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N O R D I C W O R K I N G P A P E R S

Fossil-Fuel Subsidies and Climate Change

Options for policy-makers within their Intended Nationally Determined Contributions

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Executive Summary

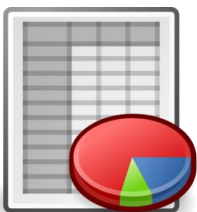




In 2014 almost 30 countries, including Egypt, Indonesia and India, delivered some form of fossil-fuel subsidy reform (FFSR). Current low oil prices make the removal of consumer fossil-fuel subsidies to the public easier because, depending on the level of subsidies, pass-through costs to the consumer are lowered. As a result, many countries that maintain subsidies to oil, gas, diesel, coal and electricity generated from such fuels will be considering or undergoing reform in the near future. Removal of fossil-fuel subsidies leads to domestic national emissions reductions in greenhouse gases (GHGs). Parties can use the opportunity, around current and planned reforms, and include such plans and expected emissions reduction estimates within their Intended Nationally Determined Contributions (INDCs).

Different analyses find that by removing subsidies to fossil fuels (consumer subsidies stood at \$543 billion in 2013 [International Energy Agency, 2014a]) we would see a decrease in global GHG emissions of between 6 and 13 per cent by 2050. Yet, such models are likely to be an underestimate as they are based on consumer subsidies only (they do not include the removal of producer subsidies) and only represent the effect of reductions in demand based on a price increase. In fact, on the policy side, a cap on emissions in Organisation for Economic Cooperation and Development (OECD) countries, coupled with multilateral action on reform, would increase the percentage reduction in emissions achieved from phasing out fossil-fuel subsidies. There are opportunities on the budgetary side as well, as removing fossil fuel subsidies also frees up significant and precious government resources. Finance that has then been invested by governments into social safety nets could also be reinvested into energy efficiency and sustainable energy for all, leading to low-carbon energy pathways. Crucially, in order for countries to gain the greatest emissions reductions from reform and to change a relatively unchanged global energy mix, governments must simultaneously invest in energy and transport infrastructure to enable switching towards a more diverse energy mix with lower-carbon options. Finally, the secondary effects from the removal of fossil-fuel subsidies on GHG emission reductions are likely to also be important and could potentially help lift the lid on growth in low-carbon energy systems. These are also often not recognized in current reduction estimates. One piece of research finds that the presence of fossil-fuel subsidies drove 36 per cent of global carbon emissions between 1980 and 2010 (Stefanski, 2014).

This paper looks at research concerning the removal of fossil fuel subsidies and the implications for GHG emissions. It then outlines a process for countries to include FFSR and emission reductions in their INDCs and proposes actions for policy-makers to support a United Nations Framework Convention on Climate Change (UNFCCC) agreement in 2015 (see Table ES1).

Current fossil-fuel subsidies lock us into a high-carbon energy world. Removing subsidies to fossil fuels is one of the keys to unlocking our dependency on carbon and represents an opportunity to open the door on a low-carbon future.

Table ES1. Summary of potential actions regarding FFSR and climate change

Climate Change Process	Inclusion of Fossil Fuel Subsidy Reform
	<p>Intended Nationally Determined Contributions (INDCs)</p> <p>Global emissions reductions of between 6 and 13 per cent are estimated from the phase-out of fossil-fuel subsidies. Parties aiming to reform fossil-fuel subsidies in the short to medium term could include estimates from emissions reductions from FFSR within INDCs for pre-2020 and post-2020 actions. Estimates of the impact of FFSR on national GHG emission reductions can be made using economic and energy models, for example with the Global Subsidies Initiative Integrated Fiscal (GSI-IF) Model.</p>
	<p>2015 UNFCCC Agreement</p> <p>The current negotiating text, <i>Lima Call to Action</i>, includes references to fossil-fuel subsidies and negotiators should try to maintain this text. Carbon pricing is also recognized within both the preamble and financing sections and should also remain. Fossil-fuel subsidies are a form of negative carbon pricing. Negotiators should consider explicitly adding FFSR wording alongside carbon pricing. FFSR is no substitute for a global agreement and defined policy targets for emission reductions. Emission reductions from subsidy reform are increased in the presence of such a cap.</p>
	<p>Technical Experts Meeting (TEM)</p> <p>In Lima, parties called for a TEM on policy options such as carbon pricing and the removal of fossil-fuel subsidies, and more parties could call for such a TEM. The official side events at the UNFCCC for the past four years on FFSR organized by the Global Subsidies Initiative and Friends of Fossil Fuel Subsidy Reform could be built on.</p>
	<p>Nationally Appropriate Mitigation Actions (NAMAs)</p> <p>Fossil-fuel subsidy reform can be included as a NAMA routed within practical projects and programs that both directly enable smooth reforms and are designed to maximize national emission reductions and energy transition pathways alongside reform through complimentary low-carbon energy and transportation investments. These NAMAs can be based on existing transportation and energy sector NAMAs.</p>
	<p>Domestic Savings</p> <p>FFSR will unlock significant savings for governments in the longer term that can be used to support government priorities including national climate mitigation and adaptation strategies. Donor funding can support the process of reform. Countries can consider the reinvestment of subsidy savings back into national energy systems and low-carbon energy pathways. Currently, total funding for technical advice on FFSR is between US\$8 million and US\$10 million a year, in comparison to the subsidies themselves of US\$543 billion.</p>

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1 *Global Estimates of Greenhouse Gas Emission Reductions from FFSR*

Government support and subsidies to fossil fuels have an impact on the level of use of such fuels within the economy and therefore on the carbon emissions stemming from them. There are a number of estimates as to their size globally. Recent estimates from the IEA suggest that global subsidies to consumers stood at US\$543 billion in 2013 (International Energy Agency [IEA], 2014a) and around \$480 billion of pre-tax subsidies in 2011 (International Monetary Fund [IMF], 2013). As such subsidies act as a negative fuel tax, they work as a negative price on carbon. These are subsidies that nations can no longer afford.

Energy accounts for almost 70 per cent of human-induced carbon dioxide emissions, and of this 82 per cent of world energy supply is based on fossil fuels (IEA, 2014b). In 2012, 13 per cent of total carbon dioxide emissions were from transport (IEA, 2014b). Road transport is driving the growth in transport emissions. Carbon dioxide emissions from electricity and heat almost doubled between 1990 and 2012 and now stand at 42 per cent of world carbon dioxide emissions (IEA, 2014b). This is driven by a large increase in the generation of electricity from coal. Coal is nearly twice as emission-intensive as gas, and in the last 10 years coal has overtaken oil in terms of share of global carbon dioxide emissions. Indeed, coal represents 44 per cent of global carbon dioxide emissions from energy due to the heavy carbon content per unit of energy. Over the years, there has been some decoupling of economic growth from energy use, but the carbon intensity of the overall global energy mix remains unchanged. This, coupled with increasing wealth and population, is driving increased carbon dioxide emissions (IEA, 2014b).

If we aim to reduce global emissions in order to limit global warming to less than 2°C above pre-industrial levels, then the energy sector is of paramount importance. A critical change will be national fuel switching away from carbon-intensive sources and efforts towards increasing energy efficiency. Subsidies and support from government to fossil fuels encourage the opposite. Consumer subsidies encourage increased use of fossil fuels and decreased attention to energy efficiency by sending the wrong market signals to consumers and producers alike. Fossil-fuel subsidies act as a negative, rather than a positive, price on carbon. Currently, society significantly underprices carbon. If the wider social costs of fossil fuels within our energy systems are included (i.e., externalities of global warming, public health from local air pollution, traffic congestion and accidents), then carbon pricing amounted to US\$2 trillion in post-tax subsidies in 2011 (IMF, 2013). Particularly important from a greenhouse gas (GHG) emissions perspective are those fossil-fuel subsidies linked back to coal (for example through producer subsidies or to electricity systems based on a centralized thermal grid) and to petroleum (to consumers, the largest share of measured consumer subsidies, but also to producers for exploration and production).

