Getting on Target:

Accelerating energy access through fossil fuel subsidy reform

GSI REPORT

IISD
International Institute for Sustainable Development

Global Subsidies Initiative

Anna Zinecker
Lourdes Sanchez
Shruti Sharma
Chris Beaton
Laura Merrill

July 2018

Published by the International Institute for Sustainable Development.

International Institute for Sustainable Development

The International Institute for Sustainable Development (IISD) is an independent think tank championing sustainable solutions to 21st–century problems. Our mission is to promote human development and environmental sustainability. We do this through research, analysis and knowledge products that support sound policy-making. Our big-picture view allows us to address the root causes of some of the greatest challenges facing our planet today: ecological destruction, social exclusion, unfair laws and economic rules, a changing climate. IISD's staff of over 120 people, plus over 50 associates and 100 consultants, come from across the globe and from many disciplines. Our work affects lives in nearly 100 countries. Part scientist, part strategist—IISD delivers the knowledge to act.

IISD is registered as a charitable organization in Canada and has 501(c)(3) status in the United States. IISD receives core operating support from the Government of Canada, provided through the International Development Research Centre (IDRC) and from the Province of Manitoba. The Institute receives project funding from numerous governments inside and outside Canada, United Nations agencies, foundations, the private sector and individuals.

Head Office

111 Lombard Avenue, Suite 325
Winnipeg, Manitoba
Canada R3B 0T4

Tel: +1 (204) 958-7700
Website: www.iisd.org
Twitter: @IISD_news

About GSI

The IISD Global Subsidies Initiative (GSI) supports international processes, national governments and civil society organizations to align subsidies with sustainable development. GSI does this by promoting transparency on the nature and size of subsidies; evaluating the economic, social and environmental impacts of subsidies; and, where necessary, advising on how inefficient and wasteful subsidies can best be reformed. GSI is headquartered in Geneva, Switzerland, and works with partners located around the world. Its principal funders have included the governments of Denmark, Finland, New Zealand, Norway, Sweden, Switzerland and the United Kingdom, as well as the KR Foundation.

Global Subsidies Initiative

International Environment House 2,
9 chemin de Balexert
1219 Châtelaine
Geneva, Switzerland
Canada R3B 0T4

Tel: +1 (204) 958-7700
Website: www.iisd.org/gsi
Twitter: @globalsubsidies

Getting on Target: Accelerating energy access through fossil fuel subsidy reform

July 2018

Written by Anna Zinecker, Lourdes Sanchez, Shruti Sharma, Christopher Beaton and Laura Merrill

Foreword

Reforming fossil fuel subsidies holds huge opportunities for the sustainable development agenda and in particular for Sustainable Development Goal 7 (SDG 7) on universal sustainable energy access. The 2030 Agenda calls upon countries to "rationalize inefficient fossil-fuel subsidies that encourage wasteful consumption" (SDG 12c) as a means of implementation for the SDGs.

The USD 425 billion spent globally on fossil fuel subsidies per year could finance access to energy—electricity and clean cooking—7.5 times over. These subsidies can put a strain on government budgets and prevent investments in other development priorities such as increasing energy access. Often, fossil fuel subsidies are socially regressive, as the poorest households without energy access benefit less or not at all.

Reinvesting a share of savings from fossil fuel subsidy reform into development priorities like health, education, job creation and social protection can make societies stronger and more resilient. An area that is often overlooked is to reinvest savings into renewable energy technologies and energy efficiency for energy access. We see a great potential to move away from costly, inefficient fossil fuel subsidies to a brighter and healthier future for all households, powered by green technologies. This is also of paramount importance in the global fight against climate change.

The Friends of Fossil Fuel Subsidy Reform have been working since 2010 to build political consensus on the importance of fossil fuel subsidy reform. This report by the IISD's Global Subsidies Initiative was supported by the Friends, as part of their efforts to better understand fossil fuel subsidies and support countries in identifying paths to reform.

Kimmo Tiilikainen
Minister of the Environment, Energy and Housing, Finland

Acknowledgements

We would like to acknowledge and thank Liz Hooper, Lucy Kitson, Mya Nwe and Andrew Scott for reviewing this report and Verena Brinkmann, Ana Moreno Morales, Jan-Hendrik Soehlemann, Lucy Stevens and Angel Verastegui Gubler for contributing their insights and ideas. All possible inaccuracies remain the responsibility of the authors.

Executive Summary

Sustainable Development Goal (SDG) 7 calls upon the global community to ensure access to affordable, reliable, sustainable and modern energy for all by 2030. Often people assume that fossil fuel subsidies help the poor by making energy more affordable. In fact, most fossil fuel subsidies are not working well for energy access and poverty goals. The annual fossil fuel subsidy expenditure of USD 425 billion could be better invested by governments towards SDG outcomes. This is already recognized by SDG 12, in which the UN General Assembly's 193 members included the reform of inefficient fossil fuel subsidies as a means of implementation to achieve more sustainable consumption and production. Subsidy savings could be invested to get on target for many development goals—not least, those on energy access.

This paper reviews the financial implications of fossil fuel subsidies and takes a closer look at how reforming fossil fuel consumption subsidies could interact with energy access goals.

Key findings

Global fossil fuel subsidies could finance the global energy access funding gap 7.5 times over. While the exact potential for reallocation depends on which countries have subsidies and how savings can be used, given political and economic realities, there are several ways in which this could happen in practice. While Organisation for Economic Development and Co-operation (OECD) countries committed USD 8.3 billion annually for development assistance to the energy sector in 2015 and 2016, they spent 10 times as much to support fossil fuels. Reforming these fossil fuel subsidies could further increase support for the energy transition. In countries with high energy access deficits and high fossil fuel subsidies, just a share of savings could help raise substantial volumes of energy access finance—and in many cases, this would be much larger than equivalent flows of overseas development aid. Countries with high fossil fuel subsidies and large energy access deficits were found to spend the equivalent of USD 573 per household without access to electricity or USD 321 per household without access to clean cooking on fossil fuel subsidies. For example, Nigeria, where 61 per cent of households have access to electricity and only 6 per cent of households have access to clean cooking, spent USD 2.5 billion on fossil fuel subsidies in 2016. In comparison, Nigeria received on average USD 132 million per year in development finance for electricity between 2011 and 2015.

At their best, untargeted fossil fuel consumption subsidies are an inefficient and unjust tool for improving energy access. At their worst, they can even have a negative impact on energy access. Untargeted consumption subsidies are subsidies that benefit anyone who buys a product, regardless of whether they are rich or poor. They only benefit people that are reached by electricity or fuel distribution networks, which typically excludes a large number of poorer households. They are also highly unfair—richer households buy larger volumes of energy, so they capture most of the benefits. That makes them highly inefficient—that is, they achieve small energy access benefits at exorbitant costs that cannot be justified in comparison with other interventions. When untargeted subsidies are badly designed, they can even make energy access problems worse. One common problem is smuggling and diversion of subsidized fuels, or when governments cut back supply because they are struggling to manage subsidy costs. This can result in fuel scarcity, which in turn creates long queues, panic paying and prices far above the official subsidized level. If the financial burden for subsidies is pushed onto state energy companies, they may cope by restricting investments for energy access.

Smart strategies for fossil fuel subsidy reform can boost sustainable energy access: Experience with fossil fuel subsidy reform has yielded a wealth of knowledge on how subsidies can be reformed to improve energy access. Good data about the socioeconomic situation of households and the energy services needed is crucial: the focus should be on energy needs for cooking, transport or lighting, instead of focusing on just one fuel. This could mean levelling the playing field between subsidized grid electricity and off-grid technologies. It could also mean targeted lifeline tariffs or support for access to clean cooking equipment. Ideally, support for energy access would be provided in a technology-neutral way, even though this is difficult to implement in practice. In some cases, countries may prefer to subsidize incomes instead of or as well as energy sources.

Recommendations

SDG 12c calls upon countries to "Rationalize inefficient fossil-fuel subsidies that encourage wasteful consumption… taking fully into account the specific needs and conditions of developing countries and minimizing the possible adverse impacts on their development in a manner that protects the poor and the affected communities" (SDG Knowledge Platform, n.d.b,). In the context of SDG 7, the Global Subsidies Initiative (GSI) recommends the following three approaches to accelerate energy access through fossil fuel subsidy reform: remove, target or swap.

