



FOSSIL FUEL SUBSIDIES IN ASIA TRENDS, IMPACTS, AND REFORMS INTEGRATIVE REPORT

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INTEGRATIVE REPORT



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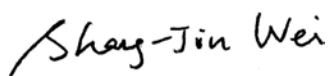
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Foreword

Energy subsidy reform has emerged as one of the most important policy challenges for developing Asian economies. Government expenditure on fossil fuel subsidies which covers the gap between global and domestic prices exceeds public spending on education or health in some Asian countries. High fossil fuel subsidies can wreck government budgets. They accrue largely to the rich and reduce incentives for investment in renewables and energy efficiency. Moreover, fossil fuels (coal, oil, and gas) are major carbon emitters, and burning coal, the most carbon-intensive energy source, has serious climate-change implications.

In 2009, the Group of Twenty and Asia-Pacific Economic Cooperation committed to rationalizing and phasing out inefficient fossil fuel subsidies; unfortunately, there has been little progress. As people get used to low prices, subsidy reform becomes difficult: powerful beneficiaries oppose it and governments fear social unrest when prices rise due to reforms. But this mindset must change as the benefits of subsidy reform are potentially immense. The substantial drop in oil prices has opened a new window of opportunity to put an end to these harmful subsidies. This study comes at a critical moment to shed new light on energy pricing. It offers guidelines for reforms and the formulation of long-term energy strategies. Based on an analysis of complex interactions between economic, social, energy, and environmental issues, the study shows that the initial rise in energy prices due to subsidy reforms will nudge households and businesses to shift to alternative fuels and to adopt energy-efficient appliances. Using the money freed up from subsidies to compensate poor households and to increase government budgets will cancel out the negative effects of the initial price rise. These changes should allay the fears of reform.

The study measures actual subsidies such as direct transfers, tax exemptions, subsidized credit, and losses of state enterprises by different fuel types. This information should help countries better sequence and prioritize reforms. The study contributes to the international and national effort to develop knowledge to ensure reforms are well-planned, sustainable, and politically acceptable. We hope the findings of this study will promote further discussion and sharing of knowledge on the best ways to anticipate the impacts of fossil fuel subsidy reform. This can help ensure that subsidies are not simply removed, but that the funds they release are put to best use in helping the poor cope with the changes.



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Highlights

- Fossil fuel subsidies in India, Indonesia, and Thailand were extensive at 2.7%, 4.1%, and 1.9% of gross domestic product (GDP), respectively, in 2012. Low-priced petroleum products account for over half of these subsidies in each country. Total subsidies are higher than official government or international organization estimates, suggesting that more budgetary transparency is needed to reveal the true scale of subsidies and to provide data to assess alternative, and potentially more effective, expenditures.
- In all three countries, the immediate macroeconomic impact of fossil fuel subsidy reforms was larger than those projected in the medium to long term when demand and supply adjust to initial energy price shock. Long-term projections showed generally marginal impacts on GDP, which were positive when government injected or reallocated all savings from subsidy removal back into the economy. Overall, the results indicated that governments will need to use only a portion of savings to fully compensate households for direct and indirect impacts, leaving funds to plow back through higher government expenditure or tax reduction, leaving the economy no worse off.
- The most vulnerable household groups varied by country. In the short term, reallocating a share of savings to households was found to effectively compensate them, but the relatively modest effect of this on economic growth required ongoing transfers to maintain levels of consumption in the medium to long term. This suggested that—in addition to cash transfers—government might need to invest a share of savings into areas such as infrastructure to stimulate economic activity in the long term. This could also be expected to improve household welfare by increasing GDP growth.
- India, Indonesia, and Thailand all have a range of sophisticated safety net programs that could accompany fossil fuel subsidy reform. But deficiencies in the coverage and effectiveness of the programs means that none of the three could target compensation with enough accuracy to assist all poor households facing higher energy prices. Governments could use the funds liberated by the reforms to help develop new or augment existing programs to fully protect the poor from economic shocks.
- In all the countries, higher energy prices were projected, predominantly, to affect the energy sector and energy-intensive industries. Price increases were expected to drive a reduction in demand and an increase in energy productivity, helping to dampen the effect of increased energy costs, as well as creating capital cost savings in the power sector. The magnitude of the energy sector impacts was found to vary significantly by country, depending on the elasticity of energy demand and the availability of alternative energy products.

- Lower demand for energy was projected to reduce greenhouse gas emissions in the three countries by 1%–9% by 2030, though these impacts varied between sectors and by the reform of subsidies to different energy products.
- The findings have a number of implications for policy. The projected impacts on the economy and on households indicated that although cash transfers are an important welfare tool, particularly in the short term, it is likely to be necessary to also invest a share of savings in ways that more effectively stimulate growth, thereby improving household welfare in the medium to long term. The projected impacts on energy systems and the environment indicate the possible need for policy interventions to maximize the environmental benefits of reform and to ensure energy poverty does not increase.
- Using standard economic and energy models together provided a clearer picture of reform. It also identified key limitations to the suitability of standard economic models, notably that they typically lack detailed disaggregation of energy products, significantly reducing the precision of analysis. Where governments lack the time and resources to collect data to adapt models, they may need to complement modeling—though a highly important analytical tool—with qualitative research methods. An assessment of alternative modeling approaches would, under these circumstances, be of value to policy makers.

Abbreviations

ADB	- Asian Development Bank
BAU	- business as usual
CGE	- computable general equilibrium
PRC	- People's Republic of China
CO ₂	- carbon dioxide
E3MG	- energy-environment-economy model at a global level
FY	- fiscal year
GDP	- gross domestic product
GSI	- Global Subsidies Initiative
HH	- households
IEA	- International Energy Agency
IISD	- International Institute for Sustainable Development
IMF	- International Monetary Fund
LPG	- liquefied petroleum gas
MARKAL	- MARKet ALlocation
OECD	- Organisation for Economic Co-operation and Development
OPEC	- Organization of the Petroleum Exporting Countries
SAM	- social accounting matrix

Executive Summary

Developing Asia is home to a majority of the world's energy poor, with about 615 million people having no electricity and about 1.8 billion burning firewood, charcoal, and crop waste for daily needs. Yet, clearly, energy is essential for economic growth and human progress, and the region's needs will continue to rise as economies grow and living conditions improve in this dynamic region. It is this that underlies the widespread use of subsidies on fossil fuels (oil, gas, and coal) and electricity in the region. Of the top 25 countries in the world that subsidized fossil fuel consumption in 2012, 10 were in Asia. Developing Asian countries also accounted for close to a third of global subsidies on fossil fuel consumption in 2012, equivalent to about 2.5% of gross domestic product (GDP).

But this large outlay on subsidies restricts public expenditure on priority development areas such as education, health, and infrastructure. Although aiming to provide incentives for higher energy production and supporting the poor, low prices for energy products result in excessive production and consumption, distorting markets, increasing the rate of depletion of fuel reserves, and adding substantially to greenhouse gas emissions. Artificially cheap fossil fuels discourage the development and deployment of alternatives such as renewable and more efficient, cleaner forms of energy. Fossil fuel subsidies are highly regressive: although designed in the interests of the poor, they typically benefit medium- to high-income households, which are bigger energy consumers. Furthermore, the subsidized products are often diverted to unintended uses or smuggled into neighboring countries, where fuel prices are higher.

In 2009, Group of Twenty and Asia-Pacific Economic Cooperation leaders agreed to phase out inefficient fossil fuel subsidies in the medium term. Although implementation has been slow and patchy, several Asian countries have lowered subsidies, including India, Indonesia, Malaysia, the Philippines, Thailand, and Viet Nam. Since then, an expert panel including two Nobel laureates ranked reform of fossil fuel subsidies in the top 19 of 169 development targets proposed by the United Nations to replace the Millennium Development Goals during 2016–2030 to give the best social returns of \$20–\$40 on every dollar of investment. This study informs this debate and provides a platform for designing reform programs for the phased removal of fossil fuel subsidies in Asia's developing economies.

The study assesses the extent of fossil fuel subsidies in three Asian countries—India, Indonesia, and Thailand—and projects the impact of their removal on those economies, households, energy use, and environmental pollution. The study's three distinct but interconnected steps included (i) quantification of an inventory of existing fossil fuel subsidies, (ii) an impact analysis of phasing out the subsidies, and (iii) an evaluation of existing social protection policies for mitigating the impacts on the poor and vulnerable households identified in the second step.

Fossil Fuel Subsidy Inventories

Most available estimates of fossil fuel subsidies use a top-down approach to calculate the gap between the cost of supplying energy and the average price paid by consumers. These estimates capture the aggregate effect of many policies at once, and are primarily intended to derive a global spread of internationally comparable data. But such a measure of the price gap does not provide much guidance for designing or implementing reforms on the ground. A detailed understanding of subsidy mechanisms is usually required to inform policy change, such as that exemptions of special conditions associated with a subsidy may affect how price rises are distributed across different economic actors. A systematic, bottom-up inventory approach provides a breakdown of aggregate subsidies, facilitating the design and implementation of reforms.

This study developed inventories that systemically identify and quantify fossil fuel subsidies created by individual policies in each of the three study countries, including tax and duty exemptions, subsidized credit, and opportunity costs. The study's scope encompasses subsidies for consumption of all fossil fuels and electricity in each country. It also covers one area of the upstream energy supply chain in each country; namely, coal mining and production in India, the electricity system in Indonesia, and the supply of natural gas for vehicles in Thailand.

The detailed accounting of fossil fuel subsidies in the three countries showed them to be extensive, representing 2.7% of GDP in 2012 in India, 4.1% in Indonesia, and 1.9% in Thailand, with the vast majority comprising consumer subsidies for petroleum products. The inventory estimates are higher than official estimates, as national accounts rarely track the full suite of energy subsidies in an economy. In particular, they may not capture subsidies “hidden” in low-priced public services, tax rebates, and cheap loans. Because of the methods and scope used, the inventory estimates are also higher than international organizations' estimates (Table E1).

Table E1: Comparison of Fossil Fuel Subsidy Estimates in India, Indonesia, and Thailand (\$)

	ADB	Government	International Energy Agency	IMF	
				Pretax	Posttax
	2011–2012 and 2012			2011	
India	48,782	40,003	42,800	31,665	81,494
Indonesia	36,002	34,090	26,500	27,919	45,318
Thailand	6,976	3,835	9,600	7,034	16,363

ADB = Asian Development Bank, IMF = International Monetary Fund.

Note: The ADB and government data for India are for the country's 2012 fiscal year. Indonesia and Thailand are for the calendar year 2012. The International Energy Agency estimates include pretax consumer subsidies and tax consumer subsidies related to exemptions from existing tax structures. IMF estimates include consumer and producer subsidies. The IMF's posttax estimates include tax subsidies that are based on an optimal tax rate including charges for road infrastructure and the environmental costs of greenhouse gas emissions

Sources: Authors; IEA (2014); Clements et al. (2013).

Subsidy Reform Impact Analysis

Unlike the standard practice of using a single input–output–based or macroeconomic model, this study employed a combination of three types of economic and energy models to estimate the impacts of reform against social, economic, and environmental indicators. It used social accounting matrices to project immediate impacts on the economy and households, market allocation models (MARKAL) for impacts on energy supply, and macroeconomic models for long-term dynamic impacts on economies and households. The models were chosen because they use approaches governments commonly employ, and would therefore provide the most relevant and practical lessons for policy makers. The results varied with the model type, its adaptability to include subsidy reduction scenarios, and the availability of input data. No single model provided all the answers, but consistent patterns nevertheless emerged.

In all three countries, reform is projected to cause larger macroeconomic impacts in the short term than in the medium to long term, when demand and supply should have worked to smooth out the initial shock of price increases. The direction of the impact of the short-term shocks on GDP varied depending on the economy, but all long-term projections showed it was generally marginal, and positive when all savings were reallocated back to households. This implies that governments should be able to reduce subsidies, use a portion of savings to compensate households, and still leave the economy no worse off.

Higher energy prices predominantly affected the energy sector and energy-intensive industries and drove an increase in energy productivity, leading to reduced energy demand. This reduced energy costs for the residential and industrial sectors, as well as led to capital cost savings in the power sector. The magnitude of the energy sector impacts was found to vary significantly by country, depending on the elasticity of energy demand and the availability of alternative energy products.

Lower demand for energy coupled with a change in the energy mix in response to costlier fossil fuels reduced greenhouse gas emissions (Table E2). In the three countries, the reductions in emissions by 2030 ranged from 1% to 9%. The findings also indicated that although reform would drive a decline in emissions in aggregate, emissions could increase in certain sectors or as a result of reforming subsidies on specific fuels. This suggested that policy intervention might be required to ensure that consumers can switch to cleaner, accessible fuels, thereby maximizing the potential environmental gains from reform and ensuring that access to modern energy is not compromised.

Table E2: Reduction in Greenhouse Gas Emissions by 2030 (%)

	India	Indonesia	Thailand
MARKAL	1.8	5.1	2.8
Macro model	1.3	9.3	...

... = not available, MARKAL = market allocation model.

Source: Authors.

In the short term, it was found that—despite shocks at the macroeconomic level to GDP—reforms could be conducted without harming household welfare. In most cases, reallocating only a share of subsidy savings to households was capable of not only compensating for direct and indirect impacts, but raising consumption above business-as-usual levels. In the medium to long term, however, cash transfers were found to deliver more modest gains to consumption. This was likely because cash transfers were not anticipated to create significant GDP growth that would in turn lead to a more marked increase in long-term household incomes.

Designing Social Safety Mechanisms to Accompany Reforms

Governments generally spend more on fuel subsidies than on social assistance programs. In India and Thailand, existing safety net programs are not designed to support fossil fuel subsidy reforms and to assist poor households when fuel prices are high. In all three countries, new or augmented programs will be needed to protect the poorest. Of course, appropriate safety net mechanisms for a given country will depend on national circumstances, particularly the specific fuels to be reformed, the anticipated impacts of reform, and government capacity to reduce these impacts.

International experience shows that a comprehensive package of policies is necessary to ensure that fossil fuel subsidy reform leads to successful and sustainable policy change. A reform strategy ideally addresses the following: pricing mechanisms and institutions, the impacts of reform, and the political economy barriers. The strategy should include investments in alternative fuels and energy-efficient systems, welfare measures to shield the poor and vulnerable from high fuel prices, independent pricing mechanisms, and public awareness and support campaigns through consultation and communication. The current period of low fuel prices would allow governments to pursue subsidy reforms with more fiscal flexibility and less resistance.



1 Fossil Fuel Subsidies: The Need for Reform

“I’d put my money on the sun and solar energy. What a source of power! I hope we don’t have to wait till oil and coal run out before we tackle that.” - Thomas A. Edison

Developing Asia is home to a majority of the world’s energy poor: over 600 million of its people have no electricity, while three times as many burn wood, dung, and crop waste for day-to-day needs. Yet the poor spend much larger portions of their income on fuel than the better-off. Reliable and affordable access to modern forms of energy is increasingly recognized as essential for economic growth and human progress (OECD/IEA 2010). Heating and cooling systems, lighting that extends daily work hours, machines and equipment, and better quality transport can all improve lives. But the actual consumption of energy varies greatly between consumers in developed and emerging economies. As Thornton (2014) notes, an “average American” consumes 13,246 kilowatt-hours of energy a year, while someone in Bihar state in India consumes just 122 kilowatt-hours. Despite this disparity, it is obvious that the energy needs of developing countries are rising rapidly as their economies grow—and this situation underlies the widespread subsidies on fossil fuels (oil, gas, and coal) and electricity.

Of the top 25 countries in the world that subsidized fossil fuel consumption in 2012, 10 were in Asia. The International Energy Agency (IEA) estimates that, globally, subsidies on fossil fuel consumption exceeded \$544 billion in 2012, of which developing Asian countries accounted for \$168 billion (IEA 2014a). According to the International Monetary Fund (IMF), the average fiscal cost of all energy subsidies is 2.3% of the gross domestic product (GDP) in those countries (Clements et al. 2013). If the definition of subsidy is expanded to include posttax subsidies (that is, taxation to account for the costs of local air pollution, carbon dioxide [CO₂] emissions, and other negative effects of fuel use), the average rises to 4.0% of GDP.

The large outlay on energy subsidies restricts public expenditure on priority development areas such as education, health, and infrastructure. Typically, countries provide blanket subsidies by underpricing energy for the entire population to secure affordable energy access, protect vulnerable groups from energy-price volatility, and propel economic growth (Coady et al. 2006; Sterner 2012). Paradoxically, however, subsidies act against energy security and sustainable economic development by encouraging overconsumption, which promotes the rapid depletion of precious fossil fuel reserves and increases imports of fossil-fuel-based energy (von Moltke, McKee, and Morgan 2004; Clements et al. 2013; Ellis 2010; Bacon, Ley, and Kojima 2010). Cheap petrol encourages wealthy city dwellers to drive gas-guzzling vehicles, while underpriced electricity and diesel embolden well-off farmers to overrun irrigation pumps and waste water. Fuel subsidies create a sense of entitlement to cheap fuel and a lack of understanding of the forces of supply and demand that determine the true cost of fuel

internationally, resulting in very vocal and often powerful grassroots opposition to subsidy reform. Indeed, opposing attempts to remove or reduce subsidies is generally a good source of political capital for political groups, which adds to the forces aligned against subsidy reform. Where such groups are able to profit from subsidies, either through poor governance in the subsidy mechanism or in the illegal resale of subsidized fuel, such vested interests may also seek to undermine reform.

Fossil fuel subsidies are highly regressive and hit the poor hardest. An IEA (2011) survey of 11 countries showed that only 8% of fossil fuel subsidies in 2010 benefited the poorest 20% of the population. In a larger set of low- and middle-income countries, the richest 20% of households capture, on average, six times more in fossil fuel consumer subsidies than the poorest 20% of households, which lack electricity and gas connections and seldom own vehicles (IMF 2013a).

Cheap energy consumption has become a major cause of greenhouse gas emissions globally and a life-threatening health hazard through indoor cooking. An artificially low coal price makes this fuel attractive for power generation; indeed, it costs just \$0.032 to produce 1 kilowatt-hour of electricity from a highly polluting coal plant and four times as much (\$0.122) for a zero-carbon-emission solar power plant (Thornton 2014). This distortion of retail and energy input prices renders renewable energy uncompetitive and prevents investment in it. If producers were to pay actual costs, alternative renewable sources of energy would become more competitive than coal. Where subsidies are funded through underinvestment in state energy companies, they can also undermine the quality and reliability of energy supply and, in turn, household welfare.

Reform of fossil fuel subsidies was among the 19 post-2015 development targets identified by an expert panel including two Nobel laureates to give the best social returns of over \$15 on every dollar of investment in development. These targets were selected after a review of 169 development targets proposed by the United Nations to replace the Millennium Development Goals during 2016–2030. Fuel subsidy reforms are expected to discourage energy overuse, reduce the need for energy rationing, improve economic efficiency, and lessen fiscal vulnerability. In 2009, Group of Twenty and Asia-Pacific Economic Cooperation leaders agreed to phase out inefficient fossil fuel subsidies in the medium term. Implementation, however, has been slow and patchy. Nevertheless, across Asia, unilateral political commitments have lowered subsidies, including in India, Indonesia, Malaysia, the Philippines, Thailand, and Viet Nam. Along with falling oil prices, the December 2015 United Nations Climate Change Conference offered a great opportunity to advance the agenda for subsidy reform and momentum in Asia to pursue it. This study informs this debate and provides a platform for designing reform programs for the phased removal of fossil fuel subsidies in Asia's developing economies.

The study selected India, Indonesia, and Thailand to represent a range of country situations, fuel subsidies, and approaches to previous subsidy reforms (Table 1).¹ Most electricity in these countries is derived from fossil fuels (Figure 1). Historically, subsidy policies in their electricity sectors created investment bottlenecks, retarded electrification and the development of cleaner fuels, and reduced the supply of consumer energy. Low prices reduced the incentive and ability of suppliers to invest in energy infrastructure, particularly where state-owned energy companies operate at a loss. The result was poor and unreliable energy supply, power shortages, rationing, and a situation in which renewable sources cannot compete. Low prices for domestically produced energy also hastened reserve depletion, thereby lowering energy security in the longer term. The three study countries are all reforming their fossil fuel subsidies and the empirical results of this timely study can inform their reform strategies.