Consumer subsidies to fossil fuels and GHG emissions reductions: In 2010 the Global Subsidies Initiative (GSI) did a comprehensive survey of the analysis undertaken in the past to quantify the economic and environmental consequences of fossil-fuel subsidies at the world level (Ellis, 2010). This report updates



that research from the perspective of the impact on GHG emissions. A number of studies provide research as to the effect of removing subsidies to fossil fuels with a focus on GHG emissions reductions:

- An 8 per cent reduction in global GHG emissions or 6.1 gigatonnes of carbon dioxide (by 2050) from a staggered removal of consumer fossil-fuel subsidies based on 2008 subsidy figures (including an emissions cap on Organisation for Economic Co-operation and Development [OECD] countries and Brazil, increases the reduction to 10 per cent) (Burniaux & Chateau, 2014).
- A 13 per cent decrease in carbon dioxide emissions based on global removal of consumer pre- and post-tax fossil-fuel subsidies (IMF, 2013).
- A 12 per cent reduction in energy sector emissions by 2020, equivalent to a reduction of carbon dioxide emissions of 369 million tonnes (Mt), from accelerating the (partial) phase-out of subsidies to fossil-fuel consumption (part of the IEA's 4-for-2°C scenario, which also includes energy efficiency [49 per cent], limiting construction and use of least-efficient coal-fired plants [28 per cent], and minimizing methane emissions from upstream oil and gas production [18 per cent]) (IEA, 2013)
- A 6.4 per cent GHG emissions reduction by 2050 based on removing all consumer subsidies by 2020 (Schwanitz et al, 2014).
- 36 per cent of global carbon emissions between 1980 and 2010 were driven by subsidies to fossil fuels (Stefanski, 2014).
- An 8 per cent reduction in carbon dioxide emissions from a phase-out of coal subsidies (production and consumption) in OECD and non-OECD countries (Anderson & McKibbin, 1997).
- Country-specific reductions: China, a 3.72 per cent carbon dioxide reduction between 2006 and 2010 (Lin & Ouyang, 2014); India, a 1.3 to 1.8 per cent reduction, 2031 (Asian Development Bank [ADB], forthcoming), Indonesia, a 5.3 to 9.3 per cent reduction by 2030 (ADB, forthcoming); Thailand, a 2.8 per cent reduction by 2025 (ADB, forthcoming).

For a table covering these models, see Appendix 1.

The main caveats with regard to these global estimates are the following:

- **Producer subsidies are not included** because they are often not quantified and therefore all estimates are likely to be underestimates of the level of GHG emissions reductions that could be achieved if both consumer and producer subsidies to fossil fuels were removed.
- Removal of fossil-fuel subsidies is no substitute for a defined policy target for emissions reductions. With an **agreement and a cap on emissions in place across OECD countries, further emission reductions are gained** from reform (from 8 per cent to 10 per cent) by reducing “carbon leakage.”
- Emission reductions estimates are based on economic models built on historical trends and using price elasticities of fuels that are often inflexible, based on the current fuel mix, which means there are limited options for switching. **Governments could invest in infrastructure, increase the potential for substitution and enable switching into low-carbon public transportation and electricity systems.**



- Positive effects from the removal of subsidies to fossil fuels are likely to be felt domestically on **energy and fuel efficiency and through substitution from fossil fuels to cleaner alternatives**, increasing economic competitiveness in international markets.
- A combination of the **removal of subsidies and the correct pricing of carbon on fossil fuels would reduce emissions by 23 per cent** in 2010 (IMF, 2014).
- Countries with consumer subsidies who reduce them **would gain from emission reductions and from government savings**, rather than those that have already removed consumer subsidies.

It is clear that global (and for some models partial) removal of consumer subsidies to fossil fuels will result in global and domestic reductions in GHG emissions. For further discussion of issues raised within the models, see Section 4. Assessments are likely to be underestimated as they do not consider the removal of producer subsidies. Many countries are reviewing and reforming their subsidies to fossil fuels. This presents parties with an opportunity to factor emission reductions from reforms into their INDCs.

Country data for fossil-fuel subsidy figures:

IMF: <http://www.imf.org/external/np/pp/eng/2013/012813.pdf>

OECD: <http://www.oecd.org/site/tadffss/>

IEA: <http://www.iea.org/subsidy/index.html>

GSI: <http://www.iisd.org/gsi/interactive-maps>

ODI/OCI: <http://www.odi.org/g20-fossil-fuel-subsidies> (producer G20)

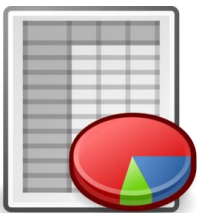




2 Utilizing FFSR within the UNFCCC

Under the **Ad Hoc** Working Group on the **Durban Platform** for Enhanced Action (ADP) of the United Nations Framework Convention of Climate Change (UNFCCC), there are two primary objectives: Workstream 1, negotiating a new international climate change agreement, protocol or other legal instrument to be signed in 2015 and take effect in 2020, and Workstream 2, increasing pre-2020 ambition in the near-term with a view to keeping average temperatures from rising more than 2°C above pre-industrial levels.

Fossil-fuel subsidy reform (FFSR) can play an integral role in both Workstream 1 and 2. Under the new agreement, there is scope for including FFSR in the preamble, financing sections, Intended Nationally Determined Contributions (INDCs) and elsewhere. Under Workstream 2, FFSR can contribute significantly to increasing pre-2020 ambition—especially because it is a measure that is ready and available to be deployed today. Jakob et al. (2014) point to FFSR, along with decentralized modern energy for rural areas and fuel switching in the energy sector, as one of three feasible mitigation policy instruments to help reach a 2°C target. IEA (2013) points to FFSR as one of the 4-for-2°C policy options for reducing emissions from the energy sector. The process by which national policy-makers and negotiators can consider this within the UNFCCC negotiations and within their INDCs is outlined Table 1.



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	<p>Technical Experts Meeting (TEM)</p> <p>In Lima, parties called for a TEM on policy options such as carbon pricing and the removal of fossil-fuel subsidies, and more parties could call for such a TEM. The official side events at the UNFCCC for the past four years on FFSR organized by the Global Subsidies Initiative and Friends of Fossil Fuel Subsidy Reform could be built on.</p>
	<p>Nationally Appropriate Mitigation Actions (NAMAs)</p> <p>Fossil fuel subsidy reform can be included as a NAMA routed within practical projects and programs that both directly enable smooth reforms and are designed to maximize national emission reductions and energy transition pathways alongside reform through complimentary low-carbon energy and transportation investments. These NAMAs can be based on existing transportation and energy sector NAMAs.</p>
	<p>Domestic Savings</p> <p>FFSR will unlock significant savings for governments in the longer term that can be used to support government priorities including national climate mitigation and adaptation strategies. Donor funding can support the process of reform. Countries can consider the reinvestment of subsidy savings back into national energy systems and low-carbon energy pathways. Currently, total funding for technical advice on FFSR is between US\$8 million and US\$10 million a year, in comparison to the subsidies themselves of US\$543 billion.</p>



2.1 FFSR Within the 2015 Agreement

The outcome of COP20 was the *Lima Call for Climate Action*, which sets in motion the negotiations in 2015 for a new international climate change agreement. Within this negotiating text, there is currently a reference to FFSR:

- “53.1 With regard to private and alternative finance... d. The phasing down of high-carbon investments and fossil fuel subsidies” (UNFCCC, 2014a, 23)

Supportive parties should advocate for this option to remain in the text and add additional content on the role of FFSR as a source of finance.

