that among petroleum fuels they are the most "progressive" (Yusuf, 2008).

- To mitigate and offset the negative impact on the economy, the re-allocation of given percentage of the savings either to the poor through cash transfer or to energy efficiency schemes mitigate the economic and social impact of subsidy removal on the poor.
  - Cash transfers can be used to mitigate the social impact of subsidy removal on the poor. Transfers targeted to the poorest quintiles of the income distribution increase their welfare relative to what it would have been in the presence of energy subsidies.
  - Energy efficiency investment also mitigates the adverse economic and social impact.
- While more difficult to implement, penalizing polluters, e.g. through internalization of external costs, represent a preferable option. Carbon cap and dividend policies can be designed to be highly progressive (Kunkel and Kammen, forthcoming). As an example, the U. S. Government has adopted a social cost of greenhouse-gas emissions into its rulemaking framework (US Government, 2010). The introduction of a carbon tax, as an alternative to fossil fuel removal, penalizes less the output (and employment) of most of the sectors, and can also mitigate the impact on the poor (Yusuf and Ramayandi, 2008). Annex 4 reports additional mechanism to encourage the development of clean energy mechanisms.

Having identified the subsidies that need to be reviewed and formed, governments need to address the obstacles to reform and identify mechanisms for overcoming resistance to changing the subsidy. The next section will review the lessons learned from case studies referring to the recent experience of fossil fuel subsidy reforms.

2.2 Lessons from recent experience of energy subsidy reforms

From the analysis of recent experience of energy subsidy reforms by countries differing by a broad set of characteristics (energy endowment, income level, region and subsidy by type of fuel and electricity) some interesting lessons emerge as summarized below.

2.2.1 Lessons from rural electrification

Impact evaluations confirm the welfare enhancing benefits of rural electrification. Extending access in rural areas requires a system of subsidies that acknowledges the lower income and electricity consumption levels of rural households and higher costs of supply resulting from the remoteness of the location, as well as the government's social objectives.[11] The inability of rural consumers to pay fully for the cost of supply due to a combination of the off-grid technology used and low income of the population in particular highlights the importance of designing a system of cost-effective subsidies to ensure the recovery of the costs of an efficient operation

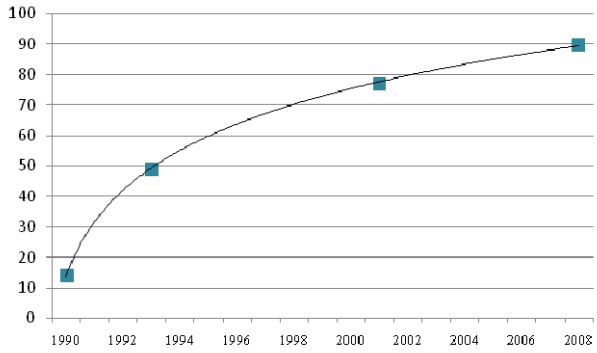
[11] The average monthly consumption per customer in rural areas is 30kWh, and around 12 KWh for newly connected customers. This contrasts with the average urban consumption of around 100 KWh.

— whatever the amount contributed by the customer — so that the service in rural areas is not neglected.

A study on removing barriers to connection was undertaken for **Ethiopia**, found that a 10% discount leads to an average 11% increase in the probability to connect, although the effect of subsidy varies greatly in relation with a household's initial income. Interestingly, the contingent valuation approach led to similar results, support the use of so-called 'smart subsidies' designed to promote access to energy for the poor, using explicit and transparent subsidies. A study in **Vietnam** finds that in addition to affecting income, rural electrification had its strongest impact on school attendance by children in households adopting electricity and this is true for both boys and girls. These impacts obviously have a long-term influence on the welfare of the country as a whole as these children move into the workforce both at higher and more productive levels.

Rural electrification through targeted grid-extension efforts can be most effective in reaching the poor in a relatively short period of time both in low and middle income countries In **Vietnam**, the establishment of the state-owned utility (EVN) and its targeted rural electrification efforts resulted in a significant increase in electrification levels and higher electrification rates for the poor households. Through an ambitious project supported by the World Bank, the Government of Vietnam has been successful in expanding rural electrification. Under this project, more than 600 communes were connected in initial phase during 2000-2004. The second phase of the project since 2005 was able to connect the remaining communes (see Figure 10).