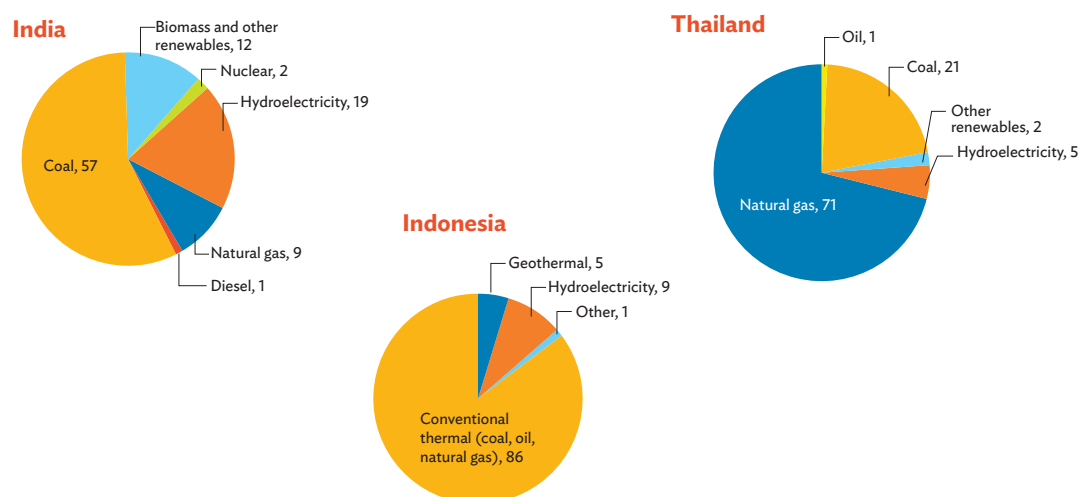
¹ ADB (forthcoming); ADB (2015a); ADB (2015b)

Table 1: Energy and Fossil Fuel Subsidy Situations in India, Indonesia, and Thailand

Country	GDP per capita (2014)	Mechanisms for Funding the Largest Subsidies	Subsidy Reforms and Related Social Safety Nets	Projected Reserve Life at Current Rates of Extraction
India	\$1,455	Budget outlays and losses by state-owned oil companies	Gasoline and diesel deregulated; no safety nets linked to fuel reforms	Oil 17.6 years Natural gas 45 years Coal 94 years
Indonesia	\$3,623	Budget outlays	Several reform events with multipronged safety net packages	Oil 11.9 years Natural gas 39.2 years Coal 61 years
Thailand	\$5,741	Tax exemptions, oil fund, and losses by state-owned oil company	Gasoline deregulated; policies to better target subsidies	Oil 2.8 years Natural gas 5.7 years Lignite 69 years

GDP = gross domestic product.

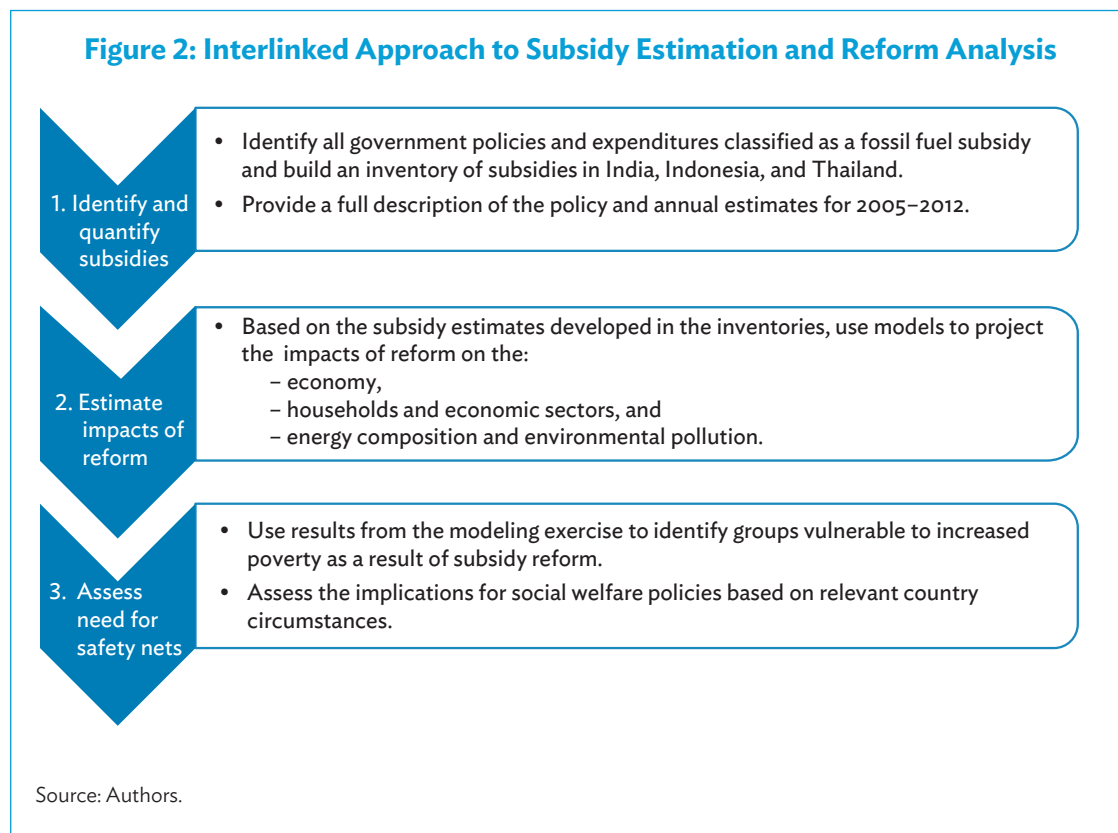
Sources: BP (2015); LEMIGAS (2012); US Energy Information Administration (2013); World Bank, World Development Indicators database.

Figure 1: Sources of Electricity Generation in India, Indonesia, and Thailand (%)


Note: Totals may not add up to 100 due to rounding.

Sources: US Energy Information Administration country analysis, <http://www.eia.gov/countries/>; Global Energy Network Institute, <http://www.geni.org/globalenergy/library/energy-issues/indonesia/>

This study was carried out in three distinct but interconnected steps (Figure 2). The first ascertains the magnitude of fossil fuel subsidies. The standard formulation applied by the IEA, IMF, and others is to estimate an aggregated fuel consumption subsidy as the difference between a reference price and the national average domestic price (or top-down approach). This report adopts the bottom-up inventory approach to estimate disaggregated subsidies by energy product, specific end-use, and type of support, e.g., direct budget support, tax revenue forgone, or below-market pricing. Such an inventory yields clear insights for governments in prioritizing and sequencing the reform of different subsidies.



The second step is a multidimensional modeling exercise analyzing the economic, energy, environmental, and social impacts of phasing out subsidies as estimated in the first step. Most national models deal with only one or two of these dimensions, which fail to capture the complex interactions among all dimensions. The analysis in this step helps identify groups of households that are most vulnerable to the phasing out of subsidies estimated in the first step. Before subsidies are reduced or gradually withdrawn, it is important to plan and prepare social safety nets to shield the poor from higher energy prices, should they occur. Social welfare programs take a long time to develop, especially in countries where institutional capacity is limited.

The third step looks at the strengths and weaknesses of existing social protection policies for mitigating the reform impacts on the poor and vulnerable households identified in the second step. It then evaluates alternative mechanisms to bolster existing programs.

The following section reviews energy subsidies in South and Southeast Asia, focusing on the impact of fossil fuel subsidies on the electricity sector. It identifies lessons for designing policy reforms by taking a holistic view of the energy sector, encompassing electricity and fossil fuels. Section 3 identifies, describes, and quantifies in the three study countries government policies and expenditures that can be classified as fossil fuel subsidies. Based on these estimates, section 4 uses various models to project the economic, energy, environmental, and household impacts of subsidy reforms. Section 5 uses the results to identify groups vulnerable to increased poverty as a result of subsidy reforms and assesses the implications of using savings from the withdrawal of subsidies for social welfare policies based on relevant country circumstances. Section 6 looks at recent movements in oil prices from a historical perspective and discusses their relevance for continuing reform initiatives. Section 7 offers policy lessons.



2 Linking Fossil Fuel and Electricity Policies: Subregional Experience

Poor access to energy is often cited as one of the main impediments to developing Asia’s economic progress and the eradication of poverty in the region. Many governments intervene in the electricity and fossil fuel sectors to make energy more affordable and accessible for the poor, and Asia’s economies rely heavily on domestic and imported fossil fuels for electricity generation and transportation.²

Countries in South and Southeast Asia generally aim to fulfill their own energy requirements and, if possible, to export energy products to the world market. That said, energy infrastructure is lacking across the region, although the scale and characteristics vary by country. Overall, the level of energy sector development, electrification, and the energy intensity of GDP is uneven. The supply of petroleum products is generally strong in central and urban areas, though problems of scarcity persist in remote regions of some countries, particularly where fixed petroleum product pricing undermines the incentive to distribute to these regions at higher costs.

Among the ASEAN-5,³ Malaysia and Thailand have the highest levels of electrification, energy intensity of GDP, and energy use per capita; and consequently they emit the most greenhouse gases (Table 2). Electrification in Viet Nam is also high, but energy use is moderate. In contrast, almost a third of the populations in Indonesia and the Philippines still have no access to electricity. A large percentage of Southeast Asia’s population uses traditional biomass for cooking, though in the last decade many countries have seen growth in the use of liquefied petroleum gas (LPG). A common challenge for both the supply of petroleum products and electricity is the strong demand for both, reflecting the fast pace of economic growth in the region.

Table 2: Access to Modern Energy Services in Southeast Asia, 2011

Country	Population without Access to Electricity		Population Relying on Traditional Use of Biomass for Cooking	
	Million	Share (%)	Million	Share (%)
Brunei Darussalam	0	0	0	0
Cambodia	9	66	13	88
Indonesia	66	27	103	42
Lao PDR	1	22	4	65
Malaysia	0	1	1	3

continued on next page

² This section draws from Chattopadhyay (2014) and Khanna (2014).
³ The Association of Southeast Asian Nations-5 are Indonesia, Malaysia, the Philippines, Thailand, and Viet Nam.

Table 2 *continued*

Country	Population without Access to Electricity		Population Relying on Traditional Use of Biomass for Cooking	
	Million	Share (%)	Million	Share (%)
Myanmar	25	51	44	92
Philippines	28	30	47	50
Singapore	0	0	0	0
Thailand	1	1	18	26
Viet Nam	3	4	49	56
Total ASEAN	134	22	279	47

ASEAN = Association of Southeast Asian Nations, Lao PDR = Lao People's Democratic Republic.

Source: IEA (2013a).

In the five South Asian countries with the largest populations (Bangladesh, India, Nepal, Pakistan, and Sri Lanka), there are similar issues with the supply of petroleum products. On average, 75% of the population of these countries had access to electricity in 2012 (IEA, World Energy Outlook 2014 Electricity database). Power sectors in these countries are quite diverse. India has the largest generation capacity (the world's fifth largest) and is heavily dependent on coal. Nepal has a small and largely undeveloped electricity market, and depends heavily on hydropower, as does Sri Lanka. Natural gas provides large shares of power generation in Pakistan and Bangladesh (Bhattacharya 2007). Bangladesh, India, and Pakistan are among the top 19 non-Organisation for Economic Co-operation and Development (OECD) countries in providing consumer subsidies. In India, these totaled \$47 billion in 2013, though they would rank lower on a per capita basis or as a percentage of GDP (IEA 2014b). Most subsidies in India go to the oil and electricity sectors, and to the coal and electricity sectors in Bangladesh and Pakistan.

For petroleum products, fixed prices are typically intended to protect low-income households from direct exposure to volatile global commodity prices (Stern 2012; Coady et al. 2006), particularly in countries with insufficiently advanced social safety nets to shield them. Subsidizing energy producers is typically designed to stimulate domestic production and to develop or sustain the domestic energy industry. Producer subsidies often come in the form of tax reimbursements, accelerated depreciation, and grants for research and development (Braithwaite et al. 2010; Gerasimchuk 2012; Aarsnes and Lindgren 2012; Sawyer and Stiebert 2010; OECD 2013). Some producer subsidies are tied to politically expedient reasons, reflecting the effectiveness of fossil fuel producer lobbies.

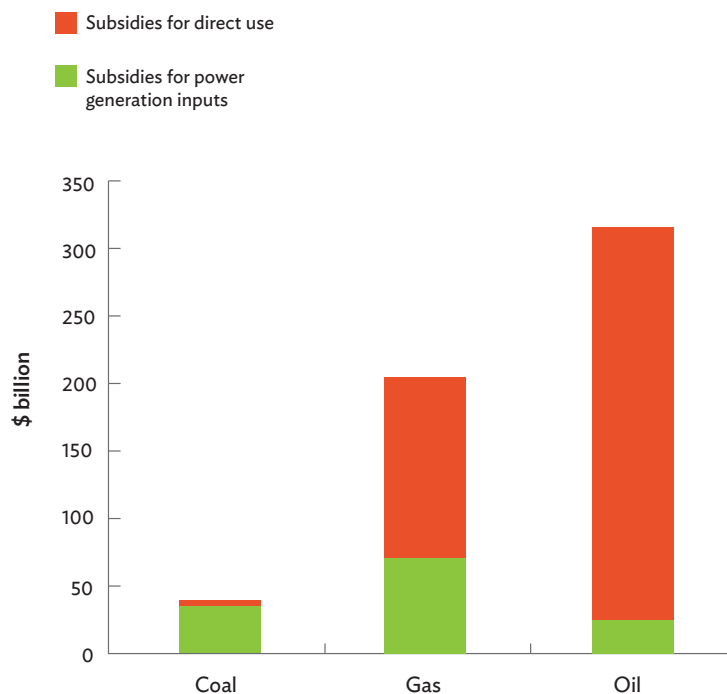
South Asia's experience with fossil fuel subsidy reform shows that fuels consumed by low-income households, such as kerosene and LPG, are often subsidized. Similarly, it is common for wholesale prices charged for gasoline and diesel to be regulated by the government and set below the cost of acquiring fuel in the international market. Where cross-subsidization exists across fuels or consumer type, the cross-subsidies are generally unable to generate sufficient revenues to cover costs of production. There are also significant cross-subsidies from the industrial sector to agricultural and domestic consumers in which energy is sold below cost. In most South Asian countries, residential electricity tariffs are higher than industrial tariffs. In India, however, industrial and commercial consumers pay about 30% more than residential consumers, while about half of electricity consumed is unmetered and unbilled.

Subsidies on primary energy resources such as coal, oil, and gas affect their use in the energy mix, investment in the power sector, and, ultimately, prices and the supply of electricity to wider groups of consumers. Coal is cheap and abundant in several South and Southeast Asian countries, especially India and Indonesia, and will remain a large share of the region's energy mix. Coal is used to produce electricity for manufacturing and households; petroleum, particularly subsidized diesel, is used mainly for transportation. Natural gas exploration and production is rapidly changing the energy landscape in both regions. In Thailand and Malaysia, gas-fired power plants will be the predominant source of electricity generation for some time.

Many developing countries are trying to increase energy prices and reduce subsidies, but governments still heavily subsidize and regulate fossil fuels. Globally, subsidies for the direct use of oil products and gas (that is, when these fuels are used in transport and industry) are by far the largest component of subsidies. Subsidies for the direct use of oil products totaled \$280 billion in 2011. By contrast, subsidies for oil as an input to electricity generation contributed only \$28 billion (Figure 3). Subsidies for power generation inputs are also significant, at \$65 billion for gas, \$32 billion for coal, and \$28 billion for oil.

In most countries, the state-owned institutions that provide fossil fuels and electricity have historically been supported by government subsidies and have not been required to earn commercial rates of return. In such cases, one immediate impact of fossil fuel subsidies on power sectors has been a shortage of capacity, because financially starved state-owned energy companies cannot invest and maintain infrastructure such as refineries or new generation capacity. Another impact has been to bias

Figure 3: Global Subsidies for Direct Use and Power Generation Inputs, 2011

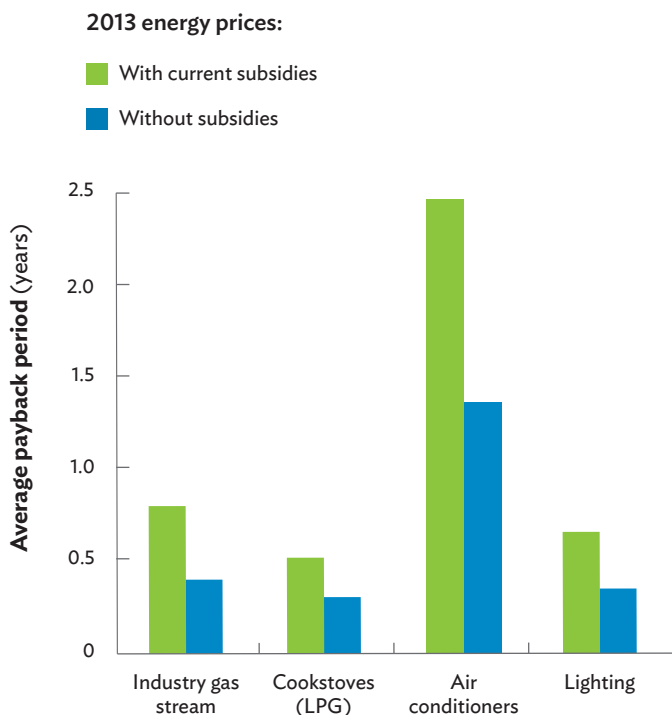


Source: IEA (2013b).

the development of the energy sector in favor of fuels that are subsidized. This can increase costs in the energy system or lead to stranded investments if capacity is subsequently underutilized due to a lack of affordable fuel. And where there are fossil fuel subsidies, renewable energy technologies require larger subsidies to get off the ground—even in cases where renewable technologies would be competitive if fossil energy was priced at market rates.

Recognition is growing that these policies are undermining the performance of state-run electricity, oil, and natural gas enterprises. Subsidies are not effectively targeted toward the most vulnerable groups and create inefficiency in energy consumption. Rising costs of production, lack of incentives for efficiency in the production and consumption of energy, and poorly performing state-owned enterprises are fiscally unsustainable and prevent energy supply growth that can match rising demand from growing populations and economies. Fossil fuel subsidies also thwart the efficient use of energy because energy efficiency options have significantly longer payback periods when fuel prices are kept low (Figure 4). For example, heavy subsidies for natural gas mean that the payback on energy-efficient boilers in industry is double the expected period of less than 5 months. The situation is worse for the replacement of old and inefficient air conditioners, which are the biggest contributors to peak-load growth.⁴ Subsidized electricity rates mean they have a payback period of 2.5 years, but this would only be 1.5 years if electricity were priced by the market. Countries could use other policies to encourage energy efficiency while subsidy reforms are implemented (ADB 2014b).

Figure 4: Fossil Fuel Subsidies and Energy Inefficiency



LPG = liquefied petroleum gas.

Source: IEA (2013b).

⁴ Total electricity demanded from a specified portion of the electrical system, typically averaged over a given period.

3 Measuring Subsidies

Subsidies on fossil fuel consumption are prevalent in developing countries and particularly high in oil-exporting countries (Table 3). Kemp (2014) notes that three-fourths of worldwide fuel consumption subsidies in 2012 stemmed from energy-exporting countries, and Organization of the Petroleum Exporting Countries (OPEC) members accounted for over half of the total (IEA 2014a). Today, such subsidies are nonexistent or small in most OECD countries, but are important in non-OECD ones—and production subsidies that seek to expand domestic supply are important in both (OECD, OECD-IEA Fossil Fuel Subsidies and Other Support).

Table 3: Share of Consumption Subsidies in the Full Cost of Supply, 2013 (%)

Country	Average subsidization rate	Country	Average subsidization rate
Venezuela	92.7	Ukraine	28.9
Algeria	77.5	Nigeria	28.8
Saudi Arabia	77.3	Pakistan	23.0
Iran	77.1	El Salvador	20.9
Libyan Arab Jamahiriya	76.7	Russian Federation	20.5
Turkmenistan	65.7	India	19.9
Egypt	61.2	Malaysia	15.6
Uzbekistan	58.7	Mexico	11.9
Iraq	53.3	Gabon	8.7
Ecuador	51.2	Ghana	8.5
Bolivia	44.1	Thailand	6.7
Angola	35.9	Viet Nam	4.3
Bangladesh	33.6	China, People's Rep. of	2.6
Kazakhstan	32.8	Korea, Rep. of	0.2
Indonesia	31.3	Colombia	0.0
Argentina	29.6		

Source: International Energy Agency online database. <http://www.iea.org/subsidy/index.html>

Fuel subsidies can be on-budget (explicit) or off-budget (implicit). On-budget subsidies are created, for example, when budgetary resources are used to make direct cash transfers to a producer or a consumer, or when publicly owned refineries and oil marketing companies are mandated to sell below the cost of production and their losses are covered by budgetary funds. Funding a supply of low-priced energy from the budget entails a reduction in public expenditure in other areas, higher taxes, or public borrowing. In contrast, off-budget subsidies are often “hidden” and difficult to calculate. Such subsidies

can take the form of domestic sales at cost price by fuel exporting countries, which forego potential government revenues from overseas sales, as well as tax exemptions or nonreimbursement of losses incurred by state-owned energy companies.