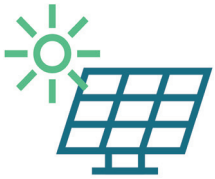
REMOVE		**Phase out fossil fuel subsidies that have no or little potential for energy access** Some fossil fuel subsidies have little or no potential to improve energy access. Governments should aim to phase out such subsidies, taking adequate steps to mitigate negative economic or social impacts, particularly for poor households and women. **Examples**: producer subsidies; gasoline and diesel subsidies
TARGET		**Targeted subsidies aimed at access for those that really need them** Some fossil fuel subsidies are used to incentivize the use of energy technologies for which there is no short-term sustainable alternative. If these subsidies are deemed necessary, governments should improve the effectiveness and efficiency of these subsidies through targeted subsidies aimed at poor households. Facilitating new connections should be a major focus in this respect. **Examples**: liquefied petroleum gas (LPG) subsidies; electricity subsidies
SWAP		**Shift fossil fuel subsidies to investments in renewable energy and energy efficiency** Shifting subsidies to renewable energy technologies for energy access and energy efficiency can support households and improve the sustainability of energy access. **Examples**: kerosene subsidies for lighting; diesel subsidies for agriculture; subsidies to transport fuels; subsidies to coal and gas for electricity generation

Table of Contents

Abbreviations and Acronyms

APEC	Asia-Pacific Economic Cooperation
discom	distribution company
G7	Group of Seven
G20	Group of Twenty
GDP	Gross Domestic Product
GSI	Global Subsidies Initiative
FISE	Fondo de Inclusión Social Energético
IEA	International Energy Agency
IBT	increasing block tariffs
IMF	International Monetary Fund
IRENA	International Renewable Energy Agency
LPG	liquefied petroleum gas
OECD	Organisation for Economic Cooperation and Development
PMUY	Pradhan Mantri Ujjwala Yojana
SDG	Sustainable Development Goal
USD	United States Dollar
U.S. AID	United States Agency for International Development
W	Watt
WHO	World Health Organisation
WTO	World Trade Organisation
VDT	volumetric differentiated tariffs

1.0 The Targets: Achieving Universal Energy Access and Fossil Fuel Subsidy Reform

Universal access to affordable, reliable, sustainable and modern energy services is a necessary condition for human development, health, prosperity, security and comfort. It has cross-linkages throughout many goals in the 2030 Agenda because it enables essential services used by households and communities, and supports the ability to earn a living, such as through lighting, powering machines, cooking, telecommunications, heating and transport. Reflecting this importance, access to sustainable energy has been included as Sustainable Development Goal 7 (SDG 7, see Box 1). The targets are ambitious: the 2030 Agenda calls for universal energy access by 2030, which is far from today's reality. In 2016, 1.1 billion people lived without electricity, and about 2.5 billion people relied primarily on traditional cooking fuels (World Bank, 2018a). In addition, many households do have electricity or clean cooking access and face challenges with energy affordability, quality and supply disruptions.

Fossil fuel subsidy reform was included in the 2030 Agenda as SDG 12.c, with the aim to achieve sustainable consumption and production patterns. Fossil fuel subsidy reform has many linkages to other SDGs through its potential to free up financing that could be used for other purposes, as well as through its impact on sustainability (see Box 3).

This paper will shed light on the linkages between fossil fuel subsidies and energy access by bringing together findings from country studies, academic research and practitioner knowledge. It will outline how the financing spent on fossil fuel subsidies could boost investments in energy access. The paper will then analyze the relevance of fossil fuel subsidies as a policy tool for energy access and point to the challenges associated with untargeted consumption subsidies in achieving universal energy access. Based on this, the paper will present smarter strategies for reforming fossil fuel subsidies to benefit energy access, including reform of subsidies that do not benefit energy access, better targeting and swapping savings from subsidy reform to invest in renewable energy technologies and energy efficiency.

BOX 1. THE ENERGY ACCESS GOAL AND ITS INDICATORS

SDG 7.1 By 2030, ensure universal access to affordable, reliable and modern energy services

7.1.1 Proportion of population with access to electricity

7.1.2 Proportion of population with primary reliance on clean fuels and technology

Source: SDG Knowledge Platform (n.d.a)

BOX 2. THE FOSSIL FUEL SUBSIDY GOAL AND ITS INDICATORS

SDG 12.C Rationalize inefficient fossil fuel subsidies that encourage wasteful consumption by removing market distortions, in accordance with national circumstances, including by restructuring taxation and phasing out those harmful subsidies, where they exist, to reflect their environmental impacts, taking fully into account the specific needs and conditions of developing countries and minimizing the possible adverse impacts on their development in a manner that protects the poor and the affected communities

12.C.1 Amount of fossil-fuel subsidies per unit of GDP (production and consumption) and as a proportion of total national expenditure on fossil fuels

Source: SDG Knowledge Platform (n.d.b)

1.1 The Energy Access Challenge

Energy access is defined in the context of the multi-tier framework as the "ability of the end user to utilize energy supply that is usable for the desired energy services" (World Bank, 2015).[1] This means that energy supply must be adequate in quantity, available when needed, of good quality, reliable, convenient, affordable, legal, healthy and safe. This applies to different contexts, including households, productive engagements and community infrastructures.

Just under one billion people lived without electricity in 2016. The highest number of households without electricity access was in sub-Saharan Africa, where 43 per cent of the population had access to electricity in 2016 (World Bank, 2018a). The links between access to electricity and development are clear. Access to electricity helps to reduce poverty, improve health and improve education (literacy and school enrollment rates), and it has a positive impact in the evolution of household income and GDP (Khandker et al., 2009; Morimoto & Hope, 2001; U.S. Agency for International Development [U.S. AID], n.d.). In addition to grid electricity, off-grid solar solutions are emerging as an important complement in rural areas, where access to electricity is significantly lower than in urban areas. According to the International Renewable Energy Agency (IRENA, 2018), solar off-grid systems supply electricity to 141 million people in developing countries, of which 30 million are connected to larger systems or mini grids that provide services similar to grid access. Nevertheless, under the current trajectory, 674 million people will still be without electricity by 2030 (World Bank, 2018a).

Almost 3 billion people, that is one third of the world's population, still lack access to clean cooking.[2] Most people without access to clean cooking live in Asia (66 per cent), followed by sub-Saharan Africa (29 per cent) (World Bank, 2018a). The situation can be described as a triple challenge between the use of traditional cooking fuels like wood, charcoal, coal, crop waste and dung; the use of potentially harmful modern fuels such as kerosene; and the use of inefficient and polluting cookstoves. The use of biomass in traditional, polluting or inefficient stoves has significant negative impacts on health, socioeconomic development, gender equality and the environment (Ekouevi & Tuntivate, 2012; Energy Sector Management Assistance Program [ESMAP] & Global Alliance for Clean Cookstoves [GACC], 2015; Kitson et al., 2016; World Health Organization [WHO], 2016). The WHO (2016) estimates that exposure to household air pollution causes 4.3 million premature deaths each year. Progress on access to clean cooking has happened mostly in Asia, often backed by targeted policies on the use of liquefied petroleum gas (LPG) (International Energy Agency [IEA], 2017b). With the current speed of access gains, 2.3 billion of the global population will be without access to clean cooking in 2030 (World Bank, 2018a).

1.2 The Unrealized Potential of Reforming Fossil Fuel Subsidies

Broadly speaking, fossil fuel subsidies are government policies that reduce the cost burden borne by the producers or consumers of fossil fuels.[3] Fossil fuels are defined as oil, gas and coal products, as well as electricity[4] that is mostly generated from fossil fuels (IEA, 2005). The total value of fossil fuel subsidies varies from year to year, reflecting both changes in the global oil price and the introduction of fossil fuel subsidy reforms. Based on a compilation of the different data sources,[5] the GSI estimated global fossil fuel subsidies to be USD 425 billion

[1] The multi-tier framework was developed to improve the way that energy access is measured. It moved away from a binary framework focused only on an electricity connection and the use of solid fuels for cooking. This binary notion omits the role of other factors such as volume of supply, quality, reliability, the type of cookstove in usage and the different characteristics of different cooking fuels. Large data collection exercises are now ongoing in numerous countries around the world to create an improved evidence base on the full scale of energy access problems and the exact ways in which access can be improved.

[2] "Clean cooking" in the sense of this report signifies primary reliance on clean fuels and technology for cooking, whereby "clean" is defined by the emission rate targets and specific fuel recommendations (that is, against unprocessed coal and kerosene) included in the normative guidance WHO guidelines for indoor air quality: household fuel combustion (cf. World Bank, 2018a).

[3] The GSI uses a definition of subsidy that is based on the WTO Agreement on Subsidies and Countervailing Measures (ASCM), agreed by 164 members. This defines subsidies as a "financial contribution by a government or any public body" or "any form of income or price support" whereby a benefit is conferred (WTO, 1994). For a full breakdown of the type of policies captured by this definition, see the GSI's typology of energy subsidies in Gerasimchuk, Wooders, et al. (2017).

[4] In the context of this paper, "electricity" will signify electricity generated mostly from fossil fuels, unless otherwise specified.