In addition to the reference to FFSR, there are also references to carbon pricing in the preamble:

- “Acknowledging that carbon pricing is a key approach for cost-effectiveness of the cuts in global greenhouse gas emissions” (UNFCCC, 2014a, 6).

In addition, the Finance section states:

- “44. The contribution of resources under this agreement to consider predictable financial contributions by developed country governments; increasing options for leveraging a greater share of the carbon market-related proceeds including option for carbon pricing and raising contribution via alternative and innovative sources of finance” (UNFCCC, 2014a, 22).

Parties could consider making an explicit reference to FFSR alongside the carbon pricing references, or may choose to support carbon-pricing language as it stands, as an implicit reference to FFSR that acts as a negative price on carbon. Both FFSR and the introduction of taxation on fossil fuels—be that a value-added tax, a goods and services tax or a carbon tax (i.e., correct carbon pricing)—will act to increase price, reduce demand and reduce emissions.

2.2 FFSR Within INDCs

INDCs are an integral part of the 2015 UNFCCC agreement. Parties agreed to submit their INDCs well in advance of the 21st Conference of the Parties (COP 21) in Paris; however, views remain divergent in terms of the scope and nature of INDCs. There is also lack of consensus on specific criteria and information to be provided. While these issues may create issues of comparability among INDCs, the lack of standardization leaves increased flexibility for countries to include the types of information they deem useful. Thus, in line with the G20 commitment to phase out inefficient fossil-fuel subsidies, G20 countries and Friends countries¹ could commit to including FFSR in their respective INDCs. This could be achieved through describing plans to reform producer and consumer subsidies and through estimating emissions reductions from these policy changes.

Emerging and developing countries could also include estimated emission reductions from recent, anticipated and planned subsidy reforms within their INDCs. Parties may put forward a combination of

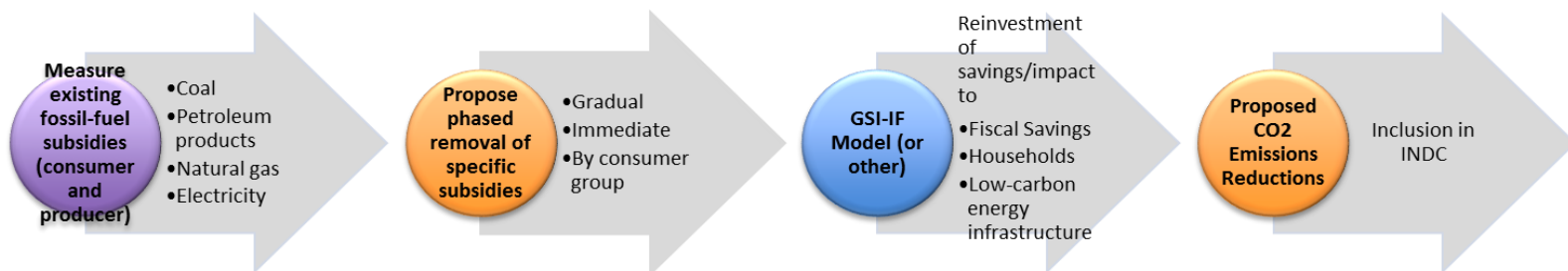
¹ The Friends of Fossil-fuel Subsidy Reform countries are Costa Rica, Denmark, Ethiopia, Finland, New Zealand and Norway, Sweden and Switzerland.



mitigation actions and outcomes. Whether parties choose to put forward individual actions as INDCs with the expected outcomes, or put forward INDCs in the form of outcomes with a list of key policies and actions to meet the target (World Resources Institute, 2014), there is scope in either approach to include FFSR activities. The IEA includes the phase-out of fossil-fuel subsidies as part of the “mobilization of non-climate goals to promote energy sector emissions reductions” included within *Five Key Actions to Achieve a Low-Carbon Energy Sector* (IEA, 2014c).

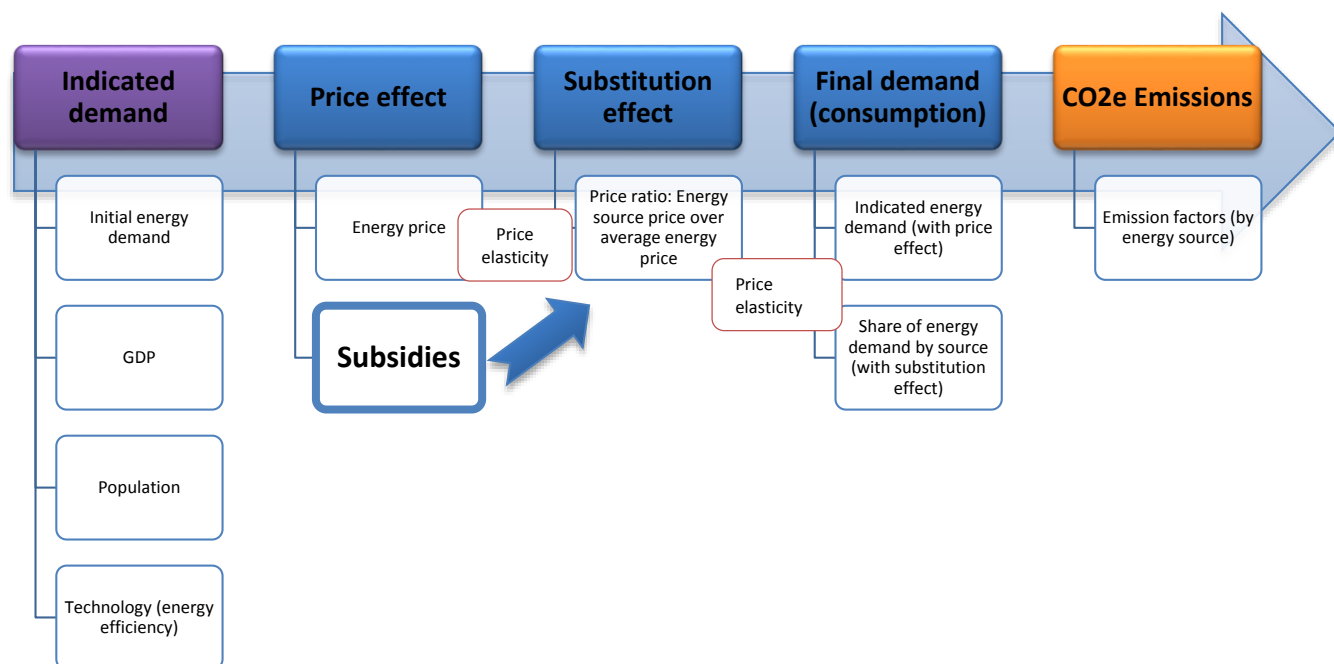
Should countries decide to include FFSR as part of an overall package of policies towards their INDCs, then countries should estimate the emissions reductions stemming from the removal of subsidies. This can be calculated using economic and energy models such as the Global Subsidy Initiative’s Integrated Fiscal Model (GSI-IF Model) or through other available models described in Appendix 1 through the process illustrated in Figure 1 below. An outline of the GSI-IF model is illustrated in Figure 2. Country estimates for the removal of fossil-fuel subsidies for various countries are freely available to country negotiators from the GSI.²

Figure 1. Process for including FFSR within INDCs



² For more information, contact lmerrill@iisd.org

Figure 2. Outline of the GSI-Integrated Fiscal (GSI-IF) Model for estimating GHG emissions reductions from removal of fossil-fuel subsidies or an increase in fossil-fuel taxation (value-added tax, goods and services tax or carbon tax)



Source: Based on GSI Integrated Fiscal (GSI-IF) Model

There is an opportunity to include measured GHG emission mitigation from FFSR within INDCs from subsidies to both producers and consumers, covering developed and developing countries. The G20 and Friends countries can “lead by doing” through publishing and highlighting existing public information in this area from their own countries, made available through both peer review and self-reporting. Friends can also reflect any recent FFSR efforts within their own INDCs. Furthermore, *Lima Call for Climate Action* states that least-developed countries and Small Island Developing States may communicate information on strategies, plans and actions for low GHG emission development, reflecting their special circumstances; thus, these countries could also include FFSR plans and actions within their INDCs.