Most governments do not systematically account for or publish data on fossil fuel subsidies. In the absence of this, international agencies such as the IEA and IMF estimate the size of the subsidies using the standard procedure of measuring the difference between an international benchmark and domestic retail prices. This price-gap measure captures the aggregate effect of many policies at once, and is primarily intended to derive a global spread of internationally comparable data. However, a detailed understanding of subsidy mechanisms and costs is usually required to inform policy change. Not only is comprehensive information on subsidies rarely available, it is often highly fragmented across government departments and jurisdictions. Off-budget subsidies require additional analytical work to identify and quantify their magnitudes. These limitations are significant obstacles to reforming and rationalizing subsidies on the ground. This study aims to fill this gap by identifying and measuring subsidies at different points through the energy production cycle and at different end uses.

An Unconventional Approach

The standard top-down approach of the price-gap method produces an aggregate estimate of overall subsidies for each energy product, but it does not identify the transfers created by specific policies. This study uses a bottom-up inventory approach to reveal information on individual fossil fuel subsidy policies and their costs, particularly by quantifying subsidies that would otherwise remain “hidden” (such as tax exemptions or credit subsidies). It also provides information to understand how the subsidy policy is funded and whether particular beneficiaries are treated in specific ways. Such information is vital in sequencing and implementing subsidy reforms. Other advantages of the inventory approach are a better understanding of producer subsidies, which are typically not well captured by a price-gap approach, and an opportunity to interact it with consumer subsidies. For example, below-market access to inputs for producers can help businesses cover the cost of selling energy at below-market consumer prices. However, the usefulness of the inventory approach and the price-gap method depends on the purpose of estimation (Box 1).

Box 1: Alternative Methods of Calculating Subsidies

Fossil fuel subsidies can be categorized as those benefiting either consumers or producers, as shown in the taxonomy below. The former include policies to benefit intermediate consumers, such as transport and manufacturing industries and electricity generation, as well as final consumers, such as households or specific sectors such as agriculture. The latter includes policies that lower costs for fossil fuel producers involved in exploration, extraction, or processing.

An economic subsidy provided by a government is simply the difference between its cost of acquisition and returns from sale. Based on this definition, the standard top-down approach of estimating subsidies compares domestic prices to a benchmark reference price. The most commonly quoted estimates of fossil fuel subsidies are those for consumers, generated by the International Energy Agency and the International Monetary Fund (IMF):

$$\text{Subsidy} = (\text{reference price} - \text{end-user price}) \times \text{units consumed}$$

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Box 1 *continued*

The IMF also distinguishes between “pretax” and “tax” subsidies, which, when added together, are referred to as “posttax subsidies.” Tax subsidies are subsidies that operate through tax exemptions and by charging energy taxes at a lower-than-efficient level, defined as not incorporating the cost of adverse effects caused by energy use, such as local air pollution and global warming.

Subsidy Taxonomy	
<p>Consumer subsidy: Fossil fuel consumer subsidies are policies that shift part of the cost of energy from consumers onto other actors in the economy. Most often, the cost burden is shifted onto the public budget, where taxpayer money or foregone revenue by the government is used to keep retail energy prices low. But costs can be shifted in other ways, such as by requiring energy distributors to operate at a loss. The economic cost of energy includes opportunity costs, so it is still a consumer subsidy if countries choose to make domestically produced fossil energy resources available to their citizens at prices below the market level. Fossil fuel subsidies do not truly reduce the cost of energy for a country; they simply alter who pays and how.</p>	<p>Producer subsidy: Fossil fuel producer subsidies are policies that shift the cost of energy production away from the companies that find, extract, refine, and generate fossil energy and on to other actors in the economy. Most often, the cost burden is shifted on to the public budget, where taxpayer money may be used to provide project infrastructure, tax cuts may be provided to incentivize investments, and below-market-price access may be granted to government land or goods and services.</p>
<p>Pretax subsidy: The IMF distinguishes between pretax and posttax subsidies. A pretax subsidy is the difference between the cost of supplying energy and the price paid by users.</p>	<p>Tax subsidy: Tax subsidies include efficient taxation to reflect both revenue needs and the cost of adverse effects caused by energy users. Opinion differs as to exactly what should be included in this category. It is commonly agreed, however, that any deviation from the general tax structure, such as exemptions from value-added tax, is a subsidy. The IMF goes further and argues that tax rates should reflect the full cost of a good or service to society. By this definition, tax rates that do not charge the cost of roads and air pollution are included as subsidies to vehicle users.</p>
<p>Posttax subsidy: A posttax subsidy is the sum of all pretax subsidies and tax subsidies.</p>	

The bottom-up approach used in this study is similar to that employed by the Organisation for Economic Co-operation and Development (OECD) for its inventory of estimated budgetary support and tax expenditures relating to the production or use of fossil fuels in member countries. The practice of identifying and measuring posttax subsidies as defined by the IMF is still not generally followed, and pretax subsidies alone are sufficiently large to provide the impetus for reform. The OECD uses an inventory approach to quantify subsidies, but it has only done so for its members and to date this includes only budgetary transfers and tax subsidies related to deviations from the established taxation system.

The inventories systematically identify and quantify subsidies created by individual policies in each country, including tax and duty exemptions, subsidized credit, and opportunity costs. Funded by state budgets or profits of state-owned enterprises, producer subsidies often allow inefficient state-owned enterprises to produce at high cost, but charge artificially low prices for energy sales. In the electricity sector, producer subsidies may also cover nonpayment of bills and power distribution losses. For fossil-fuel-producing nations, subsidies are also commonly viewed as a way of providing citizens with a share of natural resource wealth.

A key advantage of the inventory approach is that a detailed understanding of subsidy mechanisms is usually required to inform policy change. This is particularly true for modeling, where a robust estimate of subsidies is required to counter the criticism that poor input data have led to unreliable results, and exemptions of special conditions associated with a subsidy may affect how price rises are distributed across different economic actors.

The key disadvantage of a bottom-up approach is that the high resolution in the subsidy data comes at a cost. It can be time and resource-intensive, particularly if extensive data collection is required to estimate the scale of subsidies. The high level of detail in

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Box 1 *continued*

the inventories developed by this study may not be necessary for a country where the priority is to reform one or two of its largest and most inefficient subsidies. This trend was particularly evident with producer subsidies. Even noting that these were estimated for only one fuel type and that many upstream subsidies could not be quantified, the magnitude of producer subsidies was very low compared with consumer subsidies.

By contrast, the top-down price-gap method has the advantage of being quite fast, low-cost, and allowing for consistent cross-country comparisons. While this approach is well-suited to deriving a global estimate, it is imprecise in that it relies on the estimation of average domestic and international reference prices. Price-gap analysis requires expertise as well as data on domestic prices and the development of a benchmark. But accurate data on these factors can be difficult to access for some energy sources, particularly natural gas and electricity that are not always traded internationally. Moreover, average domestic reference prices do not take into account the tariff structure for electricity and the volumes sold at each price point.

The inventory and price-gap approaches are complementary. Where budget data are not available but the end-user price is below the cost of supply, the price-gap method can be used to quantify subsidies to a specific energy product in an inventory.

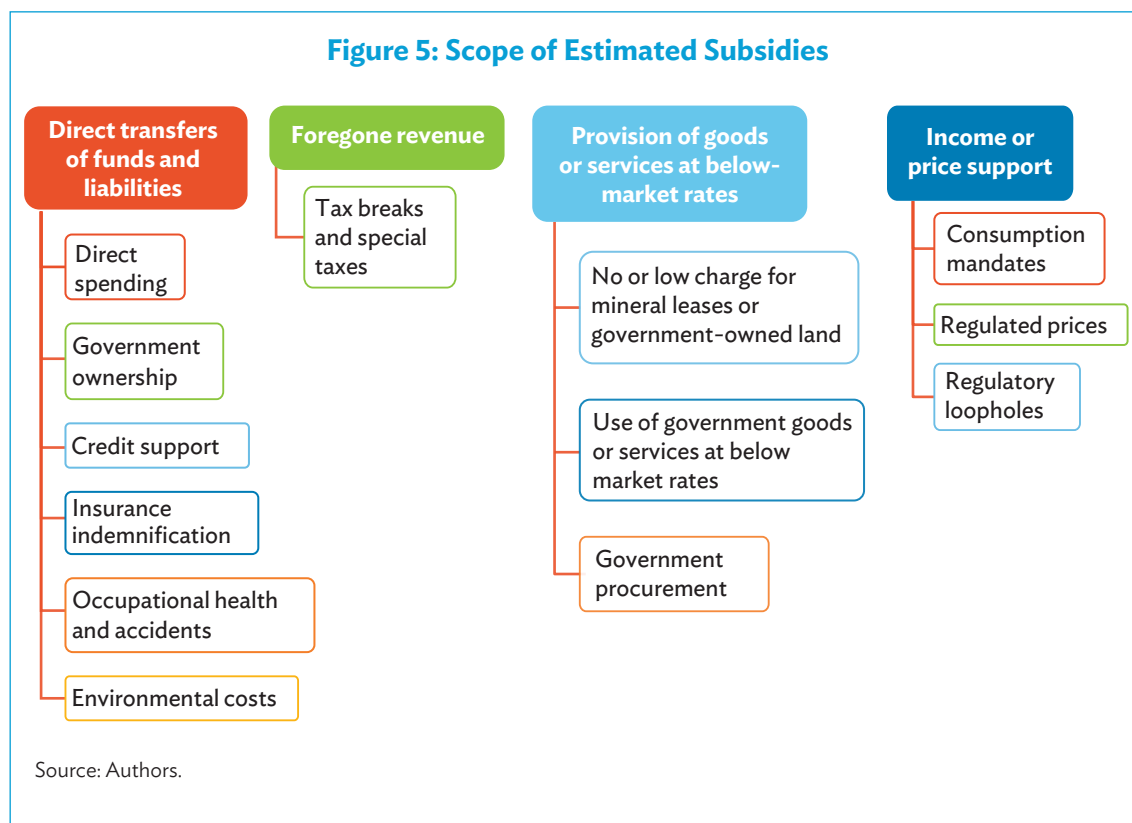
Sources: Clements et al. (2013); IEA (n.d.); Di Bella et al. (2015); El-Katiri and Fattouh (2012); Global Subsidies Initiative (2014b); Kojima and Koplou (2015); OECD (2013).

Country Inventory of Subsidies

This study systematically identified and quantified the subsidies to create a comprehensive inventory of subsidy transfers by specific policies in India, Indonesia, and Thailand. The policies cover all support measures that fall within the definition of a subsidy used by the World Trade Organization's Agreement on Subsidies and Countervailing Measures. Figure 5 shows examples of the four types of subsidies that the agreement determines. Although government support is offered to more than one sector in some cases, it is still considered a subsidy for this study if, for example, it is offered only to oil, gas, or coal sectors, or if those sectors disproportionately benefit from the support.

In contrast to consumption subsidies, subsidies to producers are harder to quantify. It is estimated that worldwide subsidies to fossil fuel producers run to about \$100 billion per year (IEA 2010). The most comprehensive international assessment of producer subsidies to date is the OECD's *Inventory of Estimated Budgetary Support and Tax Expenditures for Fossil Fuels*. However, this only includes OECD countries. In Asia and the Pacific, the OECD identifies producer subsidies of \$700 million in Australia, \$130 million in the Republic of Korea, and \$120 million in Japan. Little is known about the total scale of subsidies for fossil fuel producers across developing and emerging Asia, although one study estimates that subsidies for oil and gas production in Indonesia alone amounted to at least \$1.8 billion in 2008 (Braithwaite et al. 2010).

Figure 5: Scope of Estimated Subsidies



For its part, this study covers subsidies for the following items or activities:

- Consumption of all fossil fuels (coal, natural gas, and oil) and electricity in each country.
- One area of the upstream energy supply chain in each of the three study countries: coal mining and production in India, the electricity system in Indonesia, and the supply of natural gas for vehicles in Thailand.

Table 4 summarizes the coverage of inventories. Where available, transfers conferred by specific policies were taken from official budgetary documents, tax expenditure reports, relevant policies, legislation, and other financial statements. This information was supplemented by data from energy policy literature and collected in interviews. When official estimates were not available or incomplete,⁵ subsidies were estimated using primary data sources; that is, fuel consumption, import volumes, and prices. The price-gap method were used to calculate subsidies where prices were known to be below market levels and adequate data were not available to estimate subsidies transferred by individual policies. This was particularly the case where subsidies arise from unreported losses by state-owned enterprises or opportunity costs (that is, domestically produced resources sold below international prices). Such subsidies are not captured in government budgets or financial statements by energy companies. In cases where subsidies could not be quantified and a secondary source existed but could not be validated, these figures were not included in the total estimates of the inventory.

⁵ Such as subsidies related to tax exemptions, the cost of which is often not reported in official budgetary documents.

Table 4: Coverage of Inventories

National accounts and financial statements	ADB inventory = national accounts plus	Not in either
Direct spending	Opportunity costs	Subsidies that could not be quantified due to lack of data
Some tax and duty exemptions	Additional tax and duty exemptions	Externalities such as cost of greenhouse gas emissions
Losses from state-owned energy companies	Credit support	Optimal taxation
	Investment incentives	

ADB = Asian Development Bank.

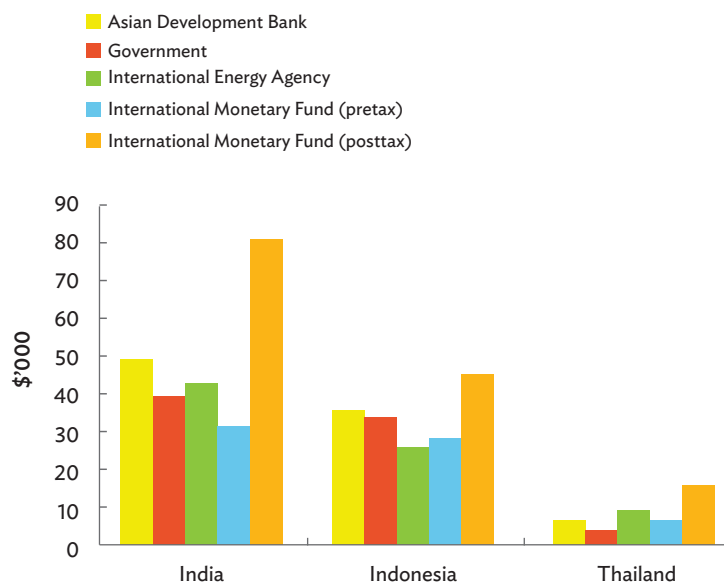
Source: Authors.

In India, the study measured 35 individual subsidies, including items as varied as compensation for under-recoveries incurred by downstream oil companies, customs duty exemptions for power companies purchasing liquefied natural gas, and low railway freight rates for coal transportation. The inventory for Indonesia contains 23 items covering subsidies including reduced income tax on fuel product sales for state-owned Pertamina's retail stations, below-market pricing of electricity, and research and development support. The Thai inventory totaled 40 subsidies, including premium investment benefits on vehicles, machinery and equipment that use natural gas, import duties and value-added tax exemptions for machinery for exploration and production of petroleum, and green fuel (tax exemptions for diesel). The three country studies in this report contain more details.

The inventory of total subsidies is higher than official government estimates because the inventory identified and quantified more subsidies than were reflected in national accounts, particularly tax expenditures, opportunity costs such as forgone tax revenue, credit subsidies, and several hidden subsidies (Figure 6). The subsidies in Thailand, for example, were found to be 82% higher than officially reported. In Indonesia, a previously unquantified tax exemption was found to cost almost \$2 billion in forgone revenue per year. Total subsidy values are likely to be even higher than reported in the inventory of total subsidies since some subsidies could not be quantified because of lack of data. As an exploratory exercise, this study restricted the estimation of producer subsidies to just one part of the upstream energy supply chain in each of the three countries.

Our estimates are also higher than those of other international organizations including the IEA and IMF (except for posttax IMF) in India and Indonesia and not very different for Thailand (Figure 6). The difference from other estimates reflects the methods used and scope. In some cases, there may also be differences, because this study was unable to identify some subsidies estimated by other organizations. For Thailand, for example, no subsidies were identified for electricity or coal, while the IEA and IMF identified significant price-gap subsidies.

Many of the subsidies had not been previously identified or quantified, particularly producer subsidies. Consumer subsidies were found to be extensive and to represent a significant share of GDP (Table 5 and Figure 7). Price subsidies for petroleum products account for the largest share of total subsidies in each of the three study countries, followed by electricity in India and in Indonesia and natural gas in Thailand. Coal accounts for 15% of total consumer subsidies in India, but has a negligible share in the other two countries. Subsidies to producers—on the single area of the upstream energy supply chain considered here—are less than 1% of total subsidies in each of the three study countries.

Figure 6: Comparison of Alternative Subsidy Estimates, 2011–2012

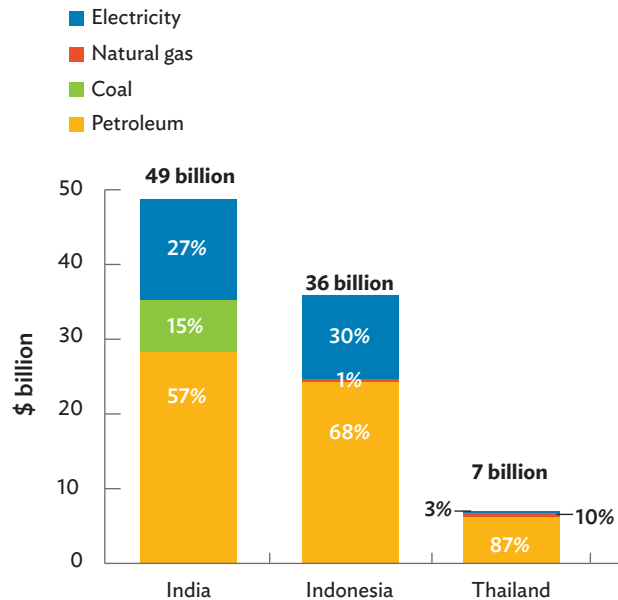
Notes: Asian Development Bank and government data for India are for the 2012 financial year. Indonesia and Thailand data are for calendar 2012. The International Energy Agency estimates are for 2012 and the International Monetary Fund for 2011. Sources: Authors' estimates; Clements et al. (2013); IEA (2014a).

Table 5: Summary of Identified Subsidies in India, Indonesia, and Thailand

Subsidy type	Energy type	India		Indonesia		Thailand	
		FY2011–12 (\$ million)	% of total subsidies	2012 (\$ million)	% of total subsidies	2012 (\$ million)	% of total subsidies
Consumer	Petroleum	27,923.0	57.0	24,595.0	68.0	6,077.0	87.0
	Natural gas	85.0	0.2	374.0	1.0	714.0	10.0
	Coal	7,288.0	15.0	0.0	0.0	0.0	0.0
	Electricity	13,486.0	27.0	11,034.0	30.0	184.0	2.6
	Total consumer subsidies	48,782.0	99.0	36,002.0	99.0	6,976.0	99.0
Producer	Natural gas for vehicles	nq	nq	nq	nq	46.0	0.70
	Coal	208.0	0.4	nq	nq	nq	nq
	Electricity	nq	nq	208.0	0.6	nq	nq
Total fossil fuel subsidies (\$ million)		48,990.0		36,210.0		7,021.0	
% of GDP		2.7		4.1		1.9	
\$ per capita		40.9		146.5		109.0	

FY = fiscal year, GDP = gross domestic product, nq = not quantified.

Source: Authors' estimates.

Figure 7: Breakdown of Total Consumer Subsidies, 2012

Note: Totals may not add up to 100 due to rounding.

Source: Authors' estimates.