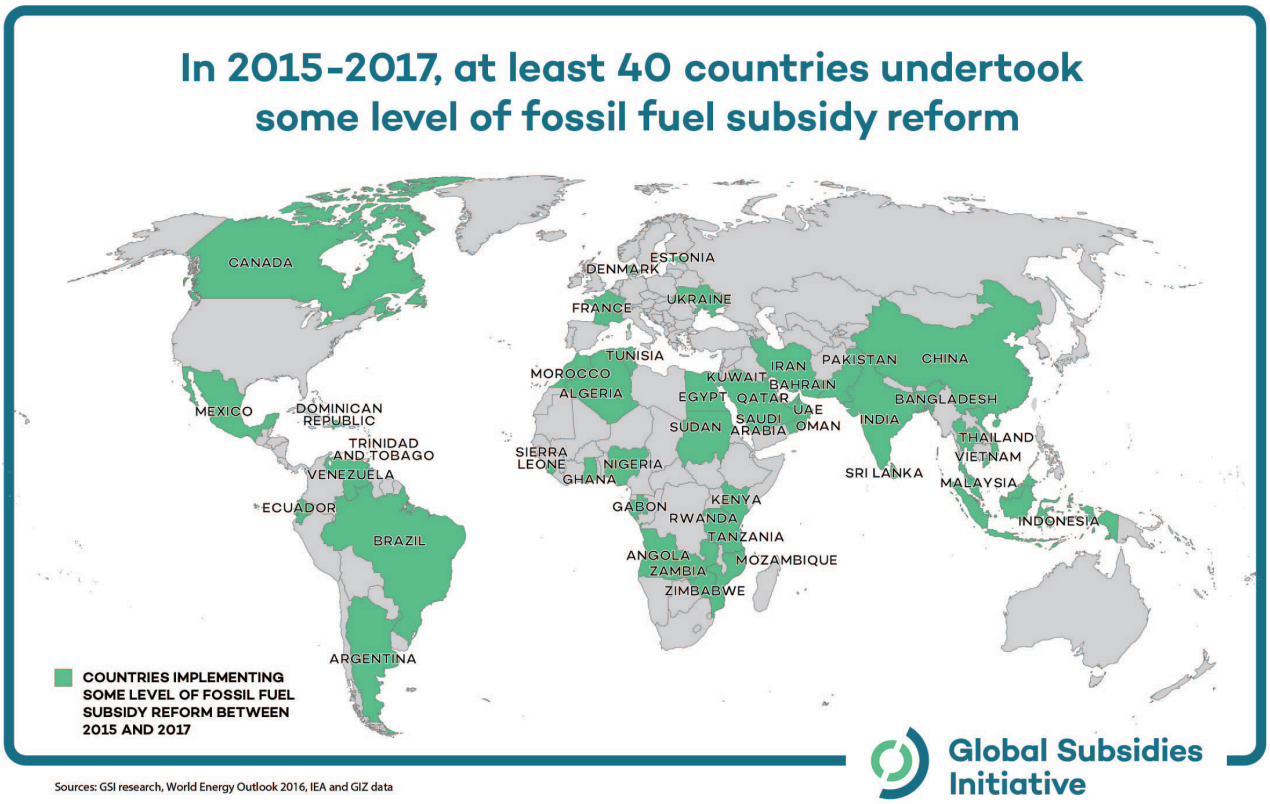
[5] Producer and consumer subsidies affect each other, as producer subsidies can lower the price paid by consumers, while mandated low end-user prices can lead to a need for direct transfers to energy companies. Careful aggregation is therefore required. A joint estimate by the OECD and IEA identified USD 372.5 billion worth of fossil fuel subsidies in 2015 (OECD, 2018). Nevertheless, this estimate excludes subsidies to electricity based on fossil fuels.

in 2015 (Merrill et al., 2017). This figure does not include the cost of externalities related to the consumption of fossil fuel subsidies, which is estimated by the International Monetary Fund (IMF) in their estimate of "post-tax subsidies" (Coady, Parry, Sears & Shang, 2015).

Fossil fuel subsidies can take a variety of forms: fuels or electricity that are set at below-market-value prices; direct financial transfers, for example to a loss-making state-owned utility; tax breaks to companies in the energy sector; or the provision of inputs, such as fuels or government services, for free or at a lower price (for a typology see Gerasimchuk, Wooders, et al., 2017; Kojima & Koplow, 2015). Often, fossil fuel subsidies are grouped into "consumer subsidies," that is subsidies that directly affect the costs borne by consumers, and "producer subsidies," that is subsidies that affect the cost borne by producers of fossil fuels. Consumer subsidies predominantly occur in developing countries for petroleum products and electricity for private customers for transport, lighting, cooking or heating, or for fuels used by strategically important domestic industries. The IEA provides a global estimate of consumer subsidies in 41 countries, which are considered to account for a large majority of global consumption subsidies (IEA, 2017b). Producer subsidies are generally large in countries that are major producers of oil, gas and coal, but can also be found in other countries across the world (GSI, 2010). A main source of information on producer subsidies is the inventory of support measures to fossil fuels established by the Organisation for Economic Cooperation and Development (OECD), which currently covers 43 countries (OECD, 2018).

With commitments for subsidy reform among the G20, Asia-Pacific Economic Cooperation (APEC), G7 and the SDGs, numerous countries worldwide have started to reform their fossil fuel subsidies over the past decade. The map below shows countries that implemented reforms of their fossil fuel subsidies between 2015 and 2017 (Figure 1). The IEA estimates that, without fossil fuel subsidy reforms adopted since 2009, the value of fossil fuel subsidies would have been 24 per cent higher compared to its estimate for 2014 (IEA, 2015a).

Figure 1. Map of countries that undertook fossil fuel subsidy reform in 2015–17



Reforming fossil fuel subsidies can mean a wide range of policy changes, including the following (adapted from Kitson et al., 2016):

- Complete liberalization of fossil energy prices.
- Attempts to redesign or "rationalize" subsidy policies (for example to improve their targeting or to cut smuggling and leakage).
- Price increases in a system of fixed prices (often only partial increases that do not fully close the gap to cost-covering prices).
- Structural changes that permanently alter how fuel is priced and give the government non-subsidy options to assist households and businesses (such as other forms of benefit transfer and social assistance policies).
- Institutional changes (such as dismantling oil price funds or liberalizing state-owned enterprises).

In almost all policy changes referred to as a "reform," it is implicitly understood that the policy change will result in fiscal savings. In some cases, reform has taken place because subsidy expenditure must be reduced in order to prevent a fiscal crisis, so a large share of savings is not used elsewhere. In other cases, a large share of savings becomes available to invest in other development priorities. Reforming fossil fuel subsidies can be politically difficult (Inchauste & Victor, 2017), and, historically, subsidies tend to stay in place for a long time. In its inventory, the OECD found 1,000 individual policies that support fossil fuels (OECD, 2018). The OECD estimates that about two thirds of these measures have been introduced prior to 2000 (OECD, 2015).

Box 3. Environment and health impacts of fossil fuel subsidies

Most fossil fuel subsidies encourage the inefficient use of fossil energy, lead to increased net greenhouse gas emissions and contribute to locking in high-carbon economic development pathways and energy infrastructure. The IEA (2015b) has identified the reform of fossil fuel subsidies as a key building block in their scenario to achieve the international goal of limiting global warming to below 2°C. Research estimates that fossil fuel subsidy reform could result in between 1 and 4 per cent of carbon emission reductions by 2030 (Jewell et al., 2018) or between 6.4 to 8.2 per cent by 2050 relative to the baseline (Burniaux & Chateau, 2011; Schwanitz, Piontek, Bertram, & Luderer, 2014). Further removal of producer subsidies could result in an additional 37 Gt of savings by 2050 (Gerasimchuk, Bassi et al., 2017). Modelling of fossil fuel subsidy reform in 20 countries found that the reallocation of subsidy savings toward renewables and energy efficiency would further increase emissions reductions (from around 11 per cent of emissions reductions to 18 per cent) (Merrill et al., 2015).