2.3 FFSR Through a Technical Experts Meeting

FFSR can contribute significantly to increasing pre-2020 ambition to decrease GHG emissions. Eliminating fossil-fuel subsidies is a measure that is cost-effective (generates savings) and readily available to be



deployed today with immediate impacts, thus it is an ideal policy approach to be showcased as part of Workstream 2's Technical Expert Meetings (TEMs).

At COP 20, many parties described the TEMs as useful and supported their continuation. The COP agreed to:

- “continue the technical examination of opportunities with high mitigation potential, including those with adaptation, health and sustainable development co-benefits, in the period 2015–2020, by requesting the secretariat to: (a) Organize a series of in-session technical expert meetings which:
- (i) Facilitate Parties in the identification of policy options, practices and technologies and in planning for their implementation in accordance with nationally defined development priorities;
- (ii) Build on and utilize the related activities of, and further enhance collaboration and synergies among, the Technology Executive Committee, the Climate Technology Centre and Network, the Durban Forum on capacity-building, the Executive Board of the clean development mechanism and the operating entities of the Financial Mechanism;
- (iii) Build on previous technical expert meetings in order to hone and focus on actionable policy options;
- (iv) Provide meaningful and regular opportunities for the effective engagement of experts from Parties, relevant international organizations” (UNFCCC, 2014b, 3).

Based on the significant potential of FFSR, a TEM on this topic would be highly beneficial. At COP 20, Norway, New Zealand and Switzerland called for adding sessions on carbon pricing and removal of fossil-fuel subsidies. Other Friends and parties could make similar statements and submissions calling for a TEM on FFSR. A TEM on fiscal instruments that could capture carbon pricing and subsidy reform would be of most use.

2.4 FFSR as a Nationally Appropriate Mitigation Action

Nationally Appropriate Mitigation Actions (NAMAs) are policies and actions that countries undertake to reduce GHG emissions within the context of sustainable development (UNFCCC, 2010). By definition, NAMAs aim to identify and implement development actions that are less GHG intensive compared to conventional practices. In this way, actions prioritized in NAMAs can be seen as clean development actions that extend beyond only efforts to reduce GHGs. In order to ensure the NAMAs can deliver both on achieving GHG reductions and promoting development, they need to provide transformational impacts and contribute to sustainable development.

Interested developing countries can play a key role by developing FFSR into NAMAs. As the NAMA mechanism is scaled up, a country implementing FFSR as a NAMA can be considered for technical and financial support.

Given the large mitigation potential of FFSR, as well as other benefits (such as investment in social safety nets and potentially in low-carbon infrastructure), parties should recognize that some countries may find it to be an appropriate and effective method of emissions reduction and sustainable development. Parties

should help ensure that assistance is available to those countries requesting reform be a supported NAMA. Currently, almost 50 energy and transportation sector NAMAs submitted to the UNFCCC registry are seeking donor support.

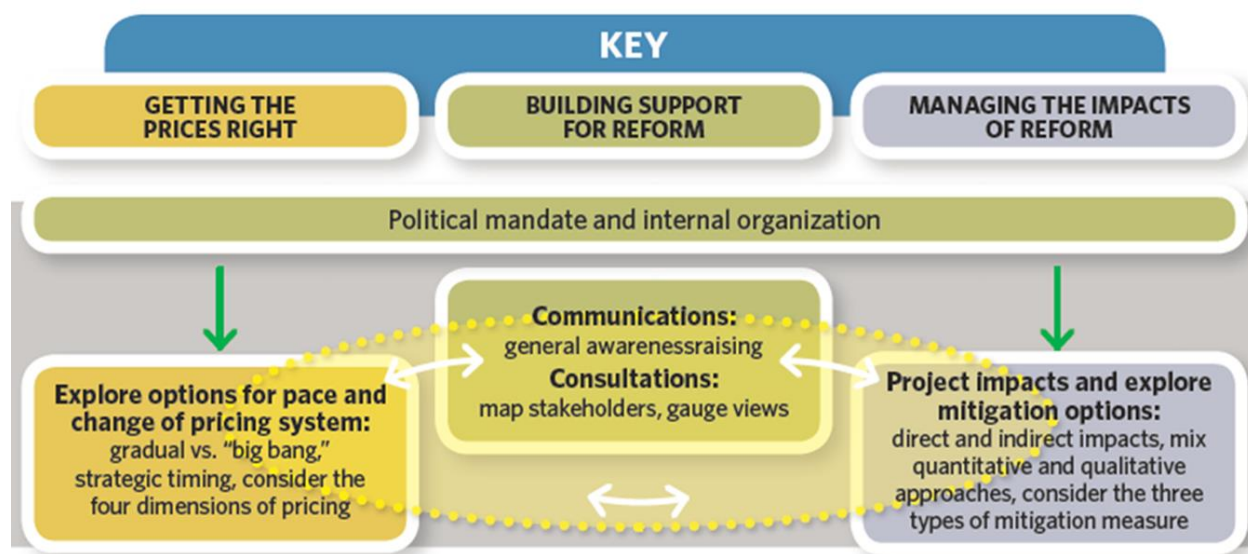
There are many forms assistance could take. Among them might be: providing expertise and tools for modelling impacts; help in rolling out social welfare programs to minimize any negative impacts on vulnerable groups that may emerge in the short term; resources for expanding public transport networks; funding for energy-efficiency improvements and renewable energy deployment alongside FFSR so that subsidy reform does not compromise, but rather aims to expand energy access; and recommendations on effective communications strategies (Benninghoff, 2013). For example, specific switching from kerosene to liquid petroleum gas for cooking projects has been very successful in Delhi. Countries could also consider rural fuel switching for lighting from kerosene to solar before or during the process of phasing out subsidies.

2.5 Domestic Savings

While consumer subsidy savings to governments themselves can be significant (for example, between 5 and 30 per cent of government expenditure in some Southeast Asian countries) (Merrill, 2014), they cannot be released or utilized until subsidies to fossil fuels have been dismantled. Support to enable technical advice on reform; sequencing and implementation of energy pricing; building support and communications about reform; and mitigating impacts of reform (see Figure 3) could be made available to countries in order to then release future savings. Technical assistance is available from various international organizations, such as the World Bank, OECD, IEA, IMF and GSI. Current global donor funding to support the smooth transition of government-led FFSR amounts to US\$8 million to \$10 million a year. This is tiny in comparison to current consumer fossil-fuel subsidies (US\$543 billion a year). Yet, the World Bank funded social safety nets between FY2007 and FY2013 of between US\$12 billion across 93 countries (World Bank, 2014). Developing and building such safety nets with governments enables countries to shift from a benefits system based on the receipt of so-called “universal” fossil-fuel subsidies to building targeted social welfare assistance based on need during the process of reform. Much of the focus of research around subsidy reforms has focused on impacts on the economy and on society—especially with regard to reforms in particular industries (public transport or manufacturing) or around reallocation of savings into targeted cash transfers or infrastructure so as to maximize positive and reduce negative impacts on both economic growth and poverty. Similar consideration and discussion around the impacts on emissions and energy investments should be taken into account within the process of reform. As with safety nets, support is also needed to enable governments to explore reinvesting some of the savings from energy sector reforms back into the energy sector itself—be that in electricity production, lighting, cooking, transport systems, etc.—and consider those low-carbon options available to countries alongside the process of reform. Investing in energy efficiency and renewable energy alongside reform is in fact expected to limit any short-term negative economic impact of subsidy removal and generate several medium- to long-term benefits (including employment). Institutions that disburse finance, such as the

Green Climate Fund and others, could consider the value of FFSR within their portfolio, given the potential emission reductions linked to reform.