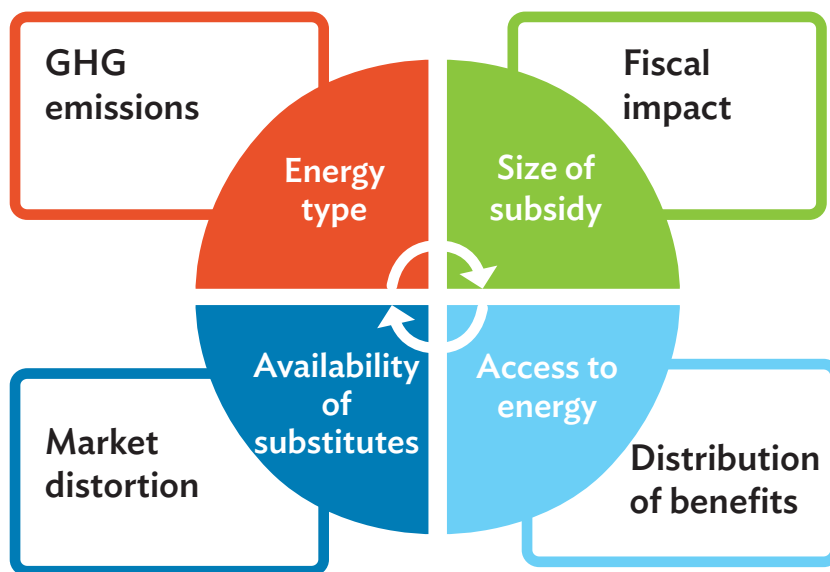
Producer subsidies may have an important impact on investment decisions, and many of the subsidies aimed at producers provided a quasi-consumer subsidy. For example, state-owned electricity suppliers in Indonesia operate at a loss due to controlled consumer prices. The government provides discounted credit and loan guarantees to help finance these losses and infrastructure investment. However, credit subsidies would be unnecessary if electricity providers were permitted to sell electricity at the long-term cost plus profit. A similar situation occurs in upstream sectors in India (coal) and Thailand (natural gas for vehicles) where producers are required to sell product at below-market prices, but are partially compensated through measures that reduce their costs of production or supply.

The detailed inventories of fossil fuel subsidies provide the most comprehensive estimates of subsidies to date in India, Indonesia, and Thailand. The information from these inventories improves transparency on the true level of government finances being used to support fossil fuel consumption and production. Nonetheless, the complex nature of fuel subsidies and their questionable merit warrant an analysis of the potential impacts of subsidy reform.

4 Reforming Fossil Fuel Subsidies

The assessment of the impacts of subsidy reform has two aims: to support country reforms by providing empirical data and to evaluate the strengths and weaknesses of the modeling tools available to most countries. Reforming fossil fuel subsidies is complex because it works through many factors. These include the type of energy subsidized, the magnitude of subsidies, their distribution between commercial and residential users and across households, the pace of reform and the surrounding economic context (such as the ability of consumers to switch fuels or reduce energy consumption), and prevailing inflation and exchange rates for energy importers. The type of energy used will influence the extent of greenhouse gas emissions and the size of the subsidy will determine fiscal impacts. Access to energy products by different income groups will be crucial in the distribution of benefits from a subsidy, and the availability of alternative sources of energy will affect market distortion (Figure 8). All these effects will play out interactively in the economy. The ultimate impacts will also depend on government reform strategies.

Figure 8: Complexity of Reforms



GHG = greenhouse gas.
Source: Authors.

Modeling Framework, Reform Scenarios, and Impacts

The choice of a model to assess the impacts of reforming fossil fuel subsidies is not obvious. No clear best model exists because the impacts are complex. Different models can offer more or less detail on how specific sectors and groups within an economy are affected. Models that are in regular use by governments are typically designed to study a simple set of reforms. Models that can capture a wider set of impacts at a higher level of disaggregation—such as system dynamics models like the Green Economy Model and the World Bank’s ENVISAGE computable general equilibrium (CGE) model—are not commonly used by most governments in Asia.

Since one of the goals of this study was to evaluate the strengths and weaknesses of readily available modeling tools, it adopted a multipronged approach using not one but three modeling frameworks that governments commonly use. This gave a fuller picture of subsidy reform impacts, drawing impacts from each model at the same time as experimenting with a greater range of models. For all models, it was assumed that only a limited degree of adaptation was possible, which reflected the real-world likelihood that the implications of an impending price increase are often commissioned at short notice.

Social-accounting-matrix (SAM)-based models with large disaggregation of sectors but limited substitutability in production and consumption were used to project short-term impacts on economies and households (Table 6). Market allocation models (MARKAL) with detailed breakdowns of the energy system were used to analyze short- and long-term switching between fuels and estimates of greenhouse gas emissions. For the macroeconomic models, the energy–environment–economy model at a global level (E3MG) developed by Cambridge Econometrics was used for India and Indonesia and a CGE for Thailand. The macroeconomic models incorporated behavioral responses of consumers and producers in more aggregated sectors than the social accounting matrix and projected long-term reform impacts.

In all countries and models, two main scenarios were explored:⁶ “business as usual” where fossil fuel subsidies are maintained and no policy change takes place, and “subsidy removal” where all subsidies are eliminated (Table 7). Two subscenarios—a “vulnerability scenario” and a “subsidy reallocation scenario”—were considered under subsidy removal. The vulnerability scenario is used to identify the socioeconomic repercussions of higher energy prices before savings are reallocated. This scenario assumes that subsidy savings are withdrawn from the economic system entirely to isolate the effect of higher prices alone. This is not intended to model a realistic policy change, but rather to identify the groups of households and businesses most likely to be affected in the short term by a price shock before the impacts of reallocated savings are felt.

⁶ A “gradual” reform scenario of a 20% reduction in subsidies every year for 5 years projected linear impacts equal to 20% of those associated with complete removal. For ease of exposition, this study presents only the complete removal scenarios.

Table 6: Strengths and Weaknesses of Economic and Energy Models Used for the Analysis

Focus	Model	Strengths	Weaknesses
Households and the economy	Social Accounting Matrix-based (SAM)	Provides highly disaggregated impacts on households and economic sectors, plus some macroeconomic indicators. Indicates a first-cut estimate of the effects of a policy shock. Foundation of much government analysis.	Over estimates scale of reform impacts because it is static and gives only short-term consequences of shocks before full demand and supply responses have played out. Allows limited or no substitution between energy inputs. Disaggregation of households or energy may not be ideally suited to analysis, and adapting SAM may be time- and resource- intensive.
Energy system	Market Allocation Model (MARKAL)	Detailed representation of technical relations in energy system that can project medium- and longer-term trends for consumption and supply but no price effects. Allows for estimation of fuel switching and long-term CO ₂ impacts.	Energy system only. Does not allow for reallocation of subsidy savings back into the economy. May not account for subsidies in original design, requiring adaptation.
Macro-economic indicators, energy, environment, and households	Energy-Environment-Economy (E3MG)	Projections up to 2030 for GDP, inflation, production, investment and trade, and GHG emissions.	Projections based entirely on historical trends.
	Computable General Equilibrium (CGE)	Aggregated to a limited number of sectors which makes it easier to track the changing conditions. Projections of long-term policy impact on macroeconomic indicators, and households.	Projections show future equilibrium, with supply and demand responses to price changes over time; sectoral (economic) focus.

GDP = gross domestic product, GHG = greenhouse gas.

Source: Authors.

Table 7: Scenarios of Fossil Fuel Subsidy Removal

1. Business as usual	Existing subsidies are maintained; no policy changes take place.
2. Full removal of all subsidies	A. Vulnerability scenario. Savings from subsidy are withdrawn from the system and not reallocated.
	B. Reallocation scenario. Savings from subsidy are reallocated or reinjected into the economy.
	(a) Bottom 40% households compensated; government expenditure increased.
	(b) All households compensated; government expenditure increased.
	(c) All subsidy savings reallocated to all households through their tax reduction.

Source: Authors.

Under the subsidy reallocation scenario, three alternative uses of the fiscal resources freed up from subsidy reduction were examined. In scenario 2B(a) in Table 7, for the social accounting matrix, the bottom 40% of households by income distribution were fully compensated through cash transfers for the increased cost of living caused by subsidy reform. The remaining savings were reallocated or transferred to the government budget to increase expenditure across sectors in the same proportion as in the

existing budget. The macroeconomic models were not structured to project any impacts from increased government expenditure, so it was assumed in these models that the remaining savings were used to pay down deficits. Scenario 2B(b), for the subsidy reallocation scenario, differs from scenario 2B(a) in that all households are fully compensated, instead of just the bottom 40% by income distribution. The third scenario 2B(c), for the subsidy reallocation scenario, is the same as scenario 2B(b) except that instead of increasing the government budget, all subsidy savings are reallocated back to households in the form of lower tax. This scenario was conducted for the macroeconomic models only.

These scenarios were intended to identify, in a way comparable between the three country studies, vulnerable groups and potential impacts on households, the economy, and the environment once all fossil fuel subsidies were eliminated and the saved funds reallocated. Assumptions about future economic and social trends were based on outlooks for economic growth, population, and energy prices (Table 8). Appendix 2 summarizes the main characteristics of the models and scenarios used to assess the impacts of the removal of energy subsidies in India, Indonesia, and Thailand.

Table 8: Assumptions Used in the Models' Projections

Country	GDP growth ^a (%)	Population growth ^b (%, average)	Fossil fuel price growth ^c (%, average)
India	6.4	1.1	2.2
Indonesia	5.0	0.8	2.2 ^d
Thailand	4.6	0.086	2.2

GDP=gross domestic product.

Notes:

^a Based on the projections included in the World Economic Outlook (IMF, 2013) and was compared with national development plans and economic growth expectations.

^b Population projections using medium variant estimates of UNDESA.

^c Based on IEA's World Energy Outlook 2012 (WEO), Current Policies Scenario (IEA, 2012).

^d Indonesian law prevents the budget deficit from exceeding 3% of GDP. For simplicity and comparability, this law was not taken into account in the business-as-usual scenario.

Sources: IEA (2012); IMF (2013b); UNDESA (2014).

All impacts are measured as a percentage change from scenario 1 (business as usual). Generally, the removal of large consumer subsidies for widely used energy sources can be expected to have a significant impact across areas as varied as government finances, the economy, consuming sectors (households, businesses, and industry), energy supply, the environment, and governance.

The following subsections present the impacts estimated from the models. The results were highly dependent on model assumptions and methodologies. Both the social accounting matrix and macroeconomic models concluded that reallocating a greater proportion of savings to households would deliver more positive results than allocating a greater proportion to government budgets. These results are due to structural assumptions in these models on the important role played by wealthier households in stimulating economic demand, and the relative effectiveness of household expenditure in stimulating economic growth, compared to government expenditure or debt reduction. In particular, the structure of the macroeconomic models included no relationship between increasing government expenditure or reducing debt and impacts on GDP or welfare.

Macroeconomic Impacts of Subsidy Reform

With SAM, there was a negative short-term shock to GDP compared to the business-as-usual scenario in India and Indonesia, and a positive one in Thailand (Table 9). In Indonesia, where short-term losses were larger, the net negative impact was mainly driven by falling output from the oil refining sector. The magnitude of this impact has likely been overestimated due to the declining role of oil and gas in Indonesia's GDP, contributing less than 5% in 2013. As noted in Table 6, SAM exaggerates the size of reform impacts because it gives the immediate effects of shocks before households and businesses can change behavior and adjust to the new reality of higher prices of fossil fuels. These results, based on partial equilibrium analysis, are thus not realistic.

Table 9: Economic Impacts (% change from business as usual)

Model	Details	India	Indonesia	Thailand
Social accounting matrix: Scenario 2B(b), short term (2012)	GDP	-0.40	-1.30	2.02
Macro: Scenario 2B(b), long term (2020)	GDP	0.04	-0.09	– ^a
	% change in CPI	0.58	3.15	– ^a
Macro: Scenario 2B(c), long term (2020)	GDP	0.20	0.27	– ^a
	% change in CPI	0.63	3.18	– ^a

CGE = computable general equilibrium, CPI = consumer price index, GDP = gross domestic product.

Note: Scenario 2B(b): all households compensated, government expenditure increased; scenario 2B(c): all subsidy savings reallocated to all households through their tax reduction.

^a The long-term impacts in the CGE model for Thailand of a fall in GDP of 0.048% for scenario 2B(b) and 0.042% for 2B(c) were minimal. They were not considered to represent an accurate outcome, as the structure of the CGE model was only capable of projecting GDP impacts in response to an increase in the factors of production, and not from transfers that stimulate household consumption or reduce government deficits.

Source: Authors.

In contrast, results from macroeconomic models are more grounded in reality since they trace how the dynamics of price changes filter through the economy, influence behavior, and determine long-term impacts, which are muted, compared to SAM. Generally, as expected, the macroeconomic models projected modest impacts on GDP (Table 9). For India and Indonesia, there was a smoothing effect on GDP in the medium to long term, as demand and supply responses in the E3MG model worked to reduce the scale of the impacts projected by the social accounting matrix. These general equilibrium impacts may underestimate long-term GDP gains, given that the model was not structured to capture the economic benefits of reduced deficits and debt. The CGE model for Thailand showed no long-term impact on GDP, given that the structure of the model was not capable of exploring the scenario being tested. The CGE model was only capable of projecting responses to an increase in factors of production for variables such as real GDP and real household consumption, and not transfers that stimulate household consumption and reduce government debt.

The inflationary impact in E3MG was limited, particularly for India (Table 9). By 2020, the consumer price index was estimated to rise about 0.6 percentage points in India and 3.2 percentage points in Indonesia, depending on exactly how the subsidy savings were reallocated. This translates into a relatively small increase in year-on-year inflation as a result of fossil fuel subsidy reform. In the scenario

that compensated all households in Indonesia with cash transfers, for example, year-on-year inflation was projected to be 0.6%–0.7% higher than usual until 2020, at which point it fell below the rates projected under the business-as-usual scenario.

It is difficult to directly compare these results with other modeling studies, as different years and economies of analysis, estimates of subsidies, and models all play a role in determining outcomes. Even so, in a review of modeling studies, Ellis (2010) reports three analyses from 2000 to 2009 projecting that fossil fuel subsidy reform would lead to an increase in non-OECD GDP ranging from 0.1% to 0.45%. Burniaux and Chateau (2011) estimated that with unilateral fossil fuel subsidy reform, GDP in non-oil exporting countries would gain 0.3% on aggregate by 2050. In an analysis focused on Indonesia, Clements, Jung, and Gupta (2007) estimated the impacts of removing subsidies equal to 0.75% of GDP, simulated in the model by increasing the price of all petroleum products by 25% and no reallocation of savings. In a scenario that assumed no benefits in reducing deficits and debt, they project a short-term GDP shock twice as large as the subsidies being reformed and an aggregate increase in prices of 1.1%. But when the model was adapted to allow reduced deficits and debt to lower interest rates, this was projected to drive private sector investment in production that led to no decrease in GDP compared to the business-as-usual level. In a dynamic model of a small economy, calibrated to Egypt, Glomm and Jung (2015) find that a cut in energy subsidies reduces GDP, as smaller amounts of energy are used in production. Their results also show that as subsidy savings are plowed back into the economy, output and welfare rise, and that they do so by a larger extent when savings fund infrastructure investments rather than being distributed to households through tax cuts.

Impacts on the Energy Sector

The energy sector analysis indicated that, in all the study countries, fossil fuel subsidy reform would increase energy productivity, which in turn would reduce energy demand and investment in power generation compared to the business-as-usual scenario. Subsidy reform also provided an incentive to switch between different sources of energy, which dampened the impact of energy price increases and generated capital cost savings in the power sector.

The energy sector impacts were generally small in India, primarily due to highly inelastic energy demand and limited potential for fuel switching, particularly in the transport sector. Impacts were more marked for Indonesia and Thailand, where final energy consumption was projected to decline, with an increase in the use of unsubsidized fuels partially offsetting the decrease in subsidized ones. In Indonesia, coal and biomass consumption was projected to increase to compensate for lower consumption of electricity and petroleum products, while in Thailand, consumption of coal- and biomass-based electricity was projected to increase to compensate for lower consumption of natural gas and petroleum products (Table 10). This indicates that while subsidy reform may cause final energy consumption to change (from natural gas to electricity, for example), fossil fuels may simply transition from a primary source of energy (such as natural gas) to a secondary one (such as natural gas used to generate electricity) *unless* reforms are combined with efforts to increase energy diversification and energy efficiency.

One consequence of consumer subsidies for fossil fuels is a so-called subsidy-rationing complex in which lower prices can lead to reduced supply (Howes and Dobes 2011). This is because energy

producers and distributors have little incentive to increase production when profits are nonexistent. Where subsidies are cofunded by losses of state-owned utilities and refineries, it can also result in debt and lack of capacity to invest in infrastructure or system repair. In Armenia, for example, electricity pricing reforms reduced the electricity sector financial deficit from 22% of GDP in 1994 to zero after 2004 (Bauer et al. 2013).

Table 10: Energy Sector Impacts

Model	Details	India	Indonesia	Thailand
MARKAL: long term ~2030 ^a	Decline in final energy consumption	Coal, oil, and petroleum products	Electricity, oil and petroleum products, and natural gas	Natural gas, oil, and petroleum products
	Growth in final energy consumption	Biomass	Coal and biomass	Electricity, coal and coke, biomass and biofuels
	Decline in power generation	Coal	Geothermal, diesel and fuel oil, coal, and hydropower	Natural gas and coal
	Growth in power generation	None	None	Biomass and hydropower

MARKAL = market allocation model.

^a The MARKAL model projected impacts to 2031 in India, and to 2030 in Indonesia and Thailand.

Source: Authors.

Subsidy reform will have a significant impact on energy systems and, in turn, businesses, industry, and households. Removing subsidies will allow energy companies to repay debts and create an incentive to rebuild and extend infrastructure, thereby improving the reliability and quality of fuel supply. And this in turn will help boost economic activity. The World Bank's enterprise surveys found that 32% of firms in India cited electricity as a major constraint to doing business in the 2006 survey, 27% in Thailand (2006 survey), and 14% in Indonesia (2009 survey). Monari (2002) found that increasing tariffs and improving the quality of supply increased farmers' incomes in India, and that farmers in two Indian states were willing to pay more for higher quality supply given the negative impact of outages and voltage surges on irrigation. Improved fuel supply would also increase household welfare and GDP, even without compensation. Studies of rural areas in Bangladesh, India, and Viet Nam found that well-functioning electricity connections significantly improved household incomes, expenditure, and education outcomes (Khandker et al. 2012, 2009; Khandker, Barnes, and Samad 2009). In Viet Nam, the benefits were found to exceed costs by a wide margin (Khandker et al. 2009).

Environmental Impacts

Lower demand for energy, coupled with a change in the energy mix, has positive environmental impacts. This was noted especially for Indonesia and Thailand, where demand for carbon-intensive energy saw the highest reduction, leading to a projected decline in CO₂ emissions in the MARKAL simulations of 5.1% and 2.8%, respectively (Table 11). This result aligns with a wide body of literature

projecting global and national reductions in CO₂ emissions from fossil fuel subsidy reform. This includes Burniaux and Chateau (2011), who project a 10% global decline in CO₂ emissions by 2050 from such reform in 37 non-OECD countries; and Clements et al. (2013), who project a 15% global decline in CO₂ emissions from the reform of posttax subsidies for petroleum, coal, and natural gas in all countries. In Indonesia, Yusuf et al. (2010) project reductions in CO₂ emissions of 5.79% from reforming fuel subsidies and 0.92% from reforming electricity subsidies.

Table 11: Environmental Impacts (% change)

Model	Details	India	Indonesia	Thailand
MARKAL: long term ~2030 ^a	Greenhouse gas emissions	-1.8	-5.1	-2.8
E3MG: long term ~2030 ^a	Greenhouse gas emissions	-1.3	-9.3	...

... = not available, E3MG = energy–environment–economy model at a global level, MARKAL = market allocation model.

^a The MARKAL model projected impacts to 2031 in India, and to 2030 in Indonesia and Thailand.

Source: Authors.

But this broadly positive impact deserves careful interpretation. Table 9 shows the economic impact of reforming all fossil fuel subsidies can vary if subsidies are reformed for just one energy product. The impact can also vary significantly between sectors. In Thailand, for example, significant increases in emissions were projected in the electricity sector, but these were counterbalanced by large emission reductions in the industrial, residential, and transport sectors. Furthermore, none of the models was capable of taking into account the subsidy-rationing complex. In such a situation, subsidy reform may lead to a significant expansion of energy supply and consumption (particularly petroleum refining and electricity generation and distribution), causing an increase in emissions that could feasibly be large enough to outweigh any emission reductions caused by higher prices. In sum, the environmental impacts were found to be positive, but further analysis could usefully explore the finer implications, as well as identify how environmental benefits could be maximized if a share of subsidy savings were reallocated to low-carbon energy infrastructure and energy efficiency.