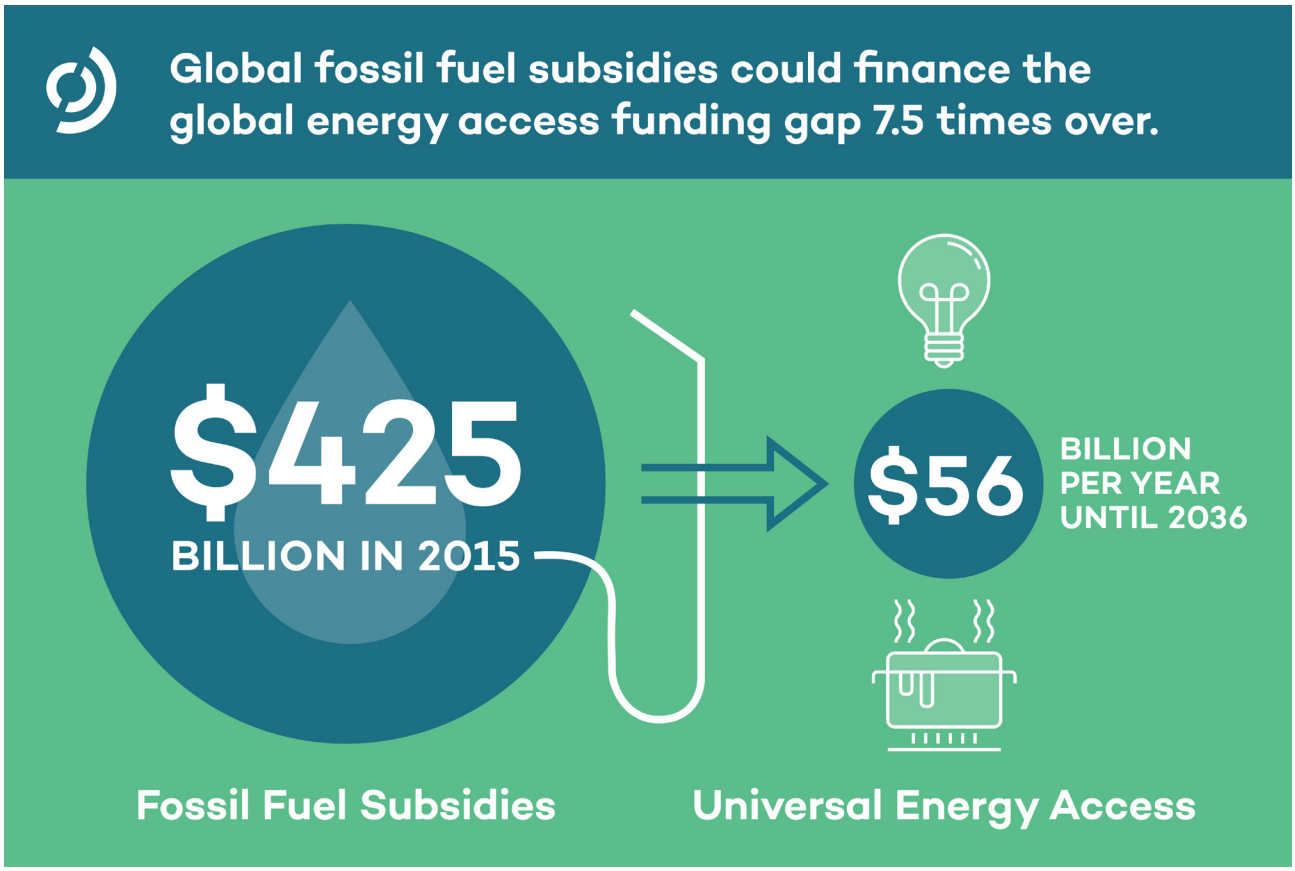
In addition, fossil energy is a major cause of air pollution with negative impacts on health. More than two thirds of power plants globally are fuelled by fossil fuels, with coal representing around 60 per cent of these (World Bank, 2018b). Coal-fired power plants are a major cause of air pollution, which in 2015 was responsible for 9 million premature deaths worldwide, mostly in low and middle-income countries (The Lancet, 2017). In Indonesia, plans to increase the number of coal power plants have been estimated to result in around 25,000 premature deaths by 2030 (Koplitz, 2017). At the same time, a study about the total cost of coal power generation in Indonesia estimated that, if health and climate change externalities were included, electricity produced by coal would be almost 2.5 times more expensive and renewable electricity would become more competitive than coal (Attwood et al., 2017).

2.0 Financing Energy Access through Fossil Fuel Subsidy Reform

Universal energy access requires substantial amounts of financing. The IEA has calculated the investment required to achieve universal energy access for electricity and clean cooking (IEA, 2017a). For universal access to electricity, the cumulative investment required would be USD 725 billion for the period leading up to 2030. For clean cooking, the cumulative investment required would be USD 61.2 billion until 2030.[6] The annual investment required to achieve both universal electricity and cooking access can therefore be calculated to be USD 56 billion.

Global fossil fuel subsidies were estimated to be about USD 425 billion USD in 2015 (Merrill et al., 2017). This amount is eight times larger than the financing required to achieve universal electricity access and 97 times larger than the financing required to achieve universal access to clean cooking. Taken together, the global amount of fossil fuel subsidies is 7.5 times larger than the amount required for universal access to electricity and clean cooking (Figure 2). It should be noted, however, that the geographical prevalence of fossil fuel subsidies is not always identical with the regions that have the biggest energy access needs (Kitson et al., 2016). While the exact potential for reallocation depends on which countries have subsidies and how savings can be used, given political and economic realities, there are several ways in which this could happen in practice.

Figure 2. Comparison between global fossil fuel subsidies and financing required for universal energy access

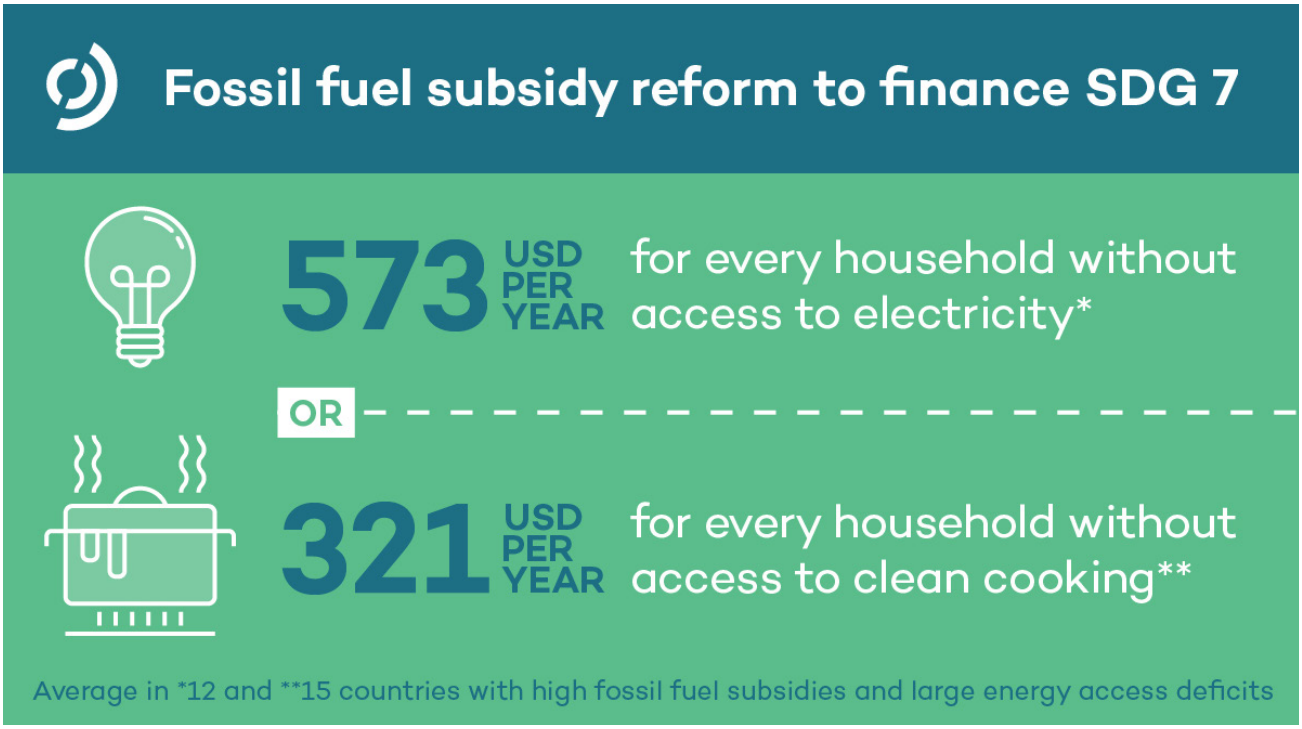


[6] For electricity, the IEA estimates that about a third each of that investment would be required for on-grid access, mini-grids (generation and distribution) and off-grid. For clean cooking, this scenario envisions access to LPG, natural gas and electricity for households in urban areas and improved and advanced cookstoves, LPG and biogas for households in rural areas (IEA, 2017a).

A comparison between development assistance for the energy sector and support provided to fossil fuels illustrates this: OECD countries supported fossil fuels with around USD 82 billion annually in 2015 and 2016 (OECD, 2018). A large share of these subsidies supports the production of fossil fuels and is not directly linked to energy access. In comparison, OECD countries committed USD 8.3 billion annually for development assistance to the energy sector in the same period (authors' calculation based on OECD Development Assistance Committee, n.d.). Fossil fuel subsidies cost 10 times the amount spent for energy development assistance. Redirecting a share of the current financing spent on supporting fossil fuels towards energy access goals could accelerate the achievement of SDG 7.

Fossil fuel subsidies have a large opportunity cost in countries with low access rates and limited amounts of government funds available.[7] The relationship between high fossil fuel subsidies and low spending on other sectors has been analyzed by Ebeke and Ngouana (2015, p. 1). They point out that "public expenditures in education and health were on average lower by 0.6 percentage point of GDP in countries where energy subsidies were 1 percentage point of GDP higher." The impact of fossil fuel subsidies on domestic budgets is crucial, given that the IEA estimates that 37 per cent of energy access finance comes from developing countries' own budgets (IEA, 2018). A review of countries that have considerable amounts of subsidies and large energy access needs demonstrates this effect (see Annex 1). In countries with high fossil fuel subsidies and large energy access deficits, fossil fuel subsidies were found to be equivalent to USD 573 per household without access to electricity (average of 12 countries) or USD 321 per household without access to clean cooking (average of 15 countries) (Figure 3). For example, Nigeria, where 61 per cent of households have access to electricity and only 6 per cent of households have access to clean cooking (IEA, 2017d), spent USD 2.5 billion on fossil fuel subsidies in 2016 according to an estimate by the IEA (2017c).