Figure 3. Three Pillars of FFSR



Source: Beaton et al. (2013)

3 Maximizing Emission Reductions from FFSR

This section covers in more detail some of the issues that the models raise (see Section 1), including the issue of producer subsidies, a cap on emissions, reinvestment of subsidy savings, secondary effects, oil price, additional taxation and distribution.

Producer subsidies: Estimates of GHG emissions reductions from the removal of all fossil-fuel subsidies from models are likely to be underestimated because our research shows that scenarios focus on removing subsidies only to consumers for oil, gas and electricity, and do not include subsidy removal to producers. Very few estimates of the removal of fossil-fuel subsidies include the effect of the removal of production subsidies, upstream to producers, on emissions reductions (ADB figures for Indonesia do include removal of some production subsidies). Yet subsidies can encourage exploration and extraction in places such as the Arctic (Lunden & Fjaertoft, 2014). Research finds that “globally, a third of oil reserves, half of gas reserves and over 80 percent of current coal reserves should remain unused from 2010 to 2050 in order to meet the target of 2°C” (McGlade & Ekins, 2015). Furthermore, “development of resources in the Arctic and any increase in unconventional oil production are incommensurate with efforts to limit average global warming to 2°C.” Fossil-fuel subsidies to exploration play a role in ensuring continued access and exploitation to such resources, rather than limiting them.



Subsidies to producers are significant and often found in developed countries. There are few estimates as to the subsidies themselves because they are complex and often opaque. Production subsidies have been estimated by the GSI to stand at around US\$100 billion globally (GSI, 2010b) and at around US\$88 billion annually across the G20 for fossil-fuel exploration and production (OCI & ODI, 2014). The fact is that nobody knows the global cost of government subsidies to fossil-fuel producers because, as yet, there is no international figure or assessment. The OECD does include some nationally self-reported producer subsidies within OECD country assessments of government support to fossil fuels (OECD, 2015). Producer subsidies cover a wide range of support mechanisms, including direct or potential direct transfers, government revenue forgone, government provision of government purchased goods and services, and direct income or price support (GSI, 2010a). More transparency and research are needed to measure the level and impact of production subsidies with regard to driving exploration, production, price and demand in fossil fuels globally.

The necessity of a climate policy agreement and cap: Removal of fossil-fuel subsidies is no substitute for a defined policy target for emission reductions. All global models consider different scenarios—for example, if subsidy reform takes place unilaterally or multilaterally, or under a capped climate policy regime or not. This matters with regard to the impact of subsidy reform on changing oil prices in the global market. Past estimates from the OECD (2009) have found improved GHG emissions reductions from FFSR of around 10 per cent from the removal of fossil-fuel subsidies from a number of non-OECD countries could be achieved if, in parallel, emissions are also capped in OECD countries. A re-run of the model in 2014 removed the cap and resulted in lower emissions reductions from subsidy removal of 8 per cent. This is because a lower oil price linked to subsidy removal in non-OECD countries could imply an increased use in countries that do not subsidize consumers or do not remove their subsidies (carbon leakage or the rebound effect). The research states that by building in “binding emission caps in OECD countries, carbon leakages would be contained, and the environmental benefits from subsidy removal would be larger,” increasing reductions from the 8 per cent to 10 per cent (Burniaux & Chateau, 2014). Different research “confirms the short-term benefits of phasing out fossil-fuel subsidies found in prior studies’ but stresses that “these policies are only sustained to a small extent in the long-term if dedicated climate policies are weak or non-existent” (Schwanitz et al., 2014). It also finds that “despite the leakage effect, on the global level, net emissions reductions are seen” and therefore that “leakage does not provide a convincing counter-argument to phasing-out of subsidies. The leakage effect is overcome by climate policy” (Schwanitz et al., 2014).

Price elasticities: The impact on emissions from a change in price is linked to own price elasticity of fuels (the level of changes in demand based on changes in price) and on cross-price elasticity (the changes in demand and price in other fuels as a result of consumers switching between fuel types). Price elasticities are generally lower in the short term and higher in the long term. Suffice to say that although economic models include price elasticities, the effect of fossil-fuel subsidies themselves leading to persistent lower prices could be entrenching the estimated low-price elasticities into energy demand and supply and acting

as a break on consumers switching between fuels, cleaner technologies and investment in other energy types.

Research from the World Bank in 2008 estimated the own-price elasticities of demand for a number of fossil fuels, suggesting that the fuels might be becoming slightly more price-elastic. This may also be linked to an increase in energy prices from 2000 to 2008. Furthermore, where it is possible for consumers to switch fuels, assumptions regarding the cross-elasticities of demand of different fossil fuels become critical. Cross-elasticities of demand relate to how much the demand for a specific good changes when the prices of other goods change. Normally, when prices for a given fuel rise, demand for competing fuels increase (IEA, 2007). If countries are concerned with maximizing emissions reductions from FFSR, then part of the effort must be focused on investment in low-carbon infrastructure in order to enable higher elasticities for both transport fuels and for electricity (with regard to the fuel types supplying electricity). In other words, a change in price in fossil fuels can lead to behaviour changes of both a decrease (demand) and change in consumption (switch) because other options have been planned for and made available. For example, if a commuter uses a private vehicle running on gasoline to get to work, and the price of gasoline increases due to subsidy removal (or an additional tax), the accessibility of good public transportation infrastructure or alternative low-carbon transport fuel types, will enable the commuter to switch to other modes of transport and, in the longer term, to more fuel-efficient or cleaner-fuelled cars. By actively investing in public transportation infrastructure at the same time as reducing fossil-fuel subsidies and increasing conventional taxation on transport fuels, governments could reduce demand (energy saving) and encourage switching, and therefore could potentially influence and increase emission reductions from subsidy reform.

Reinvestment of savings from subsidy reform towards low-carbon options: In order to actively reduce emissions, part of the process of FFSR must include ring-fencing savings from subsidy removal and re-investment in energy efficiency and a more diverse energy and transport mix from a high-carbon trajectory to a low-carbon pathway. This will maximize emissions reductions from the process of reform, whilst reducing costs to households and the private sector. Low and inelastic fossil-fuel supply elasticities imply lower reductions in GHG emissions, while higher fossil-fuel supply elasticities will result in higher reductions in GHG emissions. Burniaux and Chateau (2014) explain using the OECD Environmental Linkages model that “in the extreme case of completely inelastic fossil fuel supplies³, the environmental benefit of the subsidy removal becomes negligible, with a total emission reduction under 2 per cent” (Burniaux & Chateau, 2014). This means that consumers will continue to consume and pay almost anything for the product, and lack of other options and alternatives to enable switching, reducing price elasticity. There are real possibilities for reinvestment of savings from reform, to increase system flexibility and provide alternative options to consumers. It is estimated that renewable energy targets until 2020 in the Middle East and North Africa could cost up to US\$200 billion, less than one year’s worth of fossil-fuel subsidies in the region (US\$237 billion) (Bridle, 2014).