Distributional Implications

The vulnerability analysis in India indicated that households in urban areas would be marginally more affected by reforms before savings were reallocated, and that the largest relative impacts would be experienced by households in areas where household heads were either self-employed or low-skilled labor (Table 12). In Indonesia, it was projected that the impact on urban households would be around two-thirds larger than on rural ones, and that increased prices would most affect households headed by those in higher-paid employment. The aggregate impact on all households was projected to be a 2.1% increase in household consumption in India and a 4.4% increase in income in Indonesia. The capacity of the social accounting matrix models in these countries to project precise impacts on only

the poorest was limited because they represented households by employment group, not income deciles. In India, the analysis was relatively stronger. Here, a category for urban underprivileged and rural underprivileged groups is constructed from the one income-based group built into the model (that is, the bottom 20% by expenditure) and one employment group from rural and urban areas (agricultural labor and casual labor). Rural underprivileged households were least affected, with their cost of consumption virtually unchanged. This was because only a small proportion of their expenditure was on subsidized energy. The urban underprivileged classes were more affected, with their cost of consumption up 1.4%. In Indonesia, the bottom 40% income group by expenditure was approximated by the three employment groups likely to represent low-income households. This group was projected to experience impacts much smaller than the aggregate, with a 1.6% decline in income.

Table 12: Impact Analysis Summary: Households

Model	Details	India	Indonesia	Thailand
Social accounting matrix: Vulnerability analysis	Most affected groups (relative impacts)	Urban: underprivileged, self-employed and salaried classes. Rural: nonagricultural self-employed class	Urban and rural households with head self-employed or working in skilled group	Household deciles 7, 8, and 9. Urban affected only marginally more than rural
Social accounting matrix: Vulnerability analysis	Aggregate expenditure/income (% change)	-2.10	-4.38	-1.75
Social accounting matrix: Short term (2012), full compensation to all households, remainder to government expenditure	Aggregate expenditure/income (% change)	0.00	2.11	4.26
Macro: long term (2020), full compensation to all households, remainder to government deficit	Aggregate expenditure/income (% change)	-0.02	-0.49	– ^a
Macro: long-term (2020), compensation to bottom 40% of households, remainder to households as a value-added tax reduction	Aggregate expenditure/income (% change)	0.33	0.37	– ^a

^a The long-term impacts on gross domestic product projected by the computable general equilibrium model for Thailand (a fall in consumption of 0.402% and 0.386%, respectively, in the scenarios that reallocated a share of savings to all households and all savings to all households) were not considered to represent an accurate outcome of the scenario being tested. This is because the computable general equilibrium model was only capable of projecting impacts on household consumption in response to an increase in the factors of production and not from transfers that stimulate household consumption and reduce government debt. The results are not comparable with the assessments for the energy–environment–economy model at a global level for India and Indonesia. The results do indicate, however, that in the nonrealistic scenario that no funds are reallocated in a way that stimulates household consumption, reform would have fairly minimal impacts on levels of household consumption.

Source: Authors.

In Thailand, where the social accounting matrix was disaggregated by income deciles, households in the fourth to the second-lowest deciles were projected to be most affected, although all households were expected to experience fairly similar impacts on their relative expenditure—an aggregate increase in the cost of consumption of 1.75%. The difference between the most-affected household decile and the least-affected was only 0.51%. Similarly, the impact on agricultural and nonagricultural households was found to be very similar, with the former seeing the cost of consumption increase 1.67% and the latter by 1.75%.

In India, the social accounting matrix analysis indicated that, in the short term, the reallocation of savings to compensate all households for the direct and indirect impacts of reform and using the remainder of savings to increase government expenditure would cancel out these negative impacts. In Indonesia, this resulted in a net increase in household consumption of 2.1%, with an increase of 1.5% to the income group approximating the bottom 40%. The E3MG analysis projected that compensating all households only for the direct impacts of reform in the medium to long term and using the remainder of savings to reduce debt would result in a slight negative impact on household incomes. Positive results might have been projected if indirect impacts had also been compensated or if a relationship had been modeled between reduced debt and GDP growth. This was illustrated by the E3MG scenario that allocated all savings to all households; this saw aggregate consumption increase slightly (by about 0.3%) in India and Indonesia.

In Thailand, the social accounting matrix analysis projected that, in the short-term, the reallocation of savings to compensate all households for the direct and indirect impacts of reform and using the remainder of savings to increase government expenditure would see significant increases in consumption across all household groups, with an aggregate increase of 4.26%. Like the E3MG, the CGE model ran a scenario that compensated only for direct effects and used the remaining savings to reduce deficit. For similar reasons, this scenario saw poverty incidence increase 0.11% relative to the business-as-usual scenario. The CGE analysis also found that reallocating all subsidy savings to all households would result in positive outcomes for households, reducing poverty incidence 0.21% relative to the business-as-usual scenario.

The results of the vulnerability analysis were of a magnitude consistent with other studies. In a comprehensive review of the impacts that fuel subsidies and their reform have on households in different income groups, Del Granado, Coady, and Gillingham (2012) found that a \$0.25 per liter increase in fuel prices, with no reallocation of savings, was associated with an average 5.4% decline in household real incomes. Here, indirect impacts typically accounted for over half the total impact. The scale of absolute price changes fed into the social accounting matrix models for petroleum fuels—once converted into the models' baseline years—typically assumed an increase of \$0.10–\$0.20 (see Annex on Calculations to adapt recent-year subsidies to the social accounting matrices in the country studies), indicating a similar factor between price rises and impacts. Del Granado, Coady, and Gillingham (2012) also found that case studies from Asia and the Pacific indicated that impacts on consumption would on average be slightly higher among the middle-income quintiles in an economy. The authors found that impacts could vary significantly, depending on the type of fuel price increase and the access that low-income households have to different types of energy. They also noted that where only a subsection of low-income households have access to a subsidized fuel—for example, due to a poor distribution network—a vulnerability assessment may substantially underestimate the impacts that will be clustered on the subgroup of households with access.

The results of the reallocation scenarios are similar to those of a CGE analysis of fossil fuel subsidy reform in Yemen (Breisinger, Engelke, and Ecker 2011). The study projected an increase in the poverty rate when the majority of subsidy savings (55%) were allocated to households over 5 years and the remainder used to reduce the deficit. By contrast, it projected greater GDP growth and poverty reduction when the majority of savings were allocated to productivity-enhancing investments (construction, electricity, water, trade, and transport), with only the bottom 30% of households compensated (using about 4.5% of total savings). The authors concluded that it is important to reallocate savings in a way that drives growth to assist in poverty reduction.



5 Policy Choices

The modeling results presented in the previous section projected a wide range of impacts arising from fossil fuel subsidy reform. Once identified, the challenge for governments is to take these impacts into account in a comprehensive reform strategy. The next three subsections use this empirical research to inform the design of measures to implement the reforms while mitigating potential negative impacts. The subsections also help identify stakeholders and messages to be targeted to concerned stakeholders with varied interests.

Findings and Lessons from Country-Level Analysis

Findings from the reform analysis for India, Indonesia, and Thailand show that reform is capable of promoting economic growth and improving household welfare. Individually, neither the social accounting matrix nor the macroeconomic analyses provided an assessment of impacts over time, but together they indicate that reform would lead to a short-term shock to GDP that is gradually smoothed out as responses in supply and demand allocate resources more efficiently across the economy (Table 13). This supports the case for a gradual approach to reforming fossil fuel subsidies to ensure that shocks are manageable.

Table 13: Subsidy Reform Impacts: Short- versus Long-Term Outcomes

Short term	Long term
Rise in prices; decline in gross domestic product (GDP), private consumption, imports, and overall economic performance	Higher GDP, lower prices Reduced distortions, more efficient resource allocation Better distribution
Rise in poverty: varies with energy type (for example, kerosene is used more by the poor)	Higher renewable energy investments, increased supply
Reduction in energy supply and rationing	

Source: Authors.

The results also indicated that the improvement of economic growth and household welfare is highly dependent on how subsidy savings are reallocated via supporting policies. In the short term, using a proportion of subsidy savings as cash transfers was found to be sufficient to mitigate the negative impacts of reform on households. The vulnerability analysis showed the importance of understanding household energy access and use to effectively target assistance; for example, in India, small impacts were projected for low-income rural households and the most significant impacts on low-income urban households, whereas in Thailand, impacts for low-income households were very similar for both rural and urban areas. In the medium to long term, the results suggested that cash transfers might

need to be combined with measures more directly targeted at improving medium- and long-term welfare and stimulating higher GDP growth. Other empirical studies indicate that such measures might include using savings to reduce fiscal debt or to invest in economic drivers such as trade, transport, and telecommunications infrastructure. This is something the long-term scenarios assumed, but the macroeconomic models were not designed to assess. In this study, the macroeconomic benefits of fossil fuel subsidy reform are likely to be larger than projected due to the inability of the models to project economic benefits resulting from decreased debt or improved social welfare.

The results projected that the energy and energy-intensive sectors would be most significantly affected, but that nonenergy-intensive sectors such as forestry and services would only benefit once savings were reallocated. In some cases, the vulnerability analysis did not provide sector projections that were precise enough to inform policy due to a lack of disaggregation of energy products in the economic models. Other empirical studies complemented the assessment by indicating that sectors that largely compete with foreign producers on domestic or international markets would have a limited ability to increase prices, and therefore be most likely to suffer losses as a result of reform (Coady and Newhouse 2006). Assistance to key economic sectors was not modeled as a reallocation option, but this should be considered in future studies to explore whether complementary policies are needed to maximize the GDP and welfare gains of reform. Experience from Iran and other countries indicates that transitional assistance policies, such as energy audits and credit subsidies, can be used to help companies cope with the costs of adapting to higher energy prices (Guillaume, Zytek, and Farzin 2011).

The MARKAL analysis indicated that fossil fuel subsidy reform would have a significant impact on the development of the energy sector and its associated greenhouse gas emissions, but that outcomes would vary depending upon access to alternative and affordable energy options and whether or not subsidies were part of a larger subsidy-rationing complex. This suggests that policy interventions could be instrumental in determining the impact of reform on the environment and energy access, particularly in minimizing the extent to which there is a trade-off between the two. There is no significant literature on what policies work best to maximize the benefits of reform for the environment and energy access. But illustrative examples include energy sector strategies to drive the development of low-carbon energy options, investments in public transport infrastructure, switching from electricity consumption subsidies to electricity network expansion and connection subsidies, and the promotion of distributed renewable energy generation. Such policies may need to be introduced before reforming fossil fuel subsidies. Vagliasindi (2012a) notes that this sequencing may help improve the credibility of reform and consumer willingness to pay, and reduce the short-term costs on the vulnerable.

The MARKAL analysis does not capture all the complex causal relationships associated with fossil fuel subsidy reform, but using the three different kinds of models provides analytical inputs across an uncommonly broad set of impacts. Overall, it shows that although fossil fuel subsidy reform can lead to many benefits, there is a strong case for a package of policy measures to maximize the benefits of reform on the economy, households, businesses, and the environment.

Deploying Fiscal Savings from Reform

Subsidy reform, by letting market forces determine fuel prices, will release scarce public resources for other development priorities. The fiscal space fossil fuel subsidy reform generates is equal to the size of the subsidies themselves and represents a significant flow of funds. In India, Indonesia, and Thailand,

fossil fuel subsidies are roughly equal to their annual budget deficits. In terms of development aid, these subsidies were between 12 and 15 times higher than the flow of official development assistance received by all three study countries in 2012. In some cases, expenditure on energy subsidies is greater than annual public spending on education or health (Table 14).

Table 14: Government Expenditure

	India	Indonesia	Thailand
Value of subsidy savings			
Absolute subsidy savings (\$ billion per year)	49.0	36.2	7.0
Subsidy savings as % of GDP	2.7	4.1	1.9
Cost of compensation payments to households			
Share of savings to compensate all households ^a (%)	45.0	49.0	41.0
Share of savings to compensate bottom 40% (%)	7.0	7.0	7.0
Comparisons with other expenditure			
Receipts of ODA in 2012 (\$ billion)	3.8	2.3	0.5
Expenditure on health in 2012 (% GDP)	1.0	1.0	3.0
Expenditure on education in 2012 (% GDP)	3.4	3.6	7.9
Overall surplus/deficit in 2012 (% GDP)	-5.2	-1.8	-2.3

GDP = gross domestic product, ODA = overseas development assistance.

^a The data on share of savings used to compensate households derives from the social accounting matrix analyses and includes compensation for direct and indirect impacts.

Sources: Authors; the Asian Development Bank, Statistical Database System; Organisation for Economic Co-operation and Development, International Development Statistics; World Bank, data for the comparative expenditure.

The phase-out of subsidies raises the question of the best use of the freed-up funds. Environmentally friendly options include investment in renewable energy, climate change mitigation technology and better energy infrastructure, and access to clean and modern energy. An assessment of such options is beyond the scope of this study, which focuses on social assistance to mitigate the impact on the poor, discussed in Box 2.⁷

Social assistance was selected for further examination for three reasons. First, the poor are least able to cope with higher prices because of their limited ability to reduce energy consumption or redirect spending without cutting into essential needs. Second, the reforms provide an opportunity to transition from a regressive policy to more progressive social programs. Third, the modeling exercises show the elimination of fossil fuel subsidies would generate sufficient fiscal space not only to alleviate poverty impacts, but also to strengthen existing social protection measures and introduce new ones. Public expenditure on important items such as social assistance falls short of the amount the three study countries spend to sustain high magnitudes of energy subsidies (Figure 9). In other words, these countries could double social assistance spending—or raise it even higher—by shifting spending from inefficient fuel subsidies.

⁷ How subsidies are changed and efforts to counteract price increases and volatility are both also measures that can reduce impacts on the poor.

Box 2: Fossil Fuel Subsidy Reforms and the Poor

No international standard exists for classifying energy needs, but they are typically broken into functional categories covering lighting, heating, cooling, cooking, mechanical power for productive uses, transport, telecommunications, and domestic appliances (OECD/IEA 2010; Sovacool 2013). Energy affordability and access can affect households in direct and indirect ways: directly, through the energy goods and services they purchase; indirectly, through the embedded cost of energy in the goods and services they consume.

In poor households, most direct spending on energy is to meet lighting, heating, and cooking needs (IEA 2006; Bacon, Bhattacharya, and Kojima 2010). Low-income households widely use kerosene, fossil-fuel-derived electricity, and liquefied petroleum gas (LPG), although the primary fuel for cooking needs in developing Asia is still biomass, particularly in rural areas (Karekezi et al. 2012). The importance of these energy sources differs significantly between countries. In recent years, some countries have seen LPG grow in importance as a primary cooking fuel for the poor, and in other countries kerosene has become the dominant fuel for cooking (Bacon, Bhattacharya, and Kojima 2010). The dominant energy source for lighting, typically kerosene or electricity, is more consistent across countries.

A review of household expenditure surveys in seven South and Southeast Asian countries found that, on average, petroleum products were part of the energy mix for 80% of rural households and 74% of urban households in the lowest two income quintiles, accounting for around 2%–3% of total household expenditure among consuming households (Bacon, Bhattacharya, and Kojima 2010).^a Poor households do not purchase significant volumes of gasoline or diesel as most cannot afford to own vehicles—but many do purchase transport services. Bacon, Bhattacharya, and Kojima (2010) found that, on average, 49% of rural households and 45% of urban in the lowest two income quintiles made use of transport services, accounting for about 2%–3% of total household expenditure among consuming households. Aside from transport services, the most important forms of energy for the indirect energy costs of households are typically diesel and electricity: the former because of its use as an input in productive activities, such as agricultural and fishing vehicles, freight, and small-scale generators; and the latter because it is an intermediate good.

Rising energy prices therefore do not have a uniform impact; it depends on the type of energy subsidy being reformed and how poor households are directly and indirectly affected. The reform of subsidies related to kerosene and LPG (where there is widespread LPG use by the poor) is likely have the largest direct impacts on low-income households, either increasing their energy expenditure, decreasing their energy use, or encouraging them to return to the use of traditional biomass. The reform of fossil fuel subsidies for transport fuels tends to have the largest direct impact on the wealthiest, but the indirect effect of diesel subsidy reforms in particular can have a significant impact on general living costs for the poor (Vagliasindi 2012b). For countries with near-universal electricity coverage, fossil fuel subsidy reform that increases electricity prices tends to have the largest impact on the poor through its direct impact on lighting costs and its indirect impact on the cost of goods and services (Vagliasindi 2012b).

For decades, many Asian countries have regarded fossil fuel subsidies for energy consumers as a major component of social safety nets. The policy objective, whether explicit or implied, is typically to help households afford their direct energy costs, thereby reducing expenditure and improving energy access for modern fuels, as well as reducing the general cost of living through indirect impacts on the cost of nonenergy goods and services. However, subsidies for modern fuels, such as LPG and kerosene, do not always result in the uptake of these fuels in place of biomass. In India and Indonesia, for example, where subsidies for petroleum fuels have been available for decades, biomass remains the fuel of choice among the rural poor. In all three study countries, poor households use biomass for cooking even in the presence of subsidized alternatives. In Thailand, even the wealthiest households use some biomass for cooking.

Even when they achieve their aims, universal fossil fuel subsidies are almost always highly regressive and inefficient.^b They benefit the well-off more than the poor because the well-off consume the most energy, directly and indirectly. A comprehensive review of data on fossil fuel subsidies in 20 developing countries concluded that the bottom 40% of households by income on average

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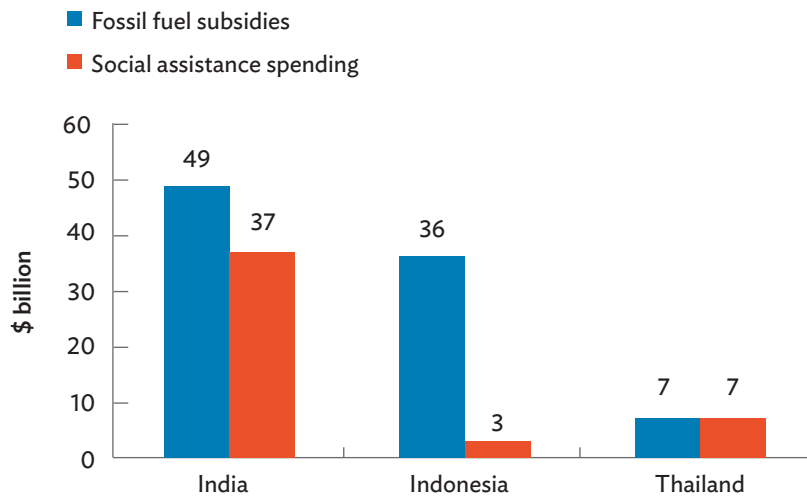
Box 2 continued

received only 18% of direct subsidy benefits and 19% of indirect benefits. By contrast, the top 20% received 48% of direct benefits and 42% of indirect benefits (Del Granado, Coady, and Gillingham 2012). However, such assessments tend to assume that the benefits of fuel subsidies are transferred to households, whereas in reality, it is often the case that low prices do not reach the intended beneficiaries because of diversion, leakage, and smuggling.

^a The study reviewed data from 2005 household expenditure surveys from Bangladesh, Cambodia, India, Indonesia, Pakistan, Thailand, and Viet Nam. The precise proportions of energy products being consumed are likely to have changed since this time, given increasing world oil prices and efforts from a number of countries to encourage the use of LPG, but there is no reason to suppose that the broad proportions have changed significantly.

^b A “universal” fossil fuel subsidy is one that is available to the entire population or a large majority of the population, without any attempt to target it to users defined as being “in need.” The large majority of fossil fuel subsidies in Asia are universal in nature.

Figure 9: Magnitude of Fossil Fuel Subsidies Compared with Social Assistance, 2012



Source: Authors' estimates.

In the three study countries, the social accounting matrix analysis indicated that less than 50% of subsidy savings were necessary to fully compensate households for the direct and indirect impacts of increased prices, and less than 10% to fully compensate the bottom 40% of households by income distribution group. This confirmed findings of other literature suggesting that low-income households typically receive a small share of benefits from subsidies (Del Granado, Coady, and Gillingham 2012), and that it is possible to compensate households at the same time as reinvesting significant savings elsewhere in the economy. For example, Coady and Newhouse (2006) estimated that, in Ghana, a well-run cash transfer program could compensate the bottom 30% of households by income distribution at 5.4% of the cost of the original subsidy. Similarly, Breisinger, Engelke, and Ecker (2011) estimated that transferring less than 5% of subsidy savings per year to support the poorest one-third of households would be sufficient to help real incomes recover to near business-as-usual levels within 3 years, leaving significant savings available to allocate to productivity-enhancing investments, such as transport and communications infrastructure.