Figure 10: Vietnam: Percent Electrification Coverage (1990-2008)



Source: World Bank (2004, 2008)

Expansion of the rural electrification system is a better and often more affordable alternative to reach the poor compared to fossil fuel subsidies which are often regressive. Although fossil fuels (including kerosene) subsidies are regressive, kerosene is -- together with biomass--the primary energy source for majority of the unconnected rural population in low income countries. A long-term policy option to reduce kerosene subsidies would be sustainable rural electricity infrastructure development. In the case of **Ethiopia**, for example, the average connection cost for customers living near the grid -- the so called "last mile" -- is about $ 75, representing about 15 percent of the average household annual income. By and large, kerosene is the fuel of choice in rural areas, even if it is much more expensive than electricity. 96 percent of households, which spend $1.60 per month on average on kerosene, much more expensive than a typical electricity bill that would fare around $ 8–10 per year at prevailing rates. Because

of the "last mile" obstacle, the connection rate has grown very slowly, at a rate of about 10 percent per year. As a result, easily targeted subsidies for connection can be used to promote rural electrification expansion instead of regressive fossil fuel subsidies.

Well designed rural electricity subsidies can make service affordable to the poor. Once the subsidy element is included most of the schemes allows making tariffs affordable to the poor. The result is that, in general, for off grid solutions rural households pay a tariff that is only slightly higher than the urban tariff, in spite of the fact that the supply cost could be from 2 to 5 times higher. In the extreme case of a high-cost isolated generation system, subsidies reduce the contribution of a low-income rural household to 16 percent of the total cost (Table 3).

Table 3: Impact of Subsidies on Tariffs for an Isolated Mini-Grid in Peru (US cents/KWh)

	Full Cost	With internal tariff subsidy	With internal tariff subsidy plus FOSE
VAD secondary grid	22.01	9.01	3.38
VAD primary grid	9.58	3.98	1.49
Capacity cost	3.32	3.32	3.32
Energy cost	17.80	5.76	2.16
Total	**52.71**	**22.07**	**8.28**

Source: OSINERGMIN

Note: FOSE is the Electricity Sector Compensation Fund, used to apply a consumption cross-subsidy; VAD is the Value Added of Distribution, which remunerates services provided by the Distribution Companies

Innovative subsidy schemes have proven successful. The success of Chile's rural electrification program in attracting private firms to provide the service hinged on a high level of multiyear financial and political commitment through various national agencies, including the energy sector regulator, *Comisión Nacional de Energía* (National Energy Commission) and the planning ministry, as well as strong regional government buy-in. Chile's rural electrification fund was launched in 1994, resulting in the creation of special mechanism (the fund) linking subsidies to output targets. The central government allocates the subsidy fund to the regions based on the number of unelectrified households and the progress each region has made in the development of RE projects in the preceding year. The government targeted $500 million to support the electrification program and government agencies provided technical assistance to local governments in establishing a methodology for cost/benefit analysis and prioritization of rural electrification projects, as well as calculating the grant required for projects to achieve an adequate rate of return (Barnes *et al.*, 2007).

Following the Chilean pioneering scheme, many other countries are now implementing Output Based Aid (OBA) reforms. Box 5 reports the recent experience in the design and implementation of such schemes in several countries characterized by different levels of income and rate of electrification. Annex 6 reports in detail the design and effectiveness of subsidies for rural electrification.