Figure 3. Fossil fuel subsidies per household without access to electricity or clean cooking in countries with high amounts of subsidies and large energy access needs



[7] Subsidy programs to support the introduction of fuels can become very expensive once uptake increases. For example, once LPG became more widely used, the Indonesian government spent almost 3 per cent of its government expenditure in 2014 on LPG subsidies (GSI, 2014). In India, in 2011/12, untargeted petroleum subsidies rose to USD 28 billion, triggering a fiscal deficit of 1.3 per cent of the GDP (GSI, 2012).

This money could be used to support grid electrification, the adoption of clean cooking technology or off-grid solar technologies. For example, a solar home system that provides four hours of television and lighting, six hours of radio and, one phone charge cost between USD 644 with standard appliances, and USD 354 with super-efficient appliances (2014 prices), with further rapid price decreases expected (Sturm et al., 2016; cf. Sadeque, 2014; Martinez, Oliver, & Trowbridge, 2017). While the upfront cost of the system is high, this cost can be spread out over the lifetime of the system, for example through pay-as-you-go business models. IRENA estimated the annualized cost of a 20 W or 100 W solar home system at USD 56 and USD 214 per year (IRENA, 2016). The large amount spent every year on fossil fuel subsidies could be used to support[8] these systems or other energy access technologies.

Fossil fuel subsidies also dwarf official development assistance. A comparison of fossil fuel subsidies with development finance disbursements in SEforALL "high-impact countries," which are priority countries for energy access (SEforALL, 2017), underlines this (see Table 1). In high-impact countries that also have large fossil fuel subsidies, fossil fuel subsidies were found to be between 2 and 19 times higher than development assistance to electricity.

Table 1. Comparison between development finance disbursements and fossil fuel subsidies

	IEA estimate of consumer subsidies to oil, gas, coal and electricity in 2016 (in USD millions)[a]	**Average annual development finance disbursements for electricity in high-impact countries** (in USD millions)[c]	**Ratio of fossil fuel subsidies to development finance disbursements for electricity**[d]
Angola	630	169.6	3.7
Democratic Republic of the Congo	678[b]	164.7	4.2
Mozambique	1'048[b]	115.8	9.1
Nigeria	2'472	132.1	18.7
Tanzania	750[b]	213.9	3.5
Bangladesh	1'018	473.1	2.2
India	13'353	1305.8	10.2

Sources: [a] IEA, 2017c [b] IMF, 2015 (if no IEA data) [c] SEforALL, 2017 [d] Authors' calculation

Countries that successfully reformed their fossil fuel subsidies have been able to invest savings into other sectors, including infrastructure. In Indonesia, a change of government in 2014 provided the opportunity to reform fossil fuel subsidies. Total fuel subsidies were reduced from IDR 246 trillion (about USD 20 billion) in 2014, which equalled 13 per cent of total state expenditure, to IDR 35 trillion in 2015, or 3 per cent of total state expenditure (Pradiptyo et al., 2016). USD 15 billion in savings were reinvested. Pradiptyo et al. (2016) found increases in three areas: a USD 10.1 billion increase in ministries' budgets, much of this supporting programs on human and economic development; a USD 4.5 billion capital injection into state-owned enterprises with a focus on infrastructure; and a USD 2.5 billion increase in transfer funds to regions and villages. Nevertheless, the savings were not directly invested in sustainable energy infrastructure or energy access.

In summary, reforming fossil fuel subsidies that exist both in developed as well as developing countries holds a huge potential to contribute to financing energy access. Nevertheless, this requires that savings from subsidy reform be strategically invested into energy access investments. This paper therefore aims to draw attention to this issue, given the large opportunities involved.

[8] This is not to advocate fully subsidizing energy technologies, but rather to provide support to low-income households, for example through support mechanisms such as vouchers, tax incentives or results-based financing (Energising Development, n.d.).

3.0 Good Intentions, Unintended Consequences: Common Problems with Consumption Subsidies for Energy Access

Affordability of energy matters, especially for poor households. The budgets of poor households are generally used to pay for the bare necessities, and poor households often spend a large share of their budgets on energy already. A study analyzing household surveys in nine developing countries found that the lowest income quintile spends between 5.8 per cent and 11 per cent of their household income on energy (Bacon, Bhattacharya, & Kojima, 2010). Affordability is a central criterion for decision making on energy use by poor households, besides many other factors that include cultural and behavioural characteristics, as well as external conditions such as availability and reliability of supply (cf. Kowsari & Zerriffi, 2011).

Affordability depends both on the income available and the relative price of fuels or electricity and equipment. This means that affordability can be influenced by an increase in the amount of income available, for example through social protection programs or cash transfers, as well as a reduction in energy prices. Kojima (2011) used regression analysis on household expenditure surveys in six countries (Guatemala, India, Indonesia, Kenya, Pakistan and Sri Lanka) to identify the variables of greatest significance in determining levels of LPG selection and consumption. They concluded that the most powerful effects on selection and consumption are household income, the price of LPG relative to other fuels and level of education. The importance of the relative price of different fuels for fuel switching has been confirmed in individual country studies (Alem, Hassen, & Köhli, 2014; Hassen, 2015; Laan, Beaton, & Presta, 2010).

Fossil fuel subsidies have been used in some countries to lower energy prices and make modern fuels more affordable for poorer households. For example, countries like India, Indonesia and Peru used LPG subsidies to incentivize its uptake and reduce the use of biomass for cooking. Nevertheless, practice has shown common challenges associated, especially with consumption subsidies,[9] that can even hinder universal energy access of poor households. This chapter will present the most common challenges that consumption subsidies pose for increasing energy access.

3.1 Consumption Subsidies Do Not Help People that Cannot Use the Subsidized Energy Source

Fossil fuel subsidies based on consumption only directly benefit households that live within reach of electricity infrastructure or fuel distribution networks, or that own the assets necessary to use certain fuels, such as vehicles in the case of gasoline and diesel or stoves in the case of natural gas and LPG. While this may seem obvious, it has serious consequences for the energy situation of poor households, especially in remote rural areas, but sometimes also urban and peri-urban slums.

In many countries with low energy access rates, the supply of modern energy does not reach beyond urban or peri-urban areas (Kusumawardhani et al., 2017). For example, in India, insufficient distribution networks mean that many households in rural areas cannot purchase subsidized LPG and therefore consumption subsidies do not benefit them (Merrill, 2014). For electricity, connections to the grid tend to be highly skewed toward higher-income groups (Huenteler et al., 2017; IMF, 2013). Analysis based on World Bank household-level microdata in the top 20 energy access deficit countries found that access to an electricity connection is four times higher for the highest quintile than for the lowest quintile (World Bank, 2018a).

[9] Consumption subsidies are based on the consumption of a fuel, as opposed to connection subsidies that support the equipment required to consume a fuel, such as a grid connection or an LPG cooker and cylinder.

Even if households live close to distribution networks, the upfront cost of getting a connection or the assets required for energy use can be prohibitively expensive—and without a connection or the right assets, consumption is effectively impossible, so consumption subsidies have no direct benefits. A study in India found that most urban poor households who purchased black market kerosene for cooking wanted to transition to LPG, but the high upfront cost of an LPG "connection" (the stove, first cylinder and service charges) was prohibitive (Parikh et al., 2014). For electricity, utilities can charge an upfront connection fee to new consumers that can reach over USD 300 per installation (African Development Bank Group, 2018). High connection costs are a de facto access barrier to electricity, limiting access for consumers who cannot afford those fees. Golumbeanu and Barnes (2013) found a telling correlation between high connection charges and electricity access, albeit using a very limited sample of countries, where every USD 10 increase in the connection charge corresponded to a 1.1 per cent decrease in the population with electricity. A study in Kenya found that demand for connections increased when connection fees were reduced (Lee, Miguel, & Wolfram, 2018).

Many countries are addressing the barriers to connections. In the context of electricity and cooking, connection subsidies can help to increase the population that is able to benefit from consumption subsidies. For electricity, subsidies to grid connections for poor households can take the form of direct cash transfers (to the utility or to the consumer), interest-free loans or deferred payment by installments. For example, in Rwanda connection fees can be paid over time, using a mixture of payments in installments and continuous payments via the electricity bill (Bishumba, 2017). Several countries have supported low-income households with clean cooking equipment, for example India under the Pradhan Mantri Ujjwala Yojana (PMUY) scheme. In Peru, the Fondo de Inclusión Social Energético (FISE) program provides free LPG cookstoves and subsidized LPG cylinders to make LPG more accessible (Kitson et al., 2016).