The extent to which low-income households are affected by fossil fuel subsidy reform will depend on the following: what fuels are subsidized; how much the poor use them; and the capacity of low-income households to reduce consumption, redirect spending from other priorities, switch to cheaper fuels, invest in more energy-efficient goods and services, and cope with volatile fuel prices.

The capacity of households to respond to higher prices is also not uniform. It depends on the degree of poverty (whether there is any disposable income), geographic location (rural households generally have greater access to biomass fuels), the availability and effectiveness of pro-poor programs and the eligibility of poor people in relation to these programs. For example, switching from modern energy to biomass may be a financially advantageous option for some households, but the effects can also be detrimental. Switching to biomass can increase the time needed to gather fuel and exposure to the health effects of smoke from biomass cooking stoves. These tasks fall most heavily on women and children, who are most likely to suffer the negative effects (Sovacool 2013). Households using biomass tend to have less time to invest in other productive activities such as paid work and education, particularly if lighting is not affordable (Saghir 2005).

As a transitional measure in the removal of universal fossil fuel subsidies, governments frequently seek to target subsidies to the poor or other sensitive sectors. Through targeting, overall subsidy expenditure is reduced and the benefiting groups are insulated from the direct impact of higher prices. In practice, it can be highly challenging to enforce differentiated energy prices for different categories of consumers. In addition, targeting fuel subsidies to the poor will not protect consumers from the indirect effect of higher prices. For example, India, Indonesia, and Thailand all subsidize diesel. The poor use little diesel directly, but it is an input to many products the poor use. Allowing only the poor access to cheap diesel would not address the generally inflationary impact of increasing diesel prices for other consumers. However, targeting diesel subsidies to key sectors such as agriculture and transport could in theory mitigate some of the indirect impacts on the poor, albeit with the aforementioned challenges to enforcement.

Cash transfers are the preferred approach to the delivery of social assistance (Clements et al. 2013). They allow consumers to choose what they need and when. They do not distort markets or lower incentives for investment and supply (Standing 2012; Argawal 2011). And they remove the need for governments to be involved in the distribution of subsidized goods, which is costly, inefficient, and prone to abuse (Grosh et al. 2008). In Latin America and Europe, where social assistance regimes are

more mature, governments tend to put the largest proportion of welfare spending into targeted cash transfer schemes (World Bank 2012).

In Indonesia, a cash transfer program was developed in the 6 months leading up to planned price increases in 2005, with payments made over several months as part of a broader package of assistance (Beaton and Lontoh 2010). This program was subsequently strengthened and used to assist households with price increases in 2008 and 2013, and the system for identifying low-income households was eventually used to develop a unified registry for the use of other welfare programs. The transfers were found to be more than sufficient for counteracting fuel price increases for the recipients (World Bank 2012). In Iran, all citizens were eligible for cash transfers following significant increases in fuel prices, although opening up eligibility to all citizens resulted in high costs and contributed to inflationary pressure (Guillaume, Zyteck, and Farzin 2011; Hassanzadeh 2012). In both countries, however, cash transfers made subsidy reform politically viable.

Indonesia is a good-practice example of implementing mechanisms to shield the poor against energy price rises resulting from subsidy reform. The government operates a temporary unconditional cash transfer program, originally called the *Bantuan Langsung Tunai* and subsequently rebranded as the *Bantuan Langsung Sementara Masyarakat*, designed especially to compensate poor households for cuts in fuel subsidies. In 2005, 19 million households were paid 100,000 rupiahs (Rp) (\$10.3) per month for 1 year following fuel price increases. Subsequent to another round of fuel price increases in 2008, the *Bantuan Langsung Tunai* again paid a monthly benefit of Rp100,000 for 9 months. The transfer program amounted to 60% of social assistance expenditure in 2005 and 40% in 2008. The *Bantuan Langsung Tunai* targeted households with per capita consumption below around Rp250,000 per month, which represented 12.1 million households, or 21% of the total in 2010, even though only 12.5% of households lived below the poverty line of Rp233,700 per person per month (or \$1.19 per day in purchasing power parity).

Cash transfers have limitations and drawbacks. Potential problems—not unique to cash transfers—include difficulties in targeting and distribution, as well as inflationary impacts and overuse for political gain. Conditional cash transfers require that recipients can be individually identified and verified, that secure distribution channels are present, and that markets are operating effectively so that goods and services are supplied at competitive prices (Standing 2012). Unconditional cash transfers, on the other hand, can be implemented relatively quickly.

Where cash transfers are not feasible in the near term, other types of transfer programs provide a next-best alternative until administrative capacity is developed (Clements et al. 2013). Existing programs that can be expanded quickly and perform well are a logical choice (World Bank 2012). Options include public works programs;⁸ funding for education (scholarships, school meals, and transport); food and nutrition (food subsidies, and maternal and child nutrition); health services (fee waivers); increased pensions; and subsidized electricity or water. One review of international experience ranked welfare policies in order of targeting efficiency (highest to lowest) as follows: public works, near cash transfers, social funds, cash transfers, food subsidies, water consumption subsidies, and electricity consumption subsidies (Komives et al. 2005). In addition to targeting effectiveness, other factors need to be considered, including cost. Public works programs, while effective in targeting, are costly for delivering assistance.

⁸ Public works programs employ the poor to create or maintain community assets.

Implementing Reforms

From an economic perspective, all fossil fuel subsidies (consumer and producer) create distortions and lead to suboptimal allocation of resources. So there is no such thing as a good fossil fuel subsidy. Even so, subsidies should be assessed against their stated objectives, the aims of the reform program (such as fiscal consolidation, environmental sustainability, or equity), and the extent of their unintended consequences. The priorities for reform clearly vary from country to country, but some general principles apply (Box 3).

Several recent studies provide significant guidance on strategies to reform fossil fuel subsidies, including case studies and best practice to implement the reforms (Beaton et al. 2013; Clements et al. 2013; Vagliasindi 2012a, 2012b; Kojima 2013a, 2013b). Countries are generally advised to situate fuel subsidy reform within a broader reform agenda with clear long-term objectives, develop measures to change pricing systems, mitigate unwanted impacts, and communicate with the public and key stakeholders about the objectives and benefits of reform. This study's impact analysis is targeted at informing the second part of this package of measures—policies to mitigate negative impacts.

There are three main ways to reduce them when implementing fossil fuel subsidy reform (Figure 10). First, reduce the shock of reform; for example, introduce reforms gradually beginning with subsidies that are most regressive and least likely to have negative macroeconomic and welfare consequences. Second, introduce complementary policy interventions to help households and businesses cope with the impacts that take place after prices rise. And third, counteract price rises through nonsubsidy

Box 3: Priorities for Subsidy Reform

Prioritize the reform of the most costly fossil fuel subsidies. Generally, these cause the biggest problems, absorbing the most expenditure from other development priorities and creating the largest price distortions. Reducing a large subsidy is likely to create many more fiscal and social benefits than eliminating a small one.

Prioritize the reform of the most inequitable subsidies, the removal of which will least affect the poor. Universal consumer subsidies will always deliver more benefits in absolute terms to those who consume the most energy—the wealthy. Gasoline illustrates this well. Well-off owners of private vehicles are its biggest consumers, and the removal of gasoline subsidies will provide fiscal space with limited impacts on the poor. Among the three study countries, India and Thailand have both eliminated subsidies for gasoline and Indonesia has announced a new pricing system that—if it can be maintained—will remove all subsidies to gasoline, with the exception of distribution costs to noncentral areas of the country. The removal of subsidies for other forms of energy, such as liquefied petroleum gas or electricity, might need to take longer and at the same time as complementary mitigation measures are designed and implemented.

Prioritize subsidy removal, not the better targeting of subsidies, as this has a poor rate of success. Targeted subsidies, in theory, only assist sensitive sectors. In practice, diversion and leakage dissipate benefits to the target group while creating negative consequences. Moreover, consumer fuel subsidies are not efficient for assisting the poor. Cash transfers and similar mechanisms more effectively reduce poverty, and replacing fuel subsidies with more effective social spending would improve equity.

Source: Authors.

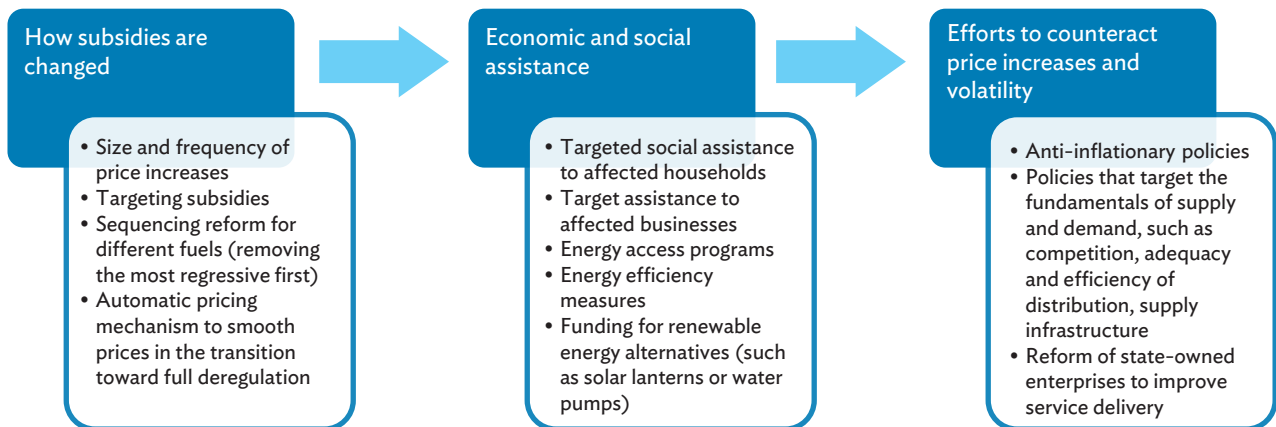
interventions that lower prices; for example, by ensuring that competitive markets are operating effectively and state-owned enterprises efficiently.

The first step for transitional assistance programs should be those already in use, as cash transfers have been implemented successfully during energy subsidy reform. Out of 28 such reform episodes studied by the IMF, eight used cash transfers (Clements et al. 2013). Some implemented or expanded existing conditional cash transfers, which make payments on certain conditions such as school or health clinic attendance (Grosh et al. 2008). Unless conditionality is already in place, it is unlikely to be feasible to implement quickly as a transitional policy in the context of subsidy reform. This is because conditions require major investments so that recipients can meet conditionality requirements—that is, sufficient schools and clinics to allow all recipients to attend—and complex administrative procedures to monitor compliance and link this with payments.

Programs need to be identified in consultation with stakeholders, particularly subnational jurisdictions with responsibility for social protection. For existing cash transfer programs, adding an energy component is fairly straightforward (Clements et al. 2013). For in-kind transfers, a range of programs might be needed to reach target participants. For example, school fee waivers will only reach households with school-aged children and pensions only the elderly. Existing programs should be assessed for effectiveness. Several weaknesses are common in developing country social assistance regimes. Scaling up programs quickly is difficult and some compromise might be necessary in program design and targeting (Grosh et al. 2008).

As Coady (2004) notes, many safety nets (i) fail to reach the target group (the poorest households); (ii) are comprised of fragmented, uncoordinated, and duplicative programs with little consultation between relevant government departments; (iii) have unnecessarily high costs in transferring benefits to recipients due to a combination of operational inefficiencies and corruption; (iv) fail to break intergenerational poverty even when benefits do reach households; and (v) have insufficient program coverage or benefits to have an appreciable impact on poverty.

Figure 10: Policies to Reduce Negative Impacts of Reform



Source: Adapted from Beaton et al. (2013).

Indonesia's experience is instructive in delivering assistance linked to fossil fuel subsidy reform through a unified registry. This helps improve coordination among different social programs to reduce errors of inclusion given common problems of poor targeting, disparate and uncoordinated programs providing benefits to different recipients, and inadequate coverage and benefit transfer. India has demonstrated that reforms to existing programs, such as to the Public Distribution System, can dramatically improve targeting and coverage. Thailand's experience in creating different prices for different consumers has reduced subsidy expenditure for some fuels.

As well as compensating the poor, linking subsidy reform and the creation, improvement, or expansion of social assistance measures has two key advantages: it improves the political palatability of reform (among those to receive the assistance), and it builds the capacity of new safety net programs, as cash transfer did in Indonesia.

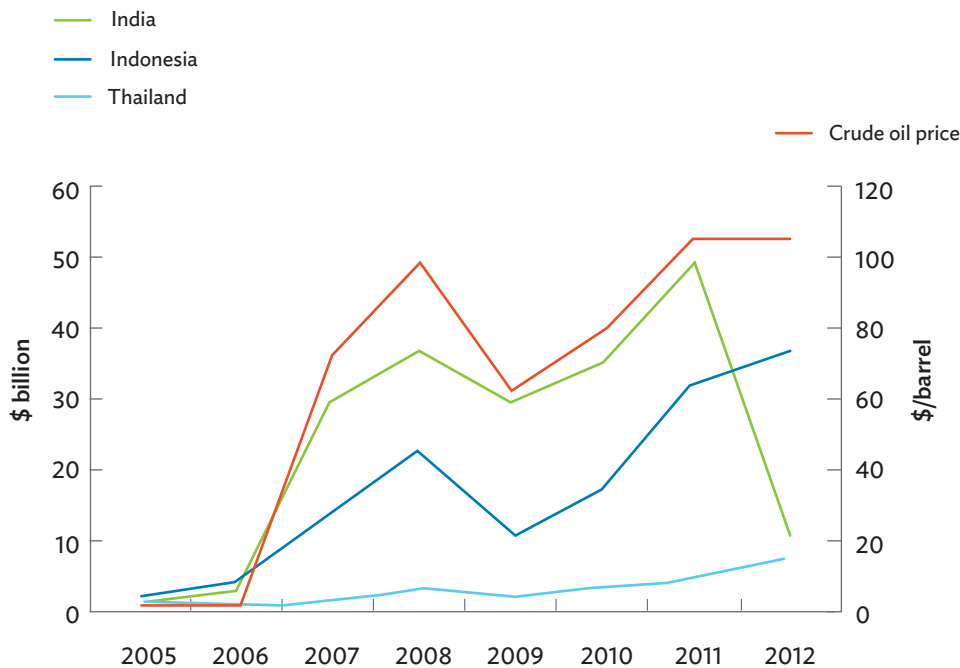
Coordination and communication are essential in program design and need to be improved in each of the study countries. Widely communicating the availability of transitional assistance can improve targeting if eligible recipients are aware of the programs and apply. Evidence suggests that this has not yet been done effectively. In India, uptake was low in the pilot programs of the Direct Benefits Transfer for LPG and cash transfers for kerosene. Poor socialization or information campaigns have been criticized for cash transfers in Indonesia (World Bank 2012). In Thailand, only 2% of eligible consumers applied for the cheapest LPG. While distributional policy options offer benefits to the poor, they suffer from potential flaws as well. In reality, governments face multiple challenges in identifying the poor and targeting them using social safety net programs. The take-home message from this is that a government's ability to mitigate impacts effectively depends on how prices affect households, the social policy instruments already available, their effectiveness, and the country's capacity to implement new measures or reform existing ones.

It is also important to address the political economy dimensions of fossil fuel pricing reform, which may be inhibited by vested interests and hidden motives associated with corruption and rent seeking, (downstream) industrial development, and overseas development assistance (Moerenhout 2014). Any reforms that can be readily implemented to improve targeting and coordination will lead to better outcomes. For implementation, transitional policies should be timely, temporary, and targeted. Assistance should be provided at or before the time of price increases to prevent shocks. It ought to be time-limited to avoid building up inflationary pressure from higher fuel prices and to retain the flexibility of policy reversal if this arises. Compensation must reach the majority of the group vulnerable to falling into poverty (or deeper into poverty), and it must cover both direct and indirect impacts on the poor if reform is not to increase poverty. The benefits of safety nets should be at least commensurate with the cost of higher energy prices to avoid poor households regressing further into energy poverty.

6 Responding to Oil Price Gyration

Oil is usually the largest component of the cost of a subsidy. In countries that regulate, administer, or control domestic oil prices, a rapid rise in global oil prices—as happened during oil price shocks in 2007–2008—can throw fiscal prudence off balance and necessitate fiscal correction (Figure 11). Government-provided subsidies may not even reach intended beneficiaries when low domestic prices lead to large price differences from other energy products within a country or from the same product in neighboring countries, which encourages cross-border smuggling. Furthermore, unscrupulous parties can take advantage of this price arbitrage by diverting the benefits of these government programs for their own illicit gain (Box 4).

Figure 11: Movement of Subsidies in Tandem with Oil Prices, 2005–2012



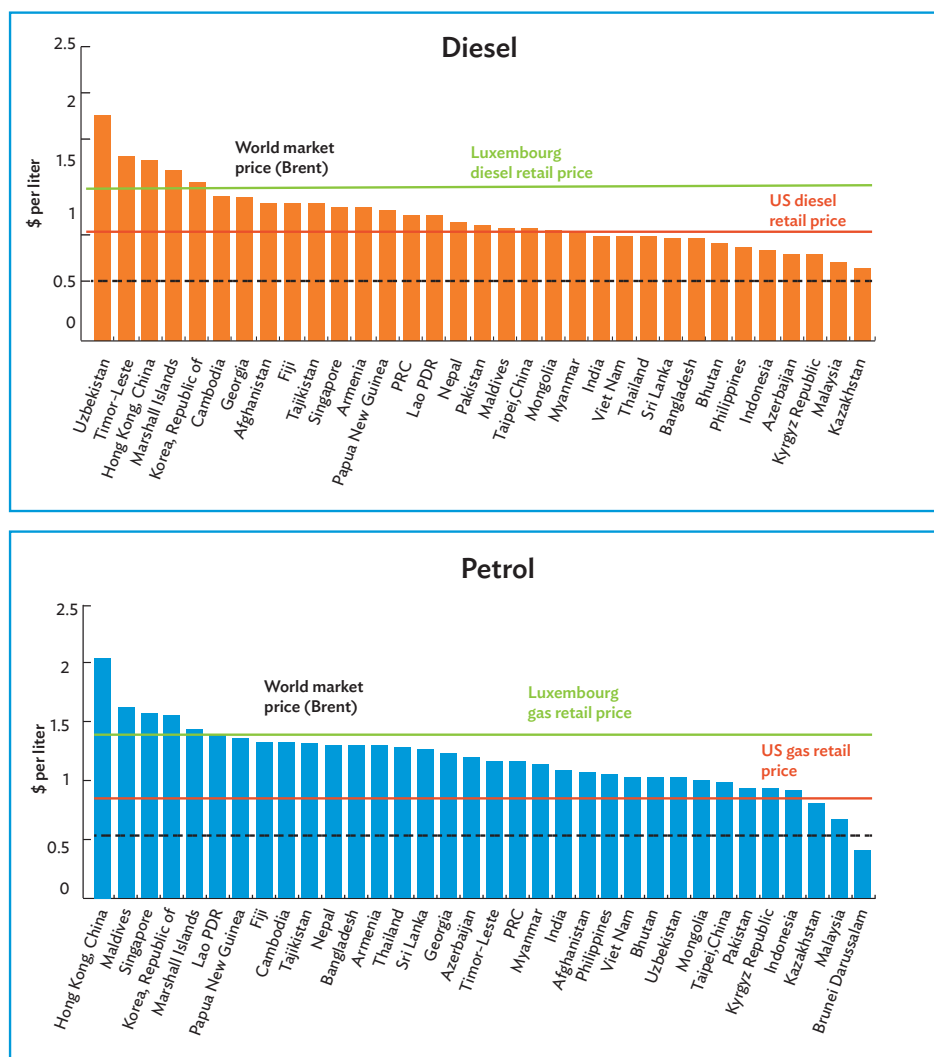
Source: Authors' estimates.

Box 4: Fraud and Diversion of Subsidies within Countries and across Borders

Fuel subsidies and differential pricing policies encourage fraudulent activity. Fuel fraud is a key political-economy problem in reforming fuel subsidies and enforcing pricing policies is a major concern for any energy market (Beaton et al. 2013). For example, higher-priced, nonsubsidized, or taxed fuels are often adulterated or diluted with subsidized fuels, meaning government revenues are "stolen" twice: once when the taxes on the higher-priced fuels are evaded and again when the subsidized fuels are diverted from their intended targeted beneficiaries.