Box 5 OBA schemes in rural electrification

In 2002 the government of **Bangladesh**, implemented installation of Solar Home Systems (SHS) component, financed by a Global Environment Facility (GEF) grant of $8.2 million for capital cost buy-down, was implemented as an OBA. Private companies in partnership with microfinance institutions (MFIs) and NGOs supply the SHSs. The project successfully installed its target of 50,000 SHSs by September 2005, three years ahead of schedule and $2 million below the estimated project cost. Indeed, the use of output-based subsidies is being increasingly used for rural electrification. In **Argentina** for instance, output based subsidies are being used to mobilize private sector expertise and provide off-grid electrification services to rural households. As of November 2008, Argentina had provided 8,000 households and 1,900 schools with access to electricity, primarily through individual solar and wind home systems. In **Senega**l, the rural electrification program launched in 2003 combined privately operated concessions with output based subsidies to leverage private financing resources and overcome the barrier of high up-front connection costs. The project has launched successful bidding processes, but actual results are yet to be seen (World Bank, 2010). In **Ethiopia** working with the state-owned utility (EEPCo) GPOBA designed and funded the smart subsidy according to which household would pay only about 20% of the connection fee after they acquired compact fluorescent lamps and metered connection. Similarly, the Government of **Mexico** has recently launched a new innovative rural electrification initiative based on medium term service contracts with output based subsidies to attract private sector participation and develop a sustainable rural electrification market. Rural households not connected to the grid and located more than 5 kilometers away from the grid are being electrified with stand alone systems. A first pilot is introducing, when they are least cost, decentralized power supply options based on renewable energy technologies. These options may include SHS, wind home systems (WHS), diesel-RET-battery hybrids, small scale biomass projects and micro-hydro plants (micro-grids) (World Bank, 2007).

2.2.2 Lessons from social safety nets

Channeling budgetary savings arising from subsidy removal or reduction to finance better-targeted compensation packages for poorest households is a more effective alternative to regressive fuel subsidies that accrue to higher income households.

- **Indonesia** successfully designed targeted cash transfers that were adopted simultaneously with the fuel price increases in 2005. The Unconditional Cash Transfers program (UCT) is the largest of such programs in the world, covering 19.2 million households, or one third of the Indonesian population. The government budget savings from the cost of fuel subsidies was estimated to be about $10.1 billion in 2005-2006. Before execution of the transfers, each household was given a proxy means test. Recipients were issued smart cards (with instructions printed on the back of the cards), and transfers delivered through the post office system. The program delivered benefits of $ 30 per quarter, significantly more than the increase in energy costs. This served to increase the level of assistance for the poor, and to make fuel price increases acceptable. At the same time by covering the bottom 40% of the population, which is more than the targeted bottom 28%, the program also helped prevent those on the verge from falling into poverty (ESMAP, 2006). Other than transferring cash to lowest income households, the government also used the savings to finance programs in education, rural development, and health. The speed with which the UCT was designed and implemented meant that some leakage, targeting errors, and logistical difficulties were inevitable. However, the government responded quickly to reports of irregularities and in spite of the challenges, the program proved largely successful in reaching the poor—the poorest deciles received 21% of the benefits, while deciles 2, 3 and 4

captured 40%. In the absence of compensation, the price hikes would have led to an estimated 5% rise in the poverty head count index.

- **Mexico**'s experience with government social safety net programs is also considerable and has shown commendable progressive results. Oportunidades is Mexico's main anti-poverty government program. The program started as Progresa but then changed its name in 2002. Oportunidades has been quite successful in targeting the neediest in rural and urban communities in order to help them invest in human capital, as it targets education, health, and nutrition of children. The distribution mechanism uses cash transfers to households linked to regular school attendance and health clinic visits. Another successful program that shows progressive characteristics is the government's temporary employment program (Empleo Temporal), which operates nationally in rural communities of up to 15,000 residents and gives preference to communities of fewer than 5,000 residents. The program is designed to provide work when labor demand is low and opportunities are few and far between. Work projects typically are related to the environmental preservation of their community and provision of basic infrastructure (Gobierno Federal 2008).
- In **Brazil**, Auxilio Gas (AG) was integrated with Bolsa Familia (BF), an income transfer program established in 2004, to compensate low-income families with targeted cash transfers in place of LPG subsidy removal. The AG cash transfer was a vital element of the subsidy phase-out program as LPG is commonly used as a cooking fuel by the poor (Grosh *et al.,* 2008). BF is available to those earning less than a quarter of the minimum salary. The system relies on the unified registry, Cadunico, established in 2001. The registry provides information on all eligible beneficiaries, and has helped to reduce administration costs and the duplication of benefits. Data is collected on the basis of geographical poverty maps and door-to-door questionnaires. This enables the government to concentrate extra social expenditures on households living in the poorest areas, resulting in a higher portion of the expenditures reaching the poor households. The AG cash transfers were a vital element of the subsidy phase-out program as LPG is commonly used as a cooking fuel by the poor. Under the program, households earning less than R$90 per month were provided with a payment of R$7.50, bi-monthly.