3.2 Badly Designed Consumption Subsidies Can Damage Supply, Drive Shortages and Push Up Prices

Fossil fuel subsidies can also have a negative impact on energy supply. First, consumer subsidies that reduce or fix the price of fossil-generated electricity can cause or exacerbate deficits in state-owned utilities (Nguyen, Bridle, & Wooders, 2014). As a result, existing infrastructure may not be maintained or improved, and the expansion of infrastructure to unconnected households is slow. For example, distribution companies (discoms) of the Indian Province of Rajasthan received large fiscal transfers from state government, which increased by 269 per cent between 2007 and 2013 to help reduce the utility's debt caused by consistently low tariffs (Garg, Sanchez, & Bridle, 2016). Nevertheless, the large debt burden and limited borrowing capacity undermined needed investment in transmission and distribution of electricity, failing to achieve the urgent rural electrification and energy access goals in this period. Low electricity tariffs can also provide a disincentive to utilities to extend the grid to rural areas or to improve the quality of supply. Venkateswaran, Solanki, Werner and Yadama (2018) found that, due to low incomes and low levels of consumption of rural households, discoms in India were found to give low priority to rural areas. As a result, power shortages are frequent, and a monitoring survey found that only 16 per cent of electrified rural households receive the entire six hours of electricity supply during the evening hours (Venkateswaran et al., 2018).

Second, smuggling and diversion of subsidized fuels can increase fuel scarcity. In India, subsidized kerosene is intended exclusively for poor households in both rural and urban areas. A study found that 45 per cent of the subsidized kerosene is lost from the official supply chain to the black market due to diversion and theft, leaving the poorest 20 per cent of the rural households with only 14 per cent of their intended share (Garg et al., 2017). Similar effects were observed in Nigeria, where black market diversion of subsidized kerosene created shortages and kerosene was found to be sold at two to five times the official subsidized price (Aramide et al., 2012).

Third, subsidies can lead to fiscal problems, which end up disrupting supply, particularly when expenditure is linked to world oil prices. In Indonesia in 2014, for example, higher-than-anticipated oil prices resulted in a gasoline subsidy bill that could not be afforded by the budget. The government responded by employing a strategy referred to as "nozzle reduction": restricting the sale of subsidized gasoline in certain gas stations across the country and banning the sale of subsidized fuel between 8.00 a.m. and 6.00 p.m. in areas prone to illegal distribution (Lontoh, Beaton, & Clarke, 2015). In Nigeria in 2015, the government's inability to reimburse importers for over USD 1 billion in backdated subsidy payments resulted in a breakdown of imported fuel supplies. Typically, such disruptions result in huge queues and mass unrest (The Economist, 2015).

3.3 Untargeted Consumption Subsidies Give More Benefits to People who Consume More Energy – and that Leaves Poor People Behind

Untargeted fossil fuel subsidies are an inefficient tool for reaching the poor. In countries where energy subsidies are untargeted, everyone can buy subsidized fuel at a low price, independent of their income. As a result, richer households who can afford to consume more energy and own more machines and devices, including cars, end up capturing a disproportionate share of benefits. The regressive nature of untargeted consumption subsidies is most pronounced for LPG and transport fuels. In a review of 32 countries, Coady, Flamini and Sears (2015) found that, on average, the lowest two income quintiles received only 7.4 per cent of gasoline subsidy benefits, while the two top income quintiles received 83.2 per cent. For LPG, the study found 12.7 per cent for the lowest two quintiles and 73.9 per cent for the top two quintiles.

This has been confirmed in a large number of studies assessing national programs (Ekouevi & Tuntivate, 2012; IMF, 2013). A GSI report found that, in Indonesia, only 12 per cent of the LPG subsidies benefited people in the bottom quintile (Kusumawardhani et al., 2017). Even for a fuel like kerosene that is used mostly by poorer households, studies in India and Nigeria found that subsidy benefits were distributed evenly across income groups (Clarke, 2014; Soile & Mu, 2015). Estimates of fuel subsidy inefficiency based on household consumption data are likely to underestimate the scale of the problem because they tend to assume that the price paid by households is the official, subsidized price while households may pay higher prices (Soile & Mu, 2015). A study on electricity subsidies in India found that about 87 per cent of subsidy payments go to households living above the poverty line instead of to the poor, and over half of subsidy payments go to the richest 40 per cent of households (Mayer, Banerjee, & Trimble, 2014). This effect is exacerbated by the fact that many poor people live outside the grid infrastructure or cannot afford to connect to the grid, as was described above.

Countries have employed a number of strategies and tools to restrict the group of beneficiaries of subsidy programs. For fuels, a very simple intervention is to reduce the size of containers in which subsidized fuels are available. This is because poor households typically find it easier to afford more frequent, low-value purchases than occasional, high-value purchases. For example, in India efforts have been made to improve the availability of smaller 5kg LPG cylinders (Samal, 2015). More sophisticated systems can involve vouchers or smart cards, or mobile phone-based verification to determine the entitlement of the buyer. A detailed description of different targeting mechanisms can be found in Toft, Beaton and Lontoh (2016). Many countries have also changed the subsidy system from a subsidy that is provided to the distributor of the fuels, to a direct transfer to the beneficiary after the purchase. For example, India introduced Aadhaar, a program based on a database of beneficiaries that can link LPG subsidies directly with beneficiaries' bank accounts, replacing price subsidies with bank transfers (Clarke, 2016). Like any subsidy, such systems require careful targeting, or they can be prohibitively expensive and inefficient.

Volumetric restrictions on the amount of subsidized energy that can be purchased are another effective way to restrict expenditures and prevent abuses, though it requires good administrative systems to measure and authenticate usage. For fuels, some countries, such as India and Peru, have restricted the number of cylinders

that a household is allowed to purchase. For electricity, differentiated tariffs between different consumption levels and consumer categories are common in developing countries to improve affordability and access among poor households (Huenteler et al., 2017), for example through increasing block tariffs (IBT) or volumetric differentiated tariffs (VDT).[10] Often, the lowest tariff block is (cross-)subsidized and called a "lifeline tariff" to assist the poorest consumers, assuming that low volumetric consumption will be a good proxy for low-income.

Box 4. Fossil fuel subsidies and gender

There has been little investigation on the impacts from fossil fuel subsidies and their reform on poor women. A scoping report by Kitson et al. (2016) provided an overview of how subsidies might affect women. This is a significant knowledge gap because energy use—and by extension policies that affect this use—varies between men and women (Skutsch, 2005). If subsidies are deemed to affect energy use, it is therefore likely that subsidies will affect men and women differently.

In particular, fossil fuel subsidies that affect cooking fuels—especially LPG and kerosene—can be expected to have starkly gender disaggregated impacts. In the majority of traditional societies, women are responsible for food preparation, and thus any change in the fuels used is likely to affect them more than men. In many cases, women and children are also responsible for collecting and preparing traditional fuels, and a switch to or from such fuels could be felt more acutely by women than by men. The potential effects on women of changes in the type of fuel can be broadly grouped into welfare impacts (quality of life), productivity (income-generating potential) and empowerment (power in decision making, control of assets, participation).

Nevertheless, and despite these benefits, it cannot be assumed that subsidizing modern fuels will lead to a transition to these same fuels. For example, as long as women do not engage in income-generating activities, and their time is considered to be "free," even very low (subsidized) prices for modern fuels will continue be higher than the perceived cost of collecting biomass.

These interactions and effects are rarely considered or assessed. A four-year research project conducted by the Global Subsidies Initiative under Energia's Gender and Energy Research Programme aimed at addressing this gap is currently underway. Findings will be published at the end of 2018.

3.4 Fossil Fuel Subsidies Are not a Magic Bullet

Energy access is a process that is influenced by the interaction of a complex set of factors. Just subsidizing a specific fuel or electricity is not sufficient to support the transition to other sources of energy like LPG or electricity, which are relevant in the context of SDG 7. Even with access to subsidies, households often do not transition completely to a new, or more modern fuel.[11] Instead, many households engage in "fuel stacking," using a mix of fuels for cooking and lighting (Masera, Saatkamp, & Kammen, 2000). Households may use a clean and convenient energy source, but only for quick tasks like making tea or preparing breakfast, while they continue to use traditional sources of energy that are harmful to health or time-consuming to acquire. This may be due to a range of reasons, among them the availability of "free" collected biomass (cf. Box 4 on fossil fuel subsidies and gender). Factors like cultural preferences and taste also matter and have to be addressed in comprehensive strategies.

[10] Under an IBT, the unit price of electricity is defined per consumption blocks, increasing with the level of consumption. A large consumer will thus pay a low price for the first units of electricity consumed and increasingly higher prices for the additional units. In the case of VDT, consumers pay a unique unit price depending on the total consumption. Unit prices are higher for higher consumption levels. Increasing block tariffs, despite being the most common tariff structure globally, are less efficient than volumetric block tariffs at targeting poor households, as all households pay the lower price for the first units consumed.