In addition, lower-priced subsidized fuels can be transported across national borders into countries with higher domestic prices or nonsubsidized programs. The net result is global financial losses estimated in the tens of billions of dollars annually. In Asia, countries with fuel subsidies, such as Bangladesh, India, Indonesia, Malaysia, and Sri Lanka, are particularly vulnerable to financial losses due to their relatively low diesel prices, as Box Figure 4.1 shows.

Box Figure 4.1: Price Differences across ADB Developing Members, 2014



PRC = People's Republic of China, Lao PDR = Lao People's Democratic Republic, US = United States.

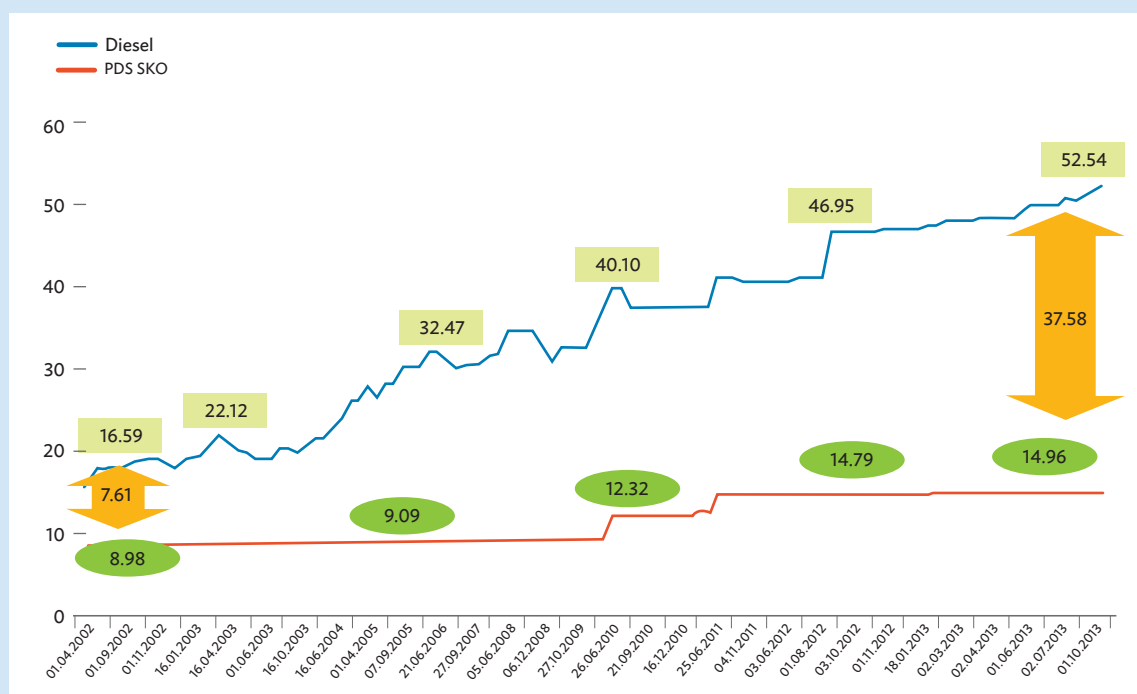
Source: GIZ (2015).

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Box 4 continued

Officials estimate that Indonesia is losing the equivalent of \$862 million and Malaysia \$175 million a year (Bailey and Conroy 2014). Even where fossil energy subsidies have been largely eliminated, such as in the Philippines, fuel smuggling is estimated to cost the government around \$600–\$700 million annually (Kojima 2013a). Price differentials within countries can also encourage diversion (Box Figure 4.2). A push for greater transparency or a tighter regulation of the supply chain often fails because of political resistance.

Box Figure 4.2: Price Differentials between Public Distribution System Kerosene and Diesel in India (Rs. per liter)



PDS SKO = Public Distribution System Superior Kerosene Oil.

Source: ADB (2014a).

To prevent such illicit activity, governments have deployed a range of both visible dyes and covert markers designed to differentiate between subsidized and nonsubsidized fuel types (Bailey and Conroy 2014). Unfortunately, criminals have devised methods to remove these dyes and markers and divert the “laundered” fuel back into the normal supply chains. Programs to catch this illegal diversion often run into trouble because color differences can be easily neutralized by simple extraction or adsorption processes and using additives to obscure or simulate color differences. In response, remarkable advancements are being made in fuel-marker technologies. A new class of nanotechnology molecular markers that are both resistant to laundering as well as environmentally friendly are being deployed as part of more comprehensive fuel integrity programs (Bailey and Conroy 2014). These are designed as sophisticated management systems that result in timely, actionable intelligence with which governments can mitigate tax evasion and subsidy abuse, resulting in significant financial benefits.

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Dedicated fuel integrity programs are aimed at addressing fuel theft and smuggling. In Thailand, for example, the government mandated fishermen who benefit from tax-free diesel to install a tracking device on their boats (Kojima 2013a).

Bailey and Conroy (2014) demonstrates that there are systems available with invisible dyes that allow both quick field and in-depth laboratory testing to identify fuel fraud. Their assessment of fuel integrity programs shows that the benefits far outweigh costs if a program is properly implemented. In Guyana, benefits were found to have outweighed costs by at least 15 times. Proper implementation not only means that the entire supply chain is authenticated, but it also often requires setting up an independent regulatory body overseeing the fuel integrity program. Transparency, carefully drafted incentive schemes, and regular external audits can help to warrant the technocratic and independent nature of such bodies. As with other fuel subsidy reform policies, operational and enforcement capacity deserve attention; not doing this will inevitably diminish the chances of combating fraud and diversion of fuel subsidies.

Source: Authors.

End of the Supercycle or a Temporary Blip?

Unlike other commodity prices, real crude oil prices displayed a unique feature of a “strikingly rising” long-term trend during 1875–2010 (Erten and Ocampo 2012). Over this period, the length of oil “supercycles” became shorter, average prices higher, amplitudes larger, and the price trend steeper (Figure 12a). The first supercycle ran about 55 years (1892–1947), when oil prices grew at 1.5% annually until the mid-1920s, driven by the expansion of electrification and the advent of motor vehicles in the late 19th century before beginning a downtrend at a slower pace of 1.1%. The end of World War II marked the beginning of the second supercycle (1947–1973), when the price fall continued at the same rate until 1962, but was followed by a much steeper climb, at 2.8% per year, than seen before. The oil price shocks of the 1970s ignited a 25-year supercycle (1973–1998). As part of a broader commodity price supercycle, the oil and non-oil supercycles did not initially move synchronously, but from 1950 their correlation went up to 0.69, rising further to 0.87 from 1970 (Figure 12b). This comovement suggests that over long periods of time commodity prices are largely demand driven. The most recent supercycle, which began in 1998, is defined by growing demand from emerging markets in the early 21st century.

International crude oil benchmark prices approximately halved between mid-2014 and early-2015 (Figure 13). Despite a slight pickup by mid-2015, this remarkable fall seems to mark the effective end of the most current oil price supercycle, which has had far-reaching consequences for fiscal, energy, and environmental policies in both oil producing and consuming countries since the turn of the 21st century (World Bank 2015a). This supercycle has been characterized by strong average yearly growth in benchmark prices: Brent crude prices increased from \$35 per barrel to \$119 per barrel between mid-2004 and mid-2014. To understand the recent fall in oil prices, it is necessary to understand what has driven the high prices over the last 10–15 years.

Figure 12. Oil Price Movements

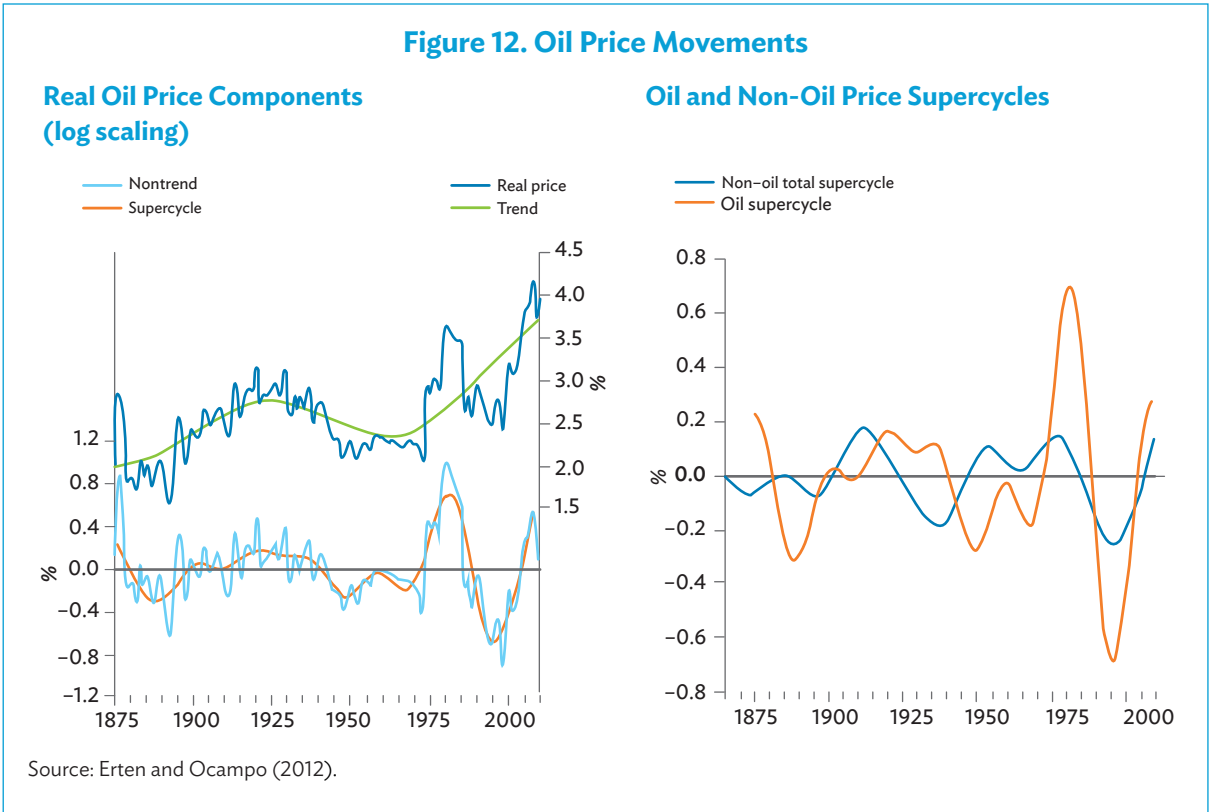
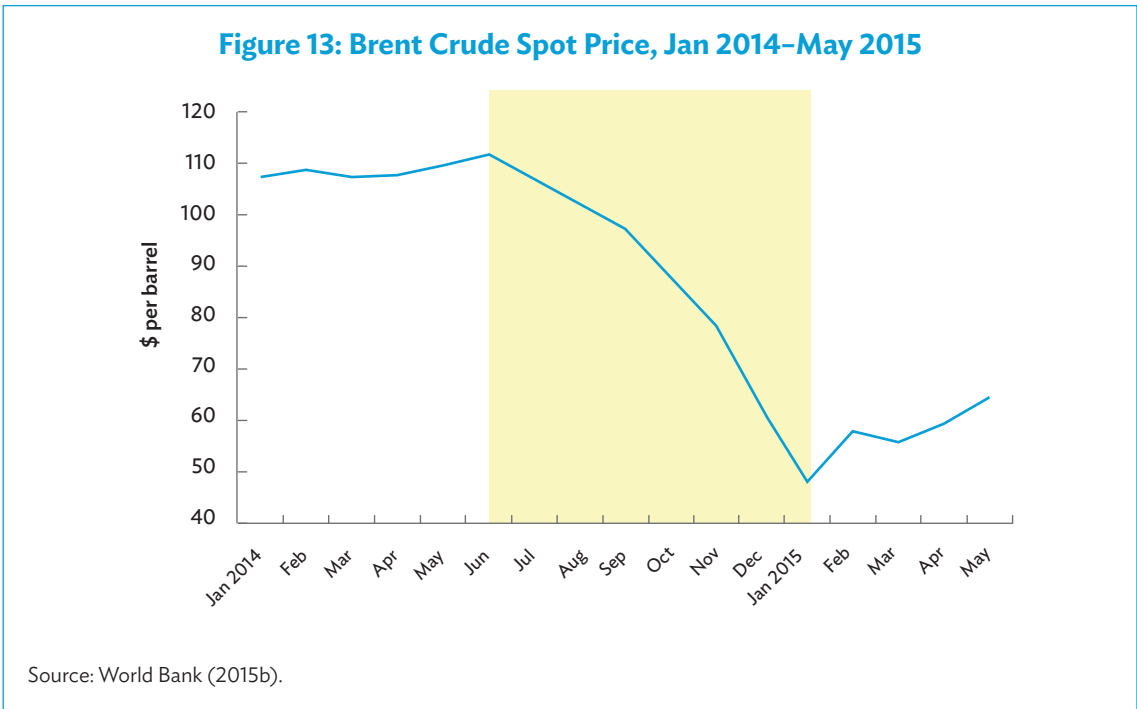
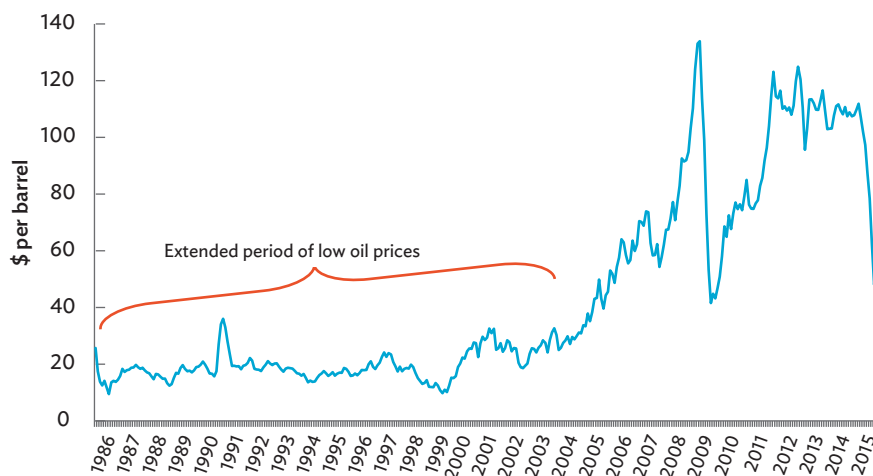


Figure 13: Brent Crude Spot Price, Jan 2014–May 2015



By 2000, with brief exceptions, oil markets had experienced benchmark prices under \$30 per barrel since 1986 (Figure 14). On the supply side, low prices in this period were driven by ample supply from non-OPEC investments made during and after the oil price shocks of the 1970s as well as the related decision by OPEC to maintain market share under conditions of greater competition from non-OPEC supply. One of the key results of low oil prices was the large-scale deferment and cancellation of marginal investments in difficult upstream projects, such as in tight oil, ultra-deepwater sites, and more costly fields in the Arctic, Africa, Latin America, and other regions (Czyzewski 2015).

Figure 14: Brent Crude Spot Price, 1986–2015



Source: World Bank (2015b).

In contrast to the static investment in supply in the late decades of the 20th century, the economic story of the early 2000s was defined by the rapid economic awakening of emerging markets in South, Southeast, and East Asia, particularly the People's Republic of China (PRC).⁹ In a short period, oil markets were forced to accommodate several million barrels per day of additional demand from emerging economies. The PRC alone added 5 million barrels per day to oil demand between 2001 and 2011 (US Energy Information Administration 2014). With supply largely inelastic in the short term and new investments to meet demand requiring long lead times to begin producing, non-OECD demand growth drove the price appreciation after 2004 (IEA 2008). In other words, crude supply—which is slow to change—could not keep pace with strong demand growth, resulting in higher prices. Similar patterns also emerged in other commodity markets. While benchmark prices fell significantly in the aftermath of the 2008–2009 global financial crisis, this was a temporary, demand-driven hiatus between periods in which oil prices were over \$100 per barrel.

But structural changes did emerge on the supply side in the most recent supercycle. Almost consistently high prices in the last 10 years—along with improvements in extraction technologies, especially in hydrofracking and horizontal drilling—encouraged strong investment in the exploitation

⁹ This economic awakening happened, but was less pronounced in Latin America.

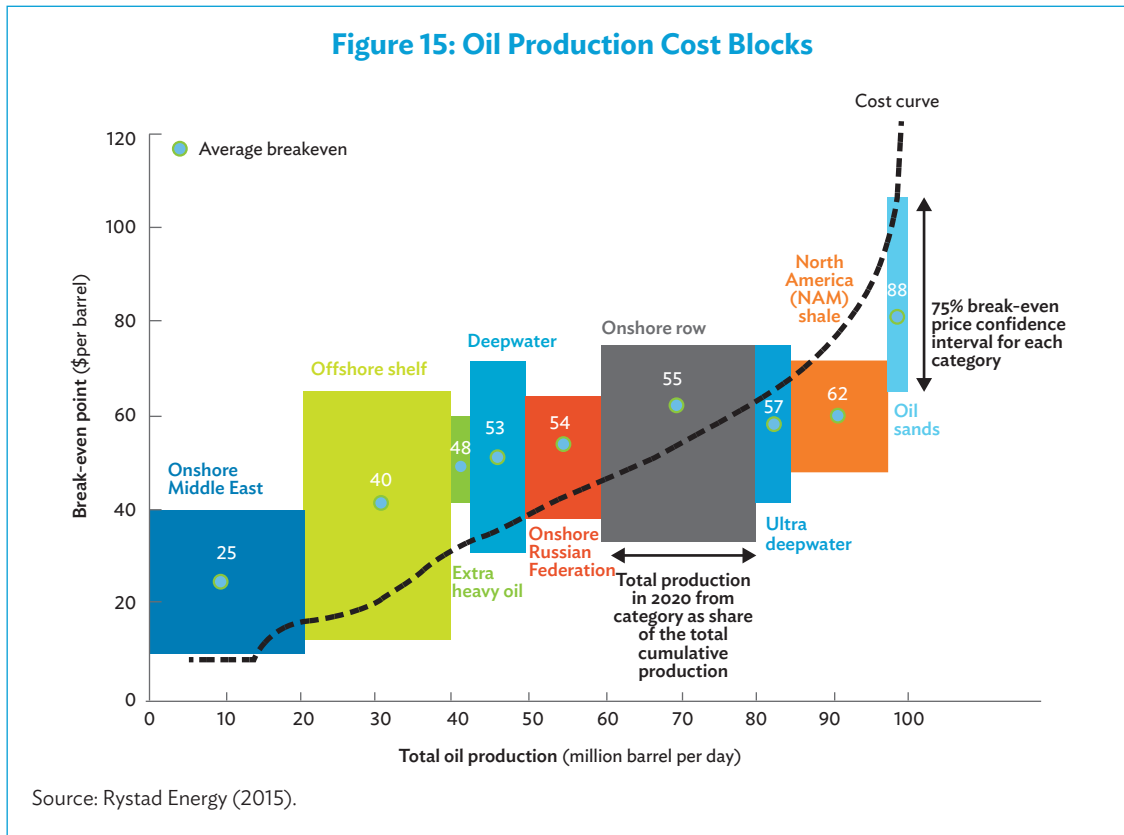
of previously uneconomic and technically difficult crude reserves. The last 10 years have seen the emergence of unconventional oil exploitation (and the United States become one of the world's largest oil producers as a result), production from ultra-deepwater sites such as in Brazil, and the expansion of production from marginal and more costly destinations. This significant supply growth has, in turn, inverted the supply–demand balances that predominated during the first decade of the 2000s (Bloomberg 2015).

Drivers of Recent Oil Price Behavior and the Price Outlook

The remarkable recent fall in oil prices largely reflects the unwinding of the fundamental market conditions that created consistently high prices between 2004 and 2014. While this latest supercycle was defined by the inability of supply to keep pace with runaway emerging economy demand, the supply that has been established from shale and other unconventional sources of crude production is now paired with relatively weak global demand. And this includes the PRC, the country which has effectively driven demand growth and oil price appreciation since the mid-2000s. In explaining the fall in oil prices, the International Energy Agency states that, “weak global demand conditions continue to act as a depressant on prices” (IEA 2015, 5). Key to this has likely been weak growth in the PRC since mid-2014, which has coincided with plummeting prices for most key commodities. The PRC faces serious economic concerns of industrial overcapacity, rising private debt, and a property sector slump, among other things, with 2014 recording the lowest rate of growth since 1990 (*Financial Times* 2014). The IEA has revised down the PRC's oil demand six times since the start of 2014 (IEA 2015), while Platts (2013, 1) predicts that the slowdown now under way could “create turmoil in commodity markets.” While the United States has recorded promising recent growth, the domestic shale oil revolution has significantly reduced its role as a driver of demand in international oil markets.