Broader reforms aimed at protecting the most vulnerable have proved effective in mitigating the impact on the poor while removing fossil fuel subsidies.

- In **Jordan**, the minimum wage was increased, with low-paid government employees receiving higher wage increases than other employees as palliative measures, largely regarded as successful in dealing with price increases. The package included also one-time bonuses given to low-income government employees and pensioners and cash transfers provided to other low-income households whose heads were nongovernmental workers or pensioners and tax exemptions aimed at low-income groups (by targeting 13 basic foodstuffs). The Jordanian government also improved the design and implementation of the National Aid Fund (NAF), which was established in 1986 as part of a strong social safety net program, in addition to increasing its funding (Kelly, 2009). Both public and private providers are involved in safety net programs delivery. Total public spending on safety nets is estimated at more than 1% of GDP, with about one half spent through the NAF. The total number of beneficiaries is estimated at about 8-10% of the population (World Bank, 2008). An electricity lifeline tariff for those using less than 160 kWh per month was kept. A one off compensation for the non poor

was also implemented by removing of government sales tax on the non-tourist restaurants, and the temporary removal for retailers with annual turnover below $1.4 million, taxis and public transport. Taxis were permitted to increase their prices, and the cost of public transport also rose. Along with subsidy reform, measures aimed at fuel substitution and energy efficiency were also implemented.

- In the case of **Ghana**, budget savings from fuel subsidies were directed towards transparent and easily monitorable poverty mitigation actions including the provision of extra funds the Community Health Compound Scheme to enhance primary healthcare in poorer parts of the country and the removal of fees for attending primary and junior secondary schools. In addition, planned investment in the provision of mass urban transport expansion was expedited and the existing rural electrification system was expanded.

2.2.3 Lessons from other reforms

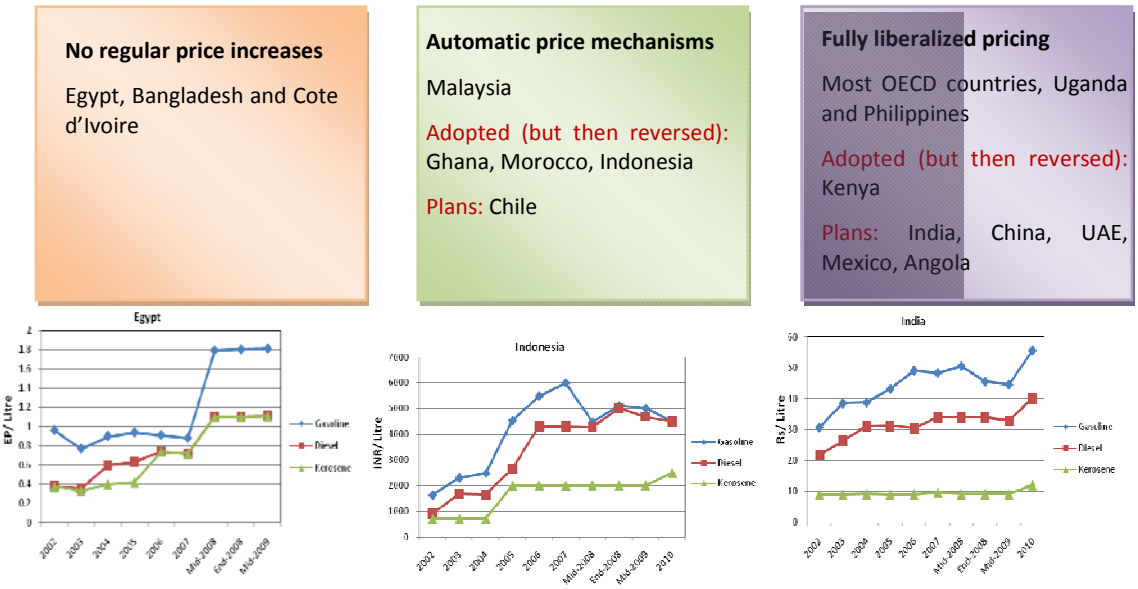
Moving towards cost reflective fossil fuel pricing

Decreasing oil prices in 2009 and 2010 offer a unique opportunity for implementing a move from relatively ad hoc pricing to the introduction of regular reviews, autonomic price adjustments or a fully liberalized system. Liberalizing the pricing system through transparent and automatic price setting mechanisms or adopting a market based scheme can help to support subsidy reforms.