[11] The fuel is being defined as modern based on its energy density, combustion efficiency and other heat characteristics. For example, 1 kg of LPG can replace 2.5 kg of charcoal when used with an improved cook stove or 21.2 kg of raw wood in a traditional cook stove (GIZ n.d.)

Using untargeted fossil fuel subsidies to reach the energy access target can be compared to using a very unwieldy, heavy and expensive hammer for the renovation of a house, instead of opening the toolbox and using the tools that are adapted for the different tasks. There is a case for opening the toolbox and using the right tools at the right time, based on a frank and thorough analysis of the socioeconomic, policy and governance contexts. Comprehensive strategies could encompass, for example, an increase in connections and improvements in the reliability of supply, as well as awareness campaigns on the benefits, economics and safety of using modern fuels.

In many countries, fossil fuel subsidies support just one fuel, for example LPG for cooking. This is a missed opportunity, given the highly dynamic developments in the energy sector, with new technologies being developed and brought to market. There is also a need for a range of solutions adapted to different settings, for example remote regions. Ideally, support programs for energy access would adopt a technology-neutral approach, focusing on the energy services required rather than promoting just one energy technology. More technology-neutral incentives could support a range of technologies, based on the services delivered, as well as different business models. This is especially relevant given the importance of private-sector-driven approaches for off-grid energy access. Such an approach could address the fact that many poor households live outside of distribution networks for subsidized fossil fuels and electricity and continue to use traditional biomass for cooking. A technology-neutral subsidy could embrace a range of solutions that can provide the energy service, including off-grid technologies. For example, Peru rapidly expanded an LPG subsidy scheme (FISE), but LPG distribution was unable to reach rural households living too far from the distribution networks. In light of this, the Peruvian government launched an improved cookstove scheme to reap health benefits (Kitson et al., 2016). Nevertheless, the program supported only the upfront costs of improved cookstoves and not repair and maintenance, while LPG receives continuous subsidies for cylinder refills. Another example of a focus on services would be to subsidize transport services instead of transport fuels. Investing socially regressive transport fuel subsidies into improvements in public transport has the potential to benefit poorer households while improving the livability and economic prospects of cities.

Another option is to subsidize the consumer, rather than a specific energy product or carrier. Countries may—alternatively or in parallel with subsidies—choose to supplement household incomes, for example with cash transfers. This reflects the fact that income is as important a variable as relative pricing in influencing household consumption of modern energy. Unless they are made conditional upon the purchase of specific energy sources, such mechanisms are automatically technology-neutral and allow households to allocate income to energy technologies that are most cost-competitive for their circumstances, and to alter their patterns of expenditure as shifts in energy technology competitiveness take place over time.[12]

[12] One potential challenge with cash transfers is that households may choose to invest additional resources into needs other than energy access, so it is hard to guarantee that energy access commitments will be achieved. Such flexibility can result in improved outcomes, as it empowers people to decide how best to meet their own needs. However, optimum decision-making may rely upon full information and be influenced by psychological attitudes regarding short-term versus long-term benefits.

4.0 "Remove, Target and Swap": Smart Strategies for Fossil Fuel Subsidy Reform and Energy Access

Financing the sustainable energy access transition requires a substantial amount of funding. Reforming fossil fuel subsidies that have no benefit for energy access and investing the money saved into reaching the energy access target can contribute to this. Smart strategies for fossil fuel subsidy reform to boost energy access will be presented in this last section. These strategies fall into three broad categories: remove subsidies that do not support or might even hinder energy access; target fossil fuel subsidies that contribute to reaching SDG 7 towards access and those people that really need them; swap existing fossil fuel subsidies by investing in renewable energy technologies and energy efficiency.

4.1 Remove: Phase Out Subsidies that Have no Benefit for Energy Access

Reforming subsidies can free substantial amounts of financing that could be used for energy access or other government priorities. Inefficient fossil fuel subsidies that do not benefit energy access should therefore be removed. There are several types of fossil fuel subsidies that do not directly support energy access but bind significant resources and should therefore be phased out. This includes producer subsidies, but also untargeted consumption subsidies, especially on fuels that are mostly used by wealthier households such as transport fuels.

Nevertheless, any attempt to reform subsidies needs to be implemented extremely carefully—just because a subsidy is inefficient or not very effective, this does not mean that there will be no impacts on poor households if it is changed. In countries where fossil fuel subsidies exist, their removal without the introduction of compensation mechanisms can lead to an increase in poverty levels (Arze del Granado et al., 2012; Beaton et al., 2013). Poor households are often not able to absorb rapid price increases due to limited income available (Laderchi, Olivier & Trimble, 2013). The GSI recommends analyzing possible negative and positive impacts, for example on households, businesses, the economy and the environment prior to reform. This allows governments to introduce or strengthen mitigation measures such as investments in social programs or cash transfers that can attenuate these impacts (Beaton et al., 2013).

4.2 Target: Redesign Subsidies to Support Energy Access and Those that Really Need Them

The uptake of LPG and electricity is a central element in scenarios for how to achieve SDG 7 (IEA, 2017b).[13] LPG is a clean-burning fuel that has considerable health, time-saving and environmental benefits (Bruce, Aunan, & Rehfuess, 2017; ESMAP & GACC, 2015). Electricity is a flexible energy source that creates no indoor air pollution, saves time, aids productivity and supports education (Khandker et al., 2009; Morimoto & Hope, 2001; U.S. AID, n.d.). Targeted subsidies to support the uptake and use by poor households of modern energy can be a relevant element in energy access strategies. To remedy some of the problems associated especially with consumption subsidies, it is recommended to be extremely restrictive in the set-up of incentive programs and target the subsidies to those that really need them. To establish which groups of the population require support for their energy consumption, a thorough analysis based on household consumption data is necessary.

[13] Kerosene is a polluting fuel, and the WHO recommends that governments and practitioners immediately stop promoting its household use (WHO, 2016).

Support connections to the grid and clean cooking equipment: The upfront cost for energy access, such as for a grid connection fee or equipment for clean cooking like a gas cooker and cylinder, can be a high barrier for low-income households. Support to households with this upfront cost can make a major contribution to increasing uptake of these energy technologies. The key design factors that influence the effectiveness and efficiency of equipment subsidies are the contributions (if any) required by households and the quality of the targeting. Such support is generally time-limited and does not incentivize overconsumption. As it mostly presents a one-off investment rather than an ongoing financial commitment, this can also reduce financial exposure of governments. If well designed, these subsidies can support poor households that cannot afford the upfront cost of purchasing the equipment and can support energy access for poor households.

Target subsidies to those that really need them: Targeting subsidies to poor households means that subsidy benefits can be clustered to those that need them most, while mitigating some of the disadvantages like strain on budgets and wasteful consumption. Targeting can cover two dimensions: restricting the group of beneficiaries and restricting the amount of benefits that these beneficiaries are entitled to. It should be noted, however, that restricting subsidies to those that need it can be difficult to implement. The targeting of subsidies should be introduced cautiously and consider relevant mitigation measures.

Countries have employed a number of strategies and tools to restrict the group of beneficiaries of subsidy programs. Some of these have been discussed in section 3.3. A detailed description of different targeting mechanisms can be found in Toft et al. (2016). Subsidy reform strategies often employ a mix of instruments for targeting; for example, since 2014, India has introduced a series of policy measures to improve targeting of its LPG subsidies to poor households. The number of cylinders that households were allowed to purchase was reduced to 12 per year; the transfer of the subsidy is implemented via bank accounts; and income-based filters and voluntary campaigns to give up the subsidy have been used to better target the subsidies.

Alternatively, some countries may choose to focus on supplementing household incomes, rather than trying to directly intervene in energy pricing, as both income and price are major factors that influence consumption patterns. Cash transfers also require targeting so that benefits are efficiently delivered to the poor.

4.3 Swaps: Invest in Renewable Energy and Energy Efficiency

Reinvesting savings from fossil fuel subsidy reform into renewable energy and energy efficiency—a subsidy "swap"—is an option to reap tangible benefits to the population and mitigate the effects of fossil fuel subsidy reform. A swap can target both on-grid and off-grid technologies. Electricity subsidies are mostly restricted to on-grid electricity, which excludes households that live far from the grid. Savings from fossil fuel subsidy reform could be used to support the introduction of solar home systems or mini-grids to increase energy access in remote areas. Distributed (off-grid) electricity systems are estimated to be the least-cost solution for allowing access to electricity to a majority in Bangladesh, Kenya and Togo (Stevens et al., 2017). Supporting off-grid solutions can also be an excellent alternative to kerosene subsidies for lighting. In India, a cost comparison found that if kerosene subsidies were removed, households with mid-level solar systems make significant savings by switching to solar over two years (Garg et al., 2017). Switching subsidies from diesel to solar pumps could have significant positive impacts on public budgets and carbon emissions (Merrill et al., 2017). An important element of swaps are therefore well-adapted business models to support these technologies that take into account the role of the private sector and the economics of poor households, for example in terms of spending patterns, convenience and risk aversion.