The strength of crude supply in the Middle East in 2014 exacerbated the price effect of weak global demand, despite considerable geopolitical turmoil in the region. Indeed, this has been compounded by OPEC's unexpected and seemingly permanent decision in November 2014 to avoid production cutbacks, despite significant price weakness, to maintain market share and out-compete marginal non-OPEC production sources (World Bank 2015a). A potent combination of very weak global demand, heavy investment in additional capacity in recent years, and strong ongoing OPEC supply has been driving oil-price dynamics since mid-2014. The year 2014 may well mark the beginning of a new supercycle.

Assuming crude supply is largely inelastic in the short term, and given that production capacity additions are likely to be constrained in a lagged fashion by currently low prices, dynamics in global oil demand are likely to drive long term crude prices. Clearly, long-term trends in total global oil demand will determine the amount of crude markets need. While demand has been weak since mid-2014, the drivers of the recent demand growth—urbanization, wealth creation, and industrialization in emerging economies—are processes that are unlikely to abate suddenly. From current demand of around 93 million barrels per day, it seems likely that the processes driving global growth will push total oil demand over time toward and above 100 million barrels per day, especially if low oil prices spur demand-side investments that lock in higher consumption patterns (IEA 2014b). For oil markets to meet this level of demand, marginal oil fields with high production costs per barrel will need to be exploited (Figure 15). For this to occur, crude prices



will have to adjust upward—and they will do so automatically as growth-driven demand meets price-constrained supply. The IEA (2015, 4) argues that “companies have been taking an axe to their budgets, postponing or canceling new projects, while trying to squeeze the most out of producing fields.” This is likely to be unsustainable. Oil prices will have to rebalance to \$80–\$100 per barrel to foster the “marginal barrel” investments required to meet total global oil demand growth over time (IEA 2014b, 2015).

IEA data show that, with the fall in oil prices, global expenditure on subsidies for fossil fuel consumption fell for the first time in 5 years in 2013, albeit marginally. However, fossil fuel subsidies remain a huge burden on public finances (IEA 2014b). Forecasting oil prices is notoriously difficult. But the current low oil prices are clearly a golden opportunity for countries that subsidize the consumption of oil products to phase out subsidies without consumers bearing the downside economic consequences of reform. India and Indonesia—once two of the world’s largest fuel subsidizers—have done just that, with both using this window of opportunity to significantly reduce fuel subsidies. However, low oil prices also make it cheaper for governments to subsidize fuels, undermining the fiscal pressures for reform. As these pressures ease, governments should not be shortsighted in formulating their energy policy. Oil prices are likely to rise again, so this is a rare chance to improve energy pricing policy without the risk of significant political upheaval.

Political Economy of Reforms in India, Indonesia, and Thailand

As the unprecedented rise in world oil prices crossed \$100 per barrel in the mid-2000s, many Asian governments increased oil subsidies assuming that the rise would be temporary. But as the price continued to climb, subsidies swelled, became unaffordable, and eventually pushed governments to raise domestic prices (Jha, Quising, and Camingue 2009). The fiscal cost of higher fuel subsidies and fuel tax reductions accounted for an average 63% of the total increase in fiscal costs during 2006–2008 (IMF 2008). By not fully passing on the world price rise to domestic consumers, governments risked incurring large fiscal costs and public debt. With the projected increase in developing Asia’s share of world energy consumption from 34% in 2010 to 51% by 2035 (ADB 2013), the fiscal cost of these subsidies will likely multiply.

The value of fossil fuel subsidies worldwide totaled \$548 billion in 2013, about \$25 billion lower than in 2012 (IEA 2014a). The fall was in line with falling international crude oil prices, as well as policy reforms in a number of countries, which offset higher consumption of subsidized fuels (Global Subsidies Initiative 2014a). In 2015, the decline in subsidies is expected to be much sharper—pretax subsidy estimated at \$333 billion by IMF (2015)—as a result of the very steep decline of oil prices in the second half of 2014. The opportunity to lower subsidies augurs well for recent developments in India, Indonesia, and Thailand (Table 15).

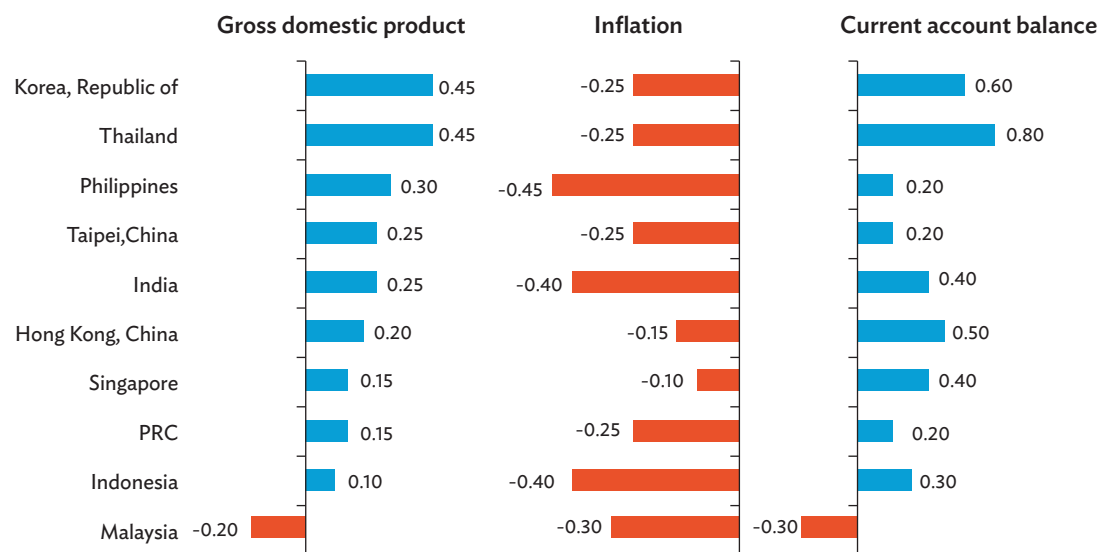
Table 15: Recent Developments in Fuel Subsidy Reforms in India, Indonesia, and Thailand

India	Indonesia	Thailand
<ul style="list-style-type: none"> • Diesel: In October 2014, full price decontrol allowed public sector oil marketing companies to price diesel on a cost-recovery basis. • Natural gas: Revision of prices and adoption of amended market linked pricing. • LPG: Introduction of the Direct Benefits Transfer for LPG and fixing the per unit subsidy for LPG. 	<ul style="list-style-type: none"> • Gasoline and diesel: The removal of subsidies on premium gasoline (although distribution costs outside central Indonesia remain subsidized) and introduction of a “fixed” subsidy on Solar-brand diesel. • Electricity tariffs: For selected user categories, tariffs were increased at various stages in 2014 and in January 2015. 	<ul style="list-style-type: none"> • Diesel and gasoline: In August 2014, modified system of cross-subsidies; in December 2014, petrol and diesel prices were decreased 50 satang (\$0.015). • Natural gas: In October and December 2014, price of compressed natural gas for vehicles increased. • LPG: In December 2014, the subsidy scheme for LPG was removed.

LPG = liquefied petroleum gas.

Sources: Clarke (2014); Global Subsidies Initiative (2015); *Bangkok Post* (2014, 2015); *The Nation* (2015).

Falling crude prices have driven many recent reforms, because they have provided governments with room to change pricing policies without introducing higher domestic energy prices, the main cause of political opposition to subsidy reform. Such price decreases usually have a positive impact on a country’s economy, resulting in stronger GDP, lower inflation, and a higher current account balance (Figure 16). The exception is for net energy exporters, who may see a significant fall in export-related revenues when energy prices are low.

Figure 16: Economic Impacts of a 10% Oil Price Drop on Asian Economies


PRC = People's Republic of China.

Source: Adapted from Yep (2015).

As a major driver of oil demand, a stronger economic performance in the PRC would likely see world oil prices pick up, and oil-importing countries will once again experience the well-recognized challenges of raising fuel prices domestically. The short- and medium-term impacts of higher energy prices—as projected in this study—will create political pressure for reintroducing subsidies. So while low world oil prices are an opportunity for subsidy reform, they may reverse the progress made in consumers getting accustomed to higher oil prices. In Indonesia, for example, gasoline and diesel prices were increased in November 2014, but since January 2015, a series of reductions returned prices to pre-November 2014 levels due to the fall in world crude prices below \$50 per barrel. When oil prices recover, the test for authorities will be whether they can maintain rational, equitable, and cost-reflective energy pricing, or at least maintain the narrower price differentials that have recently been created.

To make the most of this window of opportunity, and to ensure that subsidy reforms are sustainable in the long term, it is important that countries do not just change prices but introduce reforms at a structural level. These reforms include robust independent pricing mechanisms, competitive markets for the distribution and sale of fuel, and the development of nonsubsidy alternatives through the reallocation of subsidy expenditure.

In practical terms, no pricing mechanism is truly independent of government control. But the creation of independent institutions and regulations to govern the setting of domestic prices can reduce government intervention, while emphasizing to the general public that the government does not control the cost of energy. The simple act of deregulating markets for fuel distribution and retail—as India did for gasoline and diesel prices—also distances government from control over energy prices. In Indonesia, where recent reforms resulted in the government announcing updated fuel prices every month, intervention is rather easier.

Investing in nonsubsidy alternatives helps reduce demand for the reintroduction of subsidies by making sure that the impacts of higher prices can be dealt with through other mechanisms. In most countries, this will involve reinvesting subsidy savings into infrastructure that promotes economic growth and social assistance policies that can be used to counteract increases in the costs of living. Understanding the likely impacts of higher prices—through analysis of the kind conducted in this study—is vital to ensuring that such interventions are well-targeted and financed at the right level. Reallocations of this kind are currently taking place in Indonesia, where the government is proposing to adjust its 2015 budget to allow for massive increases in funding to state-owned enterprises for infrastructure. Such reallocation would also show citizens that there are tangible and better ways to spend funds than on fossil fuel subsidies.



7 Summary and Conclusion

Energy consumption in developing Asia is projected to increase sharply as the region's economies continue to grow at a rapid pace. This hunger for energy will be driven in part by low-priced oil, gas, and coal, the dominant sources of electricity production and industrial expansion. However, subsidized fossil fuels encourage their fast depletion and are a major source of greenhouse gas emissions. Moreover, cheap energy benefits the poor the least, while richer classes, benefiting the most due to their higher energy consumption, belong to powerful lobbies that block energy reforms. The rationale for fuel subsidies reform is to discourage energy overuse, reduce the need for energy rationing, improve economic efficiency, and lessen fiscal vulnerability.

This study breaks new ground by quantifying both budget and off-budget subsidies in three large emerging Asian countries: India, Indonesia, and Thailand. Since it is difficult to access data relating to producer subsidies, these were estimated for only one fuel type in each country. Many upstream subsidies could not be quantified and the size of estimated producer subsidies was very low compared with consumer subsidies. The inventory of total subsidies on fossil fuels and electricity in 2012, the latest year for which complete data were available, was 2.7% of GDP for India, 4.1% for Indonesia, and 1.9% for Thailand. Low-priced petroleum products account for the largest share of total subsidies in each of these countries; the next largest item is electricity in India and Indonesia and natural gas in Thailand.

The estimated subsidy inventories for these countries are higher than official figures due to the inclusion of previously unmeasured subsidies. For India and Indonesia, the estimates are higher than the price-gap estimates of the IMF (pretax subsidy) and IEA. For Thailand, they are roughly the same. In all three countries, the cost of fossil fuel subsidies is greater than official development assistance and greater than public expenditure on social assistance programs.

It is necessary to understand how reducing subsidies will impact different parts of the economy to prepare for reforms. The usual simplified input-output-based reform analyses provide only immediate short-term reactions of energy users, which are exaggerated compared to longer-term impacts. Using a combination of short- and long-term economic and energy models, this study shows that over time the new reality of higher-priced fossil fuels spurs users to change behavior and switch to cheaper forms of energy, which encourages investment in clean energy and drives down its cost. In time, the initial exaggerated effects of more expensive fossil fuels are softened as the economy returns to a path of cleaner energy and sustainable fiscal positions.

The energy sector impacts of subsidy reform that emerged from the analysis were generally small for India due to its highly inelastic energy demand and limited potential for fuel switching, particularly in the transport sector. In Indonesia, coal and biomass consumption increased to compensate for decreased consumption of electricity and petroleum products. In Thailand, consumption of coal- and

biomass-based electricity increased to offset reduced consumption of natural gas and petroleum products. So while reforms may cause the level of final energy consumption to change, the use of fossil fuels may simply transition from being a primary source of energy to a secondary one. This will likely happen unless reforms are combined with efforts to increase energy diversification by using the resources freed up from subsidy reduction. However, this use may need to be balanced with other competing demands for subsidy savings, including the reduction of energy poverty through improved energy access and efficiency, and the provision of infrastructure for climate change mitigation and adaptation. The subsidy savings could also be employed to protect poor households from higher energy prices in the short term or for longer-term priorities such as development of health, education, and infrastructure services.

This study focuses on the development of social welfare systems, the priority area. Findings from the analysis of the three countries show that the reallocation of subsidy savings back into the economy through direct or indirect transfers to households can reduce or eliminate initial negative reform impacts on households, especially the poor. The results varied by country, underscoring the fact that the design and implementation of reforms cannot be generalized. The size of subsidies, the types of fuel subsidized, their role in the energy mix and the surrounding economy, and energy infrastructure all play a role in influencing reform outcomes. Social safety net programs in India, Indonesia, and Thailand were found to have limited coverage and were insufficient to support fossil fuel subsidy reforms. Shielding the poor from the adverse impacts of higher energy prices will require a major redesign in safety net programs and substantial increases in their capacity. New or augmented programs will also be necessary to ensure that the poorest are protected.

Recognizing the need for reform, many Asian governments have begun cutting fossil fuel subsidies but implementation has been slow, constrained by economic and political factors. Even so, reform efforts are likely to succeed if they recognize the political economy of subsidy policies and are accompanied by strategies that compensate vulnerable groups and that counter opposition from powerful interest groups. The current low-oil-price scenario is an opportunity to reform subsidies, reduce market distortions, and cut fiscal costs without risking political disruption.

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Appendix 1: How Other Models Assess the Impacts of Fossil Fuel Subsidy Reform

This study focuses on modeling approaches that governments in Asia commonly use. A number of alternative modeling approaches could also be used to assess the social, economic, and environmental impacts of reform. These models, however, may be less well-recognized and understood, and therefore less trusted by policy makers. But further exploration into these models could identify their strengths and weaknesses, and, where appropriate, encourage further use.

- **Price Shifting Model.** Coady and Newhouse (2006) developed a price shifting model that can be applied to the assessment of subsidy reform policies. The model identifies how increases in fossil fuel prices are shifted on to prices in other sectors of the economy. The approach is similar to a social accounting matrix model, but simpler. The same input–output database is used, but only one assumption is made about the relationship between sectors: producers will pass on price rises to consumers if they supply a domestic market, and they will absorb price increases if they supply an export market. The approach is designed to rapidly assess first-order shocks, and relies on as few assumptions as possible.
- **Revised Minimum Standard Model.** A macro simulation tool used for the analysis of macroeconomic policies and financial flows in developing countries. It models national economies by integrating different accounting frameworks (for example, a system of national accounts, public sector accounts, stocks and flows from the monetary sector, and trade flows). The model can help analyze the impacts of changes in subsidies on the fiscal balance, trade flows, external sector accounts, and the real sector (World Bank 2010).
- **ENV-Linkages General Equilibrium Model.** A world general equilibrium model disaggregated by sector and countries and regions. This model has been used to simulate the impact of removing fossil fuel subsidies on greenhouse gas emissions and income up to 2050, comparing results against a baseline scenario. It includes the impacts that fossil fuel subsidy reform in one country or region will have on another country or region (Burniaux and Chateau 2011).
- **Environmental Impact and Sustainability Applied General Equilibrium Model.** A global dynamic computable general equilibrium model designed to analyze the economic impacts of environmental policies. It includes detailed treatment of fossil fuels and alternative technologies, links to greenhouse gas emissions, and standard macro stock-flow relationships (World Bank Data and Research).
- **MARKAL-MACRO Model.** This merges two model approaches—the MARKAL market allocation model, with detailed, explicit, technological representation, and the MACRO macroeconomics model (Manne and Richels 1992), a general equilibrium model that maximizes profit for all economic agents. Merging the two results in a single model captures the characteristics of an intertemporal general equilibrium model while retaining the rich technological detail of MARKAL (Loulou, Goldstein, and Noble 2004).

- **Green Economy Model.** The system dynamics methodology allows development of integrated models that simulate the impact of fossil fuel subsidy removal across economic, social, and environmental indicators. System dynamics models like the Green Economy Model and Targets IMage Energy Regional (TIMER) Model represent key causal relations (that is, the main drivers of change) by explicitly accounting for feedbacks, delays, and nonlinearity through the representation of stocks and flows. They integrate the use of sectoral models and enable the assessment of short-, medium-, and long-term subsidy reform impacts on key indicators, such as energy demand and costs, gross domestic product, income and employment, and emissions (Bassi 2012).

Appendix 2: Main Characteristics of the Reform Impact Models Used in the Three Study Countries

Model	Base year	Household and sectoral disaggregation	Energy sources	Impacts modeled	Reallocation assumptions
India					
Social accounting matrix	2007–2008 with subsidy adjustment	5 rural and 4 urban (employment-based) household groups; 78 economic sectors	Oil, gas, coal, and electricity	Direct and indirect	Compensation to households and reallocation to government budget.
MARKAL	2011	Rural and urban households; residential, commercial, industrial (with energy-intensive manufacturing sectors), and transport	Detailed primary and secondary energy supply	Direct	No compensation and reallocation
E3MG	2011	42 economic sectors, 5 rural and 4 urban (employment-based) household groups	Primary and secondary energy supply (22 different users of 12 different fuel types)	Direct	Compensation to households and budget/deficit reduction
Indonesia					
Social accounting matrix	2008 with subsidy adjustment	4 rural and 4 urban (employment-based) household groups; 25 economic sectors	Liquefied petroleum gas, natural gas for vehicles, gasoline, diesel, kerosene, and electricity.	Direct and indirect	Compensation to households and reallocation to government budget
MARKAL	2010	Agriculture, construction, and households; commercial, industrial (with energy-intensive manufacturing sectors), and transport, with four regions: Java, Kalimantan, Sumatra, and other islands.	Detailed primary and secondary energy supply	Direct	No reallocation
E3MG	2011	42 economic sectors, 5 rural and 4 urban (employment-based) household groups	Primary and secondary energy supply (22 different users of 12 different fuel types)	Direct	Compensation to households and budget/deficit reduction

continued on next page

Table continued

Model	Base year	Household and sectoral disaggregation	Energy sources	Impacts modeled	Reallocation assumptions
Thailand					
Social accounting matrix	2010	Agriculture and non-agriculture, household groups by decile; 10 employment groups; 79 economic sectors	18 sectors, including diesel, natural gas, and electricity	Direct and indirect	Compensation to households and reallocation to government budget
MARKAL	2007 with subsidy adjustment	Rural and urban households; residential, commercial, industrial (with energy-intensive manufacturing sectors), and transport	Detailed primary and secondary energy supply	Direct	No reallocation
CGE	2007 with subsidy adjustment	65 economic sectors (24 agricultural and 41 nonagricultural), 200 household income groups	Petroleum (gasoline, diesel, and natural gas)	Direct	Compensation to households and budget/deficit reduction

CGE = computable general equilibrium, E3MG = energy-environment-economy model at a global level, MARKAL = market allocation model.

Source: Authors.

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Integrative Report

Unsustainable budgetary cost of selling oil, gas, and coal at low prices has propelled energy subsidy reform in developing Asian economies. This report measures the size of associated subsidies on these fossil fuels including direct transfers, tax exemptions, subsidized credit, and losses of state enterprises in India, Indonesia, and Thailand. An analysis of complex interactions between economic, social, energy, and environmental issues shows that the initial rise in energy prices due to a reduction or removal of the subsidies will nudge households and businesses to shift to alternative fuels, make investment in clean energy attractive, increase energy supply, reduce energy shortages, and cut greenhouse gas emissions. Using the money freed up from subsidies to compensate poor households and to increase government budgets will offset the negative effects of the initial price rise, promote sustainable energy use, and help allay the fears of reform.

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