³ Authors footnote: i.e. Demand for a product is inelastic if consumers will pay almost any price for the product.



Secondary effects: It is difficult for models to fully capture wider secondary effects that can have both positive and negative impacts on emission reductions. For example fossil-fuel subsidy removal could have ramifications for investment in energy efficiency, reducing payback periods and increasing energy efficiency with consumers. For example, gasoline prices in Saudi Arabia are one tenth of the average price in Europe, so it takes about 16 years to recoup the cost of upgrading from a vehicle with average fuel economy. Removing subsidies would cut the payback period to just 3 years (IEA, 2014a). Kerosene subsidies for lighting undercut solar-lighting systems. A United Nations Environment Programme (UNEP) report for ECOWAS explains that hypothetically redirecting one year's worth of kerosene subsidy (at 40 per cent) towards kerosene-free lighting systems (e.g., solar) would eliminate the need for all subsequent subsidies for the service life of those new systems (UNEP, 2014). Fossil-fuel subsidies affect renewable electricity generation in that they reduce the costs of fossil-fuel-powered electricity generation, impair the cost competitiveness of renewable energy, reinforce the incumbent advantage of fossil fuels within the electricity system and favour investment in fossil-fuel-based technologies over renewable alternatives (Bridle & Kitson, 2014, and Bridle, Kitson, & Wooders, 2014). In other words, models focus on the reduction in demand in a specific fuel from an increase in price, but there are wider secondary effects on supply and some of the models build some elements of substitution into scenarios. One model suggests some level of substitution from oil to coal after removal of consumer subsidies to oil. This is linked to low coal prices and trade, a substitution which can only be prevented "if a global, stringent climate policy regime is in place" (Schwanitz et al., 2014, 889). Even with this scenario, the research also recognizes that "all phase out scenarios lead to reduced greenhouse gas emissions in comparison to the reference case" (Schwanitz et al., 2014, 886).

Oil price: Many of the models are based on subsidies calculated when oil is at a relatively high price; therefore, it is assumed the impacts of subsidy removal would be greater in terms of emissions reductions from reduced demand and investment in energy efficiency and renewables. Yet lower oil prices are helpful for governments in the process of removing and dismantling fossil-fuel subsidies in that the reform is more palatable to the population because price increases passed onto the consumer are likely lower and less pronounced. In the long run, a low price on fossil fuels does not encourage the reduction of GHG emissions in that it increases consumption. Indeed, low oil prices would work against correct energy and carbon pricing.

Carbon tax: A removal of subsidies to fossil fuels does not include the incorporation of proper taxation of carbon emissions based on their broader social and environmental impacts. The International Monetary Fund has undertaken research that looks at the correct taxation of energy globally and finds that with correct taxation (accounting for damages from air pollution, congestion and accidents as well as for climate change) through both the removal of subsidies and implementation of appropriate taxes on coal, natural gas, gasoline and diesel would result in a global 23 per cent reduction in carbon dioxide emissions based on 2010 data (IMF, 2014).



Countries: Countries that have larger subsidies to fossil fuels and who reform them will experience greater carbon dioxide emissions reductions than those who do not reform, those with no subsidies or those with smaller subsidies. So for example Burniaux and Chateau (2014, 78) find that removal of subsidies to Russia would result in a drop of 25 per cent in emissions and 45 per cent in oil-exporting countries and that “carbon dioxide emissions fall by 16 per cent in non-Annex 1 countries in 2050, they remain almost unchanged in Annex 1 countries.” This is due to the “carbon leakage” effect, which results in increases in consumption in OECD countries due to lower oil prices from reform (described above) and underscores the need for emissions caps within OECD countries to maximize emission reductions from FFSR globally.

Table 2: World GHG reductions from phasing out consumer fossil-fuel subsidies under different assumption in 2020 and 2050.

Simulations	Total GHG emissions (%)	
	2020	2050
Central scenario	-2.5	-8.2
Central scenario with emission cap in remaining countries	-3.3	-9.8
Central scenario without phasing-out electricity subsidies	-1.7	-7.6
Central scenario with high fossil fuel supply elasticities	-3.5	-11.3
Central scenario with lower fossil fuel supply elasticities	-2.9	-7.9
Central scenario with inelastic fossil fuel supply	-1.6	-1.8

Source: Based on Burniaux & Chateau (2014)



4 Conclusion

This working paper has focused only on the potential GHG emissions reductions from FFSR and implications for parties within the UNFCCC. There is a growing body of separate research that covers the process for smooth reform, and economic and social implications (Vagliasindi, 2012; IMF, 2014; Beaton et al., 2013; Arze Del Granado et al., 2010). The working paper has examined the global and national estimates available from economic models that range between 6 and 13 per cent reductions by 2050. FFSR is a policy tool that is being undertaken now (in 2014 Egypt, India, and Indonesia all undertook significant reforms) and therefore presents an opportunity for parties planning and undergoing reforms to include these within their INDC plans. Estimates of reductions of GHG emissions from reform using models such as the GSI-IF model could be included in INDCs. FFSR leads to emission reductions and is a policy tool that parties are implementing and planning for now that will lead to significant government savings. Therefore, parties should support language within the UNFCCC agreement that supports FFSR. Countries undergoing reform (both emerging and low income) should be able to access finance to support reforms and because subsidies represent lost opportunity costs of between 5 and 30 per cent of government expenditure in some regions. In the past, countries (e.g., Iran, Ghana, India, Indonesia and the Philippines) have utilized savings from reform and partially reinvested them in social welfare systems and in infrastructure. To further maximize GHG emission reductions from the process of reform, governments should consider investing savings from FFSR into energy efficiency, public transportation systems and low-carbon energy infrastructure.

Although the removal of subsidies does lead to domestic and international reductions in GHG emissions, it is no substitute for a global climate agreement with a clear cap on emissions. FFSR in the presence of a cap increases emission reductions from around 8 to 10 per cent and maintains the reductions from reform in the long term. Further, correct taxation of fossil fuels would take this higher to around a 23 per cent reduction. Parties should seriously consider including emissions reductions from FFSR within their INDCs, within the UNFCCC agreement (especially regarding early action in that this policy tool is one that countries are utilizing now), within NAMAs, and within a TEM that covers fiscal instruments (subsidy reform, carbon pricing, taxation, etc.) to share lessons and increase understanding.



5 References

Asian Development Bank. (forthcoming). *Policy Report: Fossil fuel subsidies in Asia: Trends, impacts and reforms*. ADB.

APEC Energy Working Group. (2012, September). *Reforming fossil-fuel subsidies to reduce waste and limit CO2 emissions while protecting the poor*. Retrieved from http://www.iisd.org/gsi/sites/default/files/ffs_apec.pdf

Anderson, K. & McKibbin, W. J. (2000). Reducing coal subsidies and trade barriers: Their contribution to greenhouse gas abatement. *Environment and Development*, 5(2000), 457–81.

Arze DelGranado, J., Coady, C., and Gillingham, R., (2010). The unequal benefits of fuel subsidies: A review of evidence for developing countries. Paris: IMF.