Automatic price adjustments can be a useful transitory step in moving towards a fully liberalizing pricing scheme. They are based on predetermined formulae and at regularly defined periods. The price adjustments are passed on to the market relatively quickly. However, the formulae can be modified to allow price changes only when certain thresholds are exceeded. The prevailing regulations are often monitored by a state institution or a panel of experts. Moving from one system to the other also significantly smoothen the impact of subsidy removal over time, as the trends for Egypt, Indonesia and India show (Figure 11).

Reforms moving towards automatic price adjustments mechanisms and fully liberalized system can be politically challenging. There have been examples of backtracking. In June 2010 **Kenya**'s parliament passed a bill allowing the country to return to price controls of essential food and fuel goods, after the policy was abandoned in the 1990s in favor of economic liberalization. Since the liberalization of the oil sector in the 1990s, the government has had no price control mechanism in place leading to pump prices being implemented arbitrarily by the dealers based on the international oil prices. In 2009 in **Vietnam** the government announced the move toward fully liberalized fuel prices, but was forced to suspend the plan to control soaring consumer prices amid record high world crude oil prices. Vietnam, which relies almost entirely on oil product imports as it lacks refineries, slashed retail petrol prices by 5.3 percent in August 2010 (the second time in two weeks). In June 2008, **Cote d'Ivoire** increased the price of diesel by 44% and petrol was raised by 20%. Following public out roars, the government had to revert from the price hikes two weeks after the announced price adjustments. The budgetary implications of this action were significant in the form of political costs and budgetary effects in terms of transportation costs for civil servants and shortfalls in revenues.

Figure 11: Petroleum price setting



Source: Data updated from *Coady et al.* (2010), based on national statistics

Several countries both inside and outside the G-20 countries are moving towards automatic price mechanisms and full liberalization. G-20 countries, including Indonesia, Mexico, India and China, announced further reforms (as reported in section 1.5). Other countries have done the same. This is the case for Malaysia, where prices are now subject to a managed flow where the price is determined by an automatic pricing mechanism, but also Angola. In Chile the government is currently proposing a new mechanism to buffer local fuel prices from international market variations. The old mechanism that expired at the end of June 2010 was a fuel price-stabilization fund that kept the price of fuel import within a price band to match the recent average import price level, effectively subsidizing diesel and gasoline prices if they gained above a given price range.

Introducing oil sovereign wealth funds (SWFs)

Oil SWFs can help producing countries to protect the poor while phasing out subsidies. The main objectives of oil funds are to shield the domestic economy from the volatility of world prices, to foster investment in branches other than natural-resources exploitation, and to share income equitably across generations. Oil funds are stabilization funds protected from immediate use into which partial state oil revenue is channeled. They can be an effective instrument to manage oil revenue for countries where natural resources are a dominant contributor to public revenue, and as a result the prudent management of this revenue is integral for the positive development within a stable macroeconomic environment. Partial funds from SWFs can be channeled to implement social safety nets or programs as in the case of Azerbaijan. Table 4 reports the asset value of the fund for the latest available year for selected countries that have adopted SWFs.

The Norwegian Fund display several features that could serve as a model for other oil funds.

- Norges Bank Investment Management (NBIM) manages the fund on behalf of the Ministry of Finance, which owns the fund on behalf of the Norwegian people. The fund is fully integrated with the state budget and that net allocations to the fund reflect the total budget surplus, including petroleum revenue. The ministry determines the fund's investment strategy, following advice from among others, the NBIM and discussions in Parliament.
- The ministry regularly transfers petroleum revenue to the fund. As of October 2010, the fund's overall value is $512 billion. The capital is invested abroad, to avoid overheating the Norwegian economy and to shield it from the effects of oil price fluctuations. In 2001 it was established that no more than 4 percent of the fund's return should over time be spent in financing the non oil budget deficit.