Benninghoff, V. (2013). *Prioritizing fossil-fuel subsidy reform in the UNFCCC process: Recommendations for short-term actions*. Retrieved from http://www.iisd.org/gsi/sites/default/files/pb16_prioritizing.pdf

Bridle, R. (2014, October 17). The annual cost of energy subsidies is greater than the total cost of meeting 2020 renewable energy targets in the Middle East and North Africa. BSI's Subsidy Watch Blog, Retrieved from <http://www.iisd.org/GSI/news/annual-cost-energy-subsidies-greater-total-cost-meeting-2020-renewable-energy-targets-middle>

Bridle, R. & Kitson, L. (2014). The impact of fossil-fuel subsidy reform on renewable electricity generation. Retrieved from <http://www.iisd.org/sites/default/files/publications/impact-fossil-fuel-subsidies-renewable-electricity-generation.pdf>

Bridle R., Kitson, L. & Wooders, P. (2014). *Fossil-fuel subsidies: A barrier to renewable energy in five Middle East and North African countries*. Retrieved from <http://www.iisd.org/gsi/sites/default/files/fossil-fuel-subsidies-renewable-energy-middle-east-north-african-countri%20%20%20.pdf>

Burniaux, J. & Chateau, J. (2014, December). Greenhouse gases mitigation potential and economic efficiency of phasing-out fossil fuel subsidies. *International Economics*, 140, 71 –88. <http://dx.doi.org/10.1016/j.inteco.2014.05.002>

Burniaux, J. & Chateau, J. (2011). *Mitigation potential of removing fossil fuel subsidies: A General Equilibrium Assessment*. OECD Economics Department Working Papers No. 853. Retrieved from <http://dx.doi.org/10.1787/5kgdx1jr2plp-en>.



Ellis, J. (2010, March). *The effects of fossil-fuel subsidy reform: A review of modelling and empirical studies*. Global Subsidies Initiative of the International Institute for Sustainable Development. Retrieved from http://www.iisd.org/gsi/sites/default/files/effects_ffs.pdf

Global Subsidies Initiative. (2010a, July). *How-to guide: Measuring subsidies to fossil-fuel producers*. Retrieved from http://www.iisd.org/gsi/sites/default/files/pb7_ffs_measuring.pdf

Global Subsidies Initiative (2010): "Untold Billions Fossil-Fuel Subsidies, Their Impacts and the Path to Reform. A Summary of Key Findings"

Beaton, C., Gerasimchuk, I., Laan, T., Lang, K., Vis-Dunbar, D., & Wooders, P. (2013). *A guidebook to fossil-fuel subsidy Reform for policy Makers in Southeast Asia*. Retrieved from http://www.iisd.org/gsi/sites/default/files/ffs_guidebook.pdf

International Energy Agency. (2007). *World energy outlook 2006*. Paris: IEA.

International Energy Agency. (2011). *World energy outlook 2011*. Paris: OECD/IEA.

International Energy Agency. (2013). *World energy outlook 2013*. Retrieved from <http://www.worldenergyoutlook.org/publications/weo-2013/>

International Energy Agency, Organisation for Economic Co-operation and Development & World Bank. (2010, November). *Scope of fossil-fuel subsidies in 2009 and a roadmap for phasing out fossil-fuel subsidies*. Retrieved from <http://www.oecd.org/dataoecd/8/43/46575783.pdf>

International Energy Agency. (2013). *Redrawing the energy climate map*. World Energy Outlook Special Report 2013. Retrieved from http://www.iea.org/media/freepublications/weo/WEO2013_Climate_Excerpt_ES_WEB.pdf

International Energy Agency. (2014a). *World energy outlook 2014*. Retrieved from <http://www.worldenergyoutlook.org/publications/weo-2014/>

International Energy Agency. (2014b). *CO2 Emissions from fuel combustion, 2014 Edition*. Retrieved from <http://www.iea.org/publications/freepublications/publication/co2-emissions-from-fuel-combustion-highlights-2014.html>

International Energy Agency. (2014c) *The way forward: Five key actions to achieve a low-carbon energy sector*. Retrieved from https://www.iea.org/topics/climatechange/The_Way_Forward.pdf

International Monetary Fund. (2013). *Energy subsidy reform: Lessons and implications*. Retrieved from <http://www.imf.org/external/np/pp/eng/2013/012813.pdf>



International Monetary Fund. (2014). *Getting energy prices right: From principle to practice*. Retrieved from <http://www.imf.org/external/np/fad/environ/pdf/c1.pdf>

Jakob, M., Steckel, J. C., Klasen, S., Lay, J., Grunewald, N., Martínez-Zarzoso, I. et al. (2014).. Nature Feasible mitigation actions in developing countries. *Climate Change*, 4, 961–968.
doi:10.1038/nclimate2370

Lin, B. & Ouyang, X. (2014). A revisit of fossil-fuel subsidies in China: Challenges and opportunities for energy price reform. *Energy Conversion and Management*, 82 (2014), 124–134.

Lin, B. & Jiang, Z. (2011). Estimates of energy subsidies in China and impact of energy subsidy reform. *Energy Economics*, 33 (2011), 273–283.

Lunden, P. L. & Fjaertoft, D. (2014). Government support to oil and gas in Russia. Retrieved from http://www.iisd.org/gsi/sites/default/files/ffs_awc_russia_yamalprirazlomnoe_en.pdf

Merrill, L. (2014). Financing the sustainable development goals through fossil-fuel subsidy reform: Opportunities in Southeast Asia, India and China. Geneva: Global Subsidies Initiative, International Institute for Sustainable Development.

McGlade, C. & Ekins, P. (2015, January 8). The geographical distribution of fossil fuels unused when limiting global warming to 2°C. *Nature*, 517, 187–190.

OECD. (2009). The economics of climate change mitigation: policies and options for global action beyond 2012. Paris: OECD.

OCI and ODI (2014). *The fossil fuel bailout: G20 subsidies for oil, gas and coal exploration*. Retrieved from <http://www.odi.org/sites/odi.org.uk/files/odi-assets/publications-opinion-files/9234.pdf>

OECD (2015). *OECS IEA fossil fuel subsidies and other support*. Retrieved from <http://www.oecd.org/site/tadffss/>

Schwanitz, V.J., Piontek, F., Bertram, C., & Luderer, G. (2014). Long-term climate policy implications of phasing out fossil fuel subsidies, *Energy Policy*, 67 (2014), 882 –894.

Stefanski, R. (2014). *Dirty little secrets: Inferring fossil-fuel Subsidies from patterns in emissions intensities*. Retrieved from [http://www.oxcarre.ox.ac.uk/files/OxCarreRP2014134\(1\).pdf](http://www.oxcarre.ox.ac.uk/files/OxCarreRP2014134(1).pdf)

United Nations Environment Programme. (2014). Lifting the darkness on the price of light: Assessing the effect of fuel subsidies in the off-grid lighting market. UNEP/NONE/2014/1/REV.1. Retrieved from



<http://global-off-grid-lighting-association.org/wp-content/uploads/2015/01/Lifting-the-Darkness-Effects-of-Fuel-Subsidies.pdf>

World Bank (2014). Social. Protection in Africa. Retrieved from www.worldbank.org

United Nations Framework Convention on Climate Change. (2010). Focus: Mitigation: NAMAs, Nationally Appropriate Mitigation Actions. Retrieved from <http://unfccc.int/focus/mitigation/items/7172.php>

United Nations Framework Convention on Climate Change. (2014). *Decision -/CP.20 Lima Call for Climate Action*. Retrieved from https://unfccc.int/files/meetings/lima_dec_2014/application/pdf/auv_cop20_lima_call_for_climate_action.pdf

United Nations Framework Convention on Climate Change. (2014b, December 13). *Further advancing the Durban Platform*. Retrieved from <http://unfccc.int/resource/docs/2014/cop20/eng/l14.pdf>

[Vagliasindi, M. \(2012\). Implementing energy subsidy reforms: Evidence from developing countries. Washginton, D.C.: World Bank.](#)

World Bank. (2008). *Climate change and the World Bank Group: Phase I: An Evaluation of World Bank Win-Win Energy Policy Reforms*. World Bank: Washington, DC.

World Resources Institute. (2014). *Designing and preparing Intended Nationally Determined Contributions (INDCs)*. Retrieved from http://unfccc.int/files/focus/mitigation/application/pdf/indc_designing_and_preparing_indcs.pdf



Appendix 1: Table of Models Regarding Fossil-Fuel Subsidy Reform and Greenhouse Gas Emissions

Name	Year	Scope country	Scope Fuel	Comments on modeled scenarios and assumptions	Emission reduction	Methodology
International Energy Agency (IEA, 2013), World Energy Outlook 2013	2014	Global	Consumer Fossil-fuel subsidies (FFS), IEA data	<p>One of the 4 recommended policy measures that the IEA recommends in order to keep the rise in temperature below 2°C is the “further partial phase out of FFS to end-consumers” (part of the 4-for-2°C scenario). IEA calculates that this package of measures will account for 80 per cent of the GHG emissions reduction that is necessary to achieve the 2degree goal, equivalent to a reduction of 3.1Gt of carbon dioxide equivalent.</p> <p>The further phase out of FFS (beyond the New Policies Scenario, which includes all current commitments made by countries) will account for 12 per cent of that reduction, or be equal to reduction of 360 million tonnes (Mt) carbon dioxide equivalent. The further phase out means full phase out by 2020 in fossil-fuel importing countries, a 25 per cent additional phase out by 2020 and a full one by 2035 in fossil-fuel net exporting countries. (p 55)</p> <p>According to the IEA, a 25 per cent reduction in fossil-fuel subsidies by 2020 in net exporting countries would reduce carbon dioxide emissions by 360 Mt in 2020 relative to its New Policies Scenario (which assumes a total phase-out in fossil-fuel importing countries by 2020)</p>	360 Mt carbon dioxide equivalent will be the reduction of the implementation of the 4-for-2°C scenario	World Energy Model
ADB (forthcoming)	2014	India	Petroleum (diesel, liquid petroleum gas [LPG], kerosene), electricity, Coal	For all models and projections in the ADB report, assumptions were made in terms of GDP growth, population growth and fossil-fuel price growth.	1.8 per cent (MARKAL) and 1.3 per cent (E3MG) by 2030	MARKAL and E3MG
ADB (forthcoming)	2014	Indonesia	Petroleum (gasoline, diesel, LPG, kerosene), electricity	Due to lower demand for energy and a change in energy mix, MARKAL model projects a reduction of 5.1 per cent in emissions, E3MG 9.3 per cent reduction. The paper also provides the emission reductions per sector based on both models.	5.1 per cent (MARKAL) and 9.3 per cent (E3MG) by 2030	MARKAL and E3MG
ADB (ADB, forthcoming)	2014	Thailand	Diesel, LPG, natural gas (vehicles), electricity	Lower demand for energy and a change in energy mix, MARKAL model projects a reduction of 2.8 per cent in emissions.	2.8 per cent (MARKAL) by 2025	MARKAL
Burniaux & Chateau (2014)	2011, 2014	37 non-OECD countries+ Korea + Mexico	FFS consumer, IEA data	Covers 37 countries (covering 95 per cent of globalized fossil-fuel consumption, IEA). If subsidies are removed gradually between 2013 and 2020 in the countries of which the data was modelled, global GHG emissions will reduce by 8 per cent compared to baseline by 2050. This is under the assumption that there is no constraint on FFS in OECD countries (no cap). Based on IEA 2010 subsidy data.	Global GHG emissions of an 8 per cent reduction by 2050	OECD ENV-Linkages General Equilibrium model



Lin & Ouyang (2014)	2014	China	Coal, oil, gas, electricity consumer subsidies. Price gap approach	<p>IEA price gap approach, calculation of subsidies for the period 2006–2010</p> <p>Price elasticity of different fuels in China based on econometric models (Lin & Jiang, 2011)</p> <p>Based on the partial equilibrium model, during the period 2006–2010, the energy-saving potential from subsidy removal amounted to 3.64 per cent of total energy consumption. This decrease in consumption would lead to reduction of 3.72 per cent of total carbon dioxide emissions in that period.</p> <p>Based on the CGE (including macroeconomic policies: trade and production, prices, emissions, institutions and system of constraints) the model shows that the removal of FFS would lead to higher energy prices, reduction of consumption as well as of carbon dioxide and SO₂ emissions.</p>	<p>3.72 per cent carbon dioxide emission reduction (based on Partial Equilibrium Model)</p> <p>Significant carbon dioxide and sulfur dioxide emission reductions (based on CGE Model)</p>	Partial Equilibrium Model and computable general equilibrium (CGE) model
Schwanitz et al. (2014)	2014	Global	IEA data	Different scenarios on climate policy dimension and the degree of phasing-out fossil-fuel subsidies are being modelled. The Zero2020 scenario (all FFS phased out by 2020) has the strongest effect on emission reductions, but all other scenarios lead to reductions as well.	6.4 per cent GHG emission reductions in the Zero2020 scenario by 2050	REMIND (intertemporal energy – economy model)
International Monetary Fund (2013)	2013	Global	Petroleum, natural gas, coal,	Assumptions in the model include one price elasticity per fossil fuel, one carbon dioxide coefficient per unit fossil fuel. carbon dioxide, sulphur dioxide and local pollutants emission reductions based on reduced consumption and the carbon dioxide coefficient.	13 per cent decrease in carbon dioxide emissions (4.5 billion tons); reduction of 10 million tons of SO ₂ ; further 13 per cent reduction in other local pollutants.	IMF Model for carbon dioxide, SO ₂ and local pollutants' emission reductions
APEC Energy Working Group (2012)	2012	APEC	FFS consumer, IEA data for APEC region	<p>Study refers back to OECD and IEA model:</p> <p>Phase out results in carbon dioxide emission reduction of 4.7 per cent by 2020 and 5.8 per cent by 2035 (IEA, 2011)</p> <p>Phase-out results in carbon dioxide emission reduction of 10 per cent by 2050 globally (IEA, OECD, & WB 2010) Reduction in Russia and Eastern European countries would be up to 20 per cent and have largest effect</p>		OECD – IEA models
OECD, <i>Environment al Outlook to 2050 (OECD, 2011)</i>	2011	Global	FFS consumer, IEA 2008 data (incl. input for electricity)	Phasing out FFS consumer subsidies in developing and emerging countries can lead to global reduction of GHG emissions of 6 per cent (p65).	6 per cent global reduction by 2050 20 per cent reduction in Russia and MENA countries	ENV-Linkages model
Anderson & McKibbin (2000)	2000	Global	Coal	Phase-out of coal subsidies (production and consumption) in OECD and non-OECD countries leads to an 8 per cent reduction in carbon dioxide emissions.	8 per cent reduction in carbon dioxide emissions	CGE Model
Stefanski (2014)	2014	Global	Emissions intensity	Comparison of emissions intensities to GDP and historical development over time to understand if distortions are linked to the presence of fossil-fuel subsidies. Linked to the historical development of model that aims to understand the drivers of falling energy intensity (energy to GDP ratio) in the process of development, linked to country deviation from the emissions intensity development profile of the UK. The model analyzes the impact of agricultural, non-agricultural productivity and the presence of energy subsidies to explain the changing shape of a country's energy intensity through the process of development.	<p>Model finds far larger and indirect subsidies to fossil fuels of around \$983 billion in 2010.</p> <p>36 per cent of global carbon emissions between 1980 and 2010 were driven by subsidies and that GDP was up to 1.7 per cent lower per year because of the distortive subsidies.</p>	A model of structural transformation calibrated to the experiences of the UK.