Table 4: Progress in the establishment of SWFs

Country	Fund Name	Assets ($m)	Asset Value as of	Inception Year	Source of Funds
Kuwait	Reserve Fund for Future Generations	250,000	2007	1953	Oil
UAE	Abu Dhabi Investment Authority	875,000	2007	1976	Oil
Norway	Government Pension Fund-Global	512,000	2010	1976	Oil
Canada	Alberta Heritage TF	14,400	2010	1976	Oil & Gas
Azerbaijan	SOFAZ	18,000	2008	1999	Oil
Iran	Oil Stabilization Fund	8,000	2007	1999	Oil
Algeria	Fonds de regulation des recettes	58,113	2008	2000	Oil
Kazakhstan	NFRK	21,600	2008	2000	Oil
Nigeria	Excess Crude Account	< 5	2010	2003	Oil
Russia	Stabilization Fund	157,000	2008	2004	Oil
Libya	Oil Reserve Fund	50,000	2007	2005	Oil

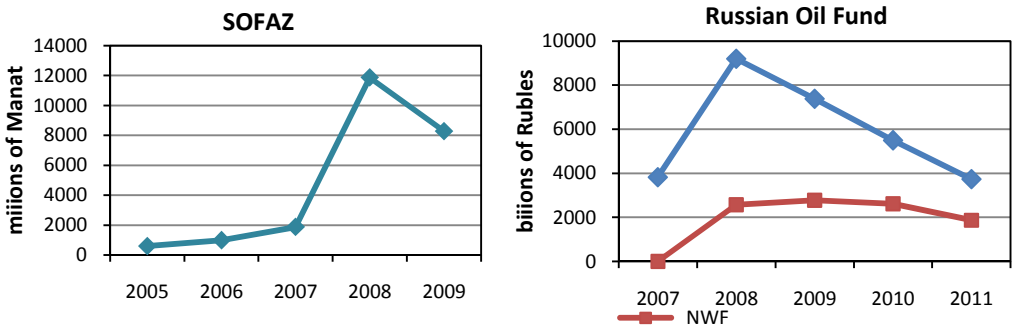
Source: Adapted and updated from IMF

More transparency and better governance has also been achieved by oil funds in the Middle East and Euro Asia

- Not surprisingly, the Abu Dhabi Investment Authority (ADIA) represents the largest oil fund in the world invests the oil surplus of Abu Dhabi, the richest city state within the **United Arab Emirates**, which also includes Dubai. Since May 2008, ADIA acted alongside the International Monetary Fund, as co-chair of the International Working Group of sovereign wealth funds. The goal was to create an agreed framework of Generally Accepted Principles and Practices that reflected appropriate governance and accountability arrangements, as well as the prudent and sound basis on which SWFs conduct their investments.

- The Azeri State Oil Fund (SOFAZ) was established in 1999 and in 2003 was the first fund to join the Extractive Industries Transparency Initiative (EITI) in 2003. As of July 2010, the fund's assets reached $18 billion.
- Responding to the recent financial crisis, several countries, including Azerbaijan and Russia, have tapped oil funds to deploy a large fiscal stimulus program and protect the poor from the recent financial crisis (Figure 12, IMF, 2009 and 2010).

Figure 12: Trends in the Azeri and Kazakh oil funds



Source: IMF Staff Reports (2009, 2010) and http://www.oenb.at/en/img/feei_2007_1_astrov_tcm16-58446.pdf

- **Iran and Nigeria** are also about to set up SWFs to prevent oil proceed to be used mainly to support budgetary shortfalls**.** Experience from the Iranian Excess Revenue Account (ECA) and the Nigeria fund have been mixed. Since September 2007, the Excess Revenue Account (ECA)'s resources have fallen from $20 billion to just under $ 500 million as state governors have used Nigeria's oil revenue to fund their budgets (Aderinokun, 2010). Both governments announced plans to create a Sovereign Wealth Fund in late 2010 to prevent from raiding oil proceeds from their funds.
- It is worth noting that another type of oil stabilization funds was used in Chile (as mentioned above up to June 2010) and other countries, but their experience has been unsuccessful (for details, see ESMAP, 2006).

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