For grid electricity, removing subsidies to input fuels like gas or coal and using the savings to increase the share of renewable energy in the electricity mix can remedy the harmful effect on the environment. Support for energy efficiency, the "hidden fuel," could also smoothen a transition from a system of artificially low fuel prices. This is especially relevant given that low fuel prices often lead to underinvestments in efficient technologies and devices.

Outlook: Reforming fossil fuel subsidies for the future we want

Reaching SDG 7 for universal energy access requires massively increased efforts in addition to the initiatives already underway. At the current speed, 674 million people will be without electricity access, and 2.3 billion without access to clean cooking by 2030. Nevertheless, the energy sector is very dynamic, with new technologies and new players and companies entering the field.

Reforming fossil fuel subsidies provides an opportunity to embrace the future and accelerate the transition towards sustainable energy access. To achieve the vision of SDG 7 and the Agenda 2030, it is crucial that reforms are implemented in a way that mitigates the effects on poor households, and that at least part of the savings can be reinvested to support positive outcomes that make societies more resilient and increase cohesion. A wide range of options can support people instead of fuels, from investments in off-grid technologies to public transport or social protection.

Countries have already committed to phasing out fossil fuel subsidies, for example under the G7, G20, APEC and the SDGs. Political leadership paired with active participation by civil society is required to reform fossil fuel subsidies and shape new pathways for a sustainable and livable future.

References

African Development Bank Group. (2018). Kenya – Last Mile Connectivity Project. Retrieved from https://www.afdb.org/en/projects-and-operations/project-portfolio/p-ke-fa0-010/

Alem, Y., Hassen, S., & Köhlin, G. (2014). Adoption and disadoption of electric cookstoves in urban Ethiopia: Evidence from panel data. *Resource and Energy Economics, 38*, 110–124. Retrieved from https://doi.org/https://doi.org/10.1016/j.reseneeco.2014.06.004

Aramide, J., Beaton, C., Ejekwumadu, I., Gbadebo-Smith, D. F., Solanke, O., Vis-Dunbar, D., & Wooders, P. (2012). A citizens ' guide to energy subsidies. Winnipeg: IISD.

Arze del Granado, F. J., Coady, D., & Gillingham, R. (2012). The unequal benefits of fuel subsidies: A review of evidence for developing countries. *World Development, 40*(11), 2234–2248. Retrieved from https://doi.org/10.1016/j.worlddev.2012.05.005

Attwood, C., Bridle, R., Gass, P., Halimanjaya, A., Laan, T., Lontoh, L., . . . Christensen, L. (2017). *Financial supports for coal and renewables in Indonesia*. Winnipeg: IISD.

Bacon, R., Bhattacharya, S., & Kojima, M. (2010). *Expenditure of low-income households on energy: Evidence from Africa and Asia* (Extractive Industries for Development Series No. 16). Washington, D.C.: World Bank.

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*. Winnipeg: IISD.

Bishumba, N. (2017, January 11). Officials explain recent power pricing. Retrieved from http://www.newtimes.co.rw/section/read/206999

Bruce, N. G., Aunan, K., & Rehfuess, E. A. (2017). *Liquefied petroleum gas as a clean cooking fuel for developing countries: Implications for climate, forests, and affordability*. (Materials on Development Financing No. 7). Retrieved from https://doi.org/10.13140/RG.2.1.1575.6003

Burniaux, J.-M., & Chateau, J. (2011). *Mitigation potential of removing fossil fuel subsidies* (OECD Economics Department Working Papers Vol. 853). Retrieved from https://doi.org/10.1787/5kgdx1jr2plp-en

Clarke, K. (2014). *Kerosene subsidies in India*. Winnipeg: IISD.

Clarke, K. (2016). *Estimating the impact of India's Aadhaar Scheme on LPG subsidy expenditure*. Retrieved from http://www.iisd.org/gsi/subsidy-watch-blog/estimating-impact-indias-aadhaar-scheme-lpg-subsidy-expenditure

Coady, D., Flamini, V., & Sears, L. (2015). *The unequal benefits of fuel subsidies revisited: Evidence for developing countries*. (IMF Working Papers Vol. WP/15/250). Washington, D.C.: IMF.

Coady, D., Parry, I., Sears, L., & Shang, B. (2015). *How large are global energy subsidies?* (International Monetary Fund Vol. Fiscal Aff). Washington, D.C.: IMF.

Ebeke, C., & Ngouana, C. L. (2015). *Energy subsidies and public social spending: Theory and evidence* (IMF WP/15/101). Washington, D.C.: IMF.

Ekouevi, K., & Tuntivate, V. (2012). *Household energy access for cooking and heating: Lessons learned and the way forward*. Washington, D.C.: World Bank.

Energising Development. (n.d.). Results-based financing. Retrieved from https://endev.info/content/Results-Based_Financing

ESMAP, & GACC. (2015). *The state of the global clean and improved cooking sector*. Washington, D.C.: ESMAP and GACC.

Garg, V., Sanchez, L., & Bridle, R. (2016). *An assessment of the financial sustainability of the electricity sector in Rajasthan*. Winnipeg: IISD.

Garg, V., Gerasimchuk, I., Bandyopadhyay, K., Beaton, C., Chugh, G., Gupta, A., . . . Patel, S. (2017, December). *India's energy transition: Mapping subsidies to fossil fuels and clean energy in India*. Winnipeg: IISD.

Gerasimchuk, I., Wooders, P., Merrill, L., Sanchez, L., & Kitson, L. (2017). *A guidebook to reviews of fossil fuel subsidies*. Geneva: IISD-GSI.

Gerasimchuk, I., Bassi, A., Dominguez Ordonez, C., Doukas, A., Merrill, L., Whitley, S. (2017). *Zombie energy: Climate benefits of ending subsidies to fossil fuel production*. Geneva: IISD-GSI.

GIZ. (n.d.). *Multiple household fuel use*. Retrieved from https://cleancookstoves.org/binary-data/RESOURCE/file/000/000/287-1.pdf.

Global Subsidies Initiative. (2010). *A how-to guide: Measuring subsidies to fossil-fuel producers*. Geneva: IISD-GSI.

Global Subsidies Initiative. (2012). *India's fuel subsidies: Q & A*. Geneva: IISD-GSI.

Global Subsidies Initiative. (2014). *LPG subsidies in Indonesia: How can they be targeted to those in need?* Geneva: IISD-GSI.

Golumbeanu, R. & Barnes, D. (2013). *Connection charges and electricity access in sub-Saharan Africa*. (Policy Research Working Paper 6511). Washington, D.C.: World Bank.

Hassen, S. (2015). *On the adoption and dis-adoption of household energy and farm technologies*. Gothenburg: Department of Economics, University of Gothenburg.

Huenteler, J., Dobozi, I., Balabanyan, A., & Banerjee, S. G. (2017). *Cost recovery and financial viability of the power sector in developing countries: A literature review* (Policy Research Working Paper No. 8287). Washington, D.C.: World Bank.

International Energy Agency. (2005). *Energy statistics–Manual*. Paris: International Energy Agency.

International Energy Agency. (2015a). *World energy outlook 2015.* Paris: International Energy Agency.

International Energy Agency. (2015b). *World energy outlook 2015: Special report on energy and climate change*. Paris: International Energy Agency.

International Energy Agency. (2017a). *Energy access outlook 2017: From poverty to prosperity*. Paris: International Energy Agency.

International Energy Agency. (2017b). *World energy outlook 2017.* Paris: International Energy Agency.

International Energy Agency. (2017c). *IEA fossil-fuel subsidies database*. Retrieved January 5, 2018, from https://www.iea.org/media/publications/weo/Subsidies20142016.xlsx

International Energy Agency. (2017d). *Energy access database*. Retrieved from https://www.iea.org/energyaccess/database/

International Energy Agency. (2018). *Financing energy access*. Retrieved from https://www.iea.org/energyaccess/financingenergyaccess/

International Monetary Fund. (2013). *Energy subsidy reform in sub-Saharan Africa: Experiences and lessons.* Washington, D.C.: World Bank.

Inchauste, G., & Victor, D. G. (eds). (2017). *The political economy of subsidy reform.* Retrieved from https://doi.org/10.1596/978-1-4648-1007-7

IRENA. (2016). *Solar PV in Africa: Costs and markets.* Abu Dhabi: IRENA.

IRENA. (2018). *Measurement and estimation of off-grid solar, hydro and biogas energy.* Abu Dhabi: IRENA.

Jewell, J., McCollum, D., Emmerling, J., Bertram, C., Gernaat, D. E., Krey, V., . . . Riahi, K. (2018). Limited emission reductions from fuel subsidy removal except in energy-exporting regions. *Nature, 554*(7691), 229–233

Khandker, S. R., Barnes, D. F., & Samad, H. a. (2009). *Welfare impacts of rural electrification: A case study from Bangladesh* (World Bank Policy Research Working Paper 4859). Washington, D.C.: World Bank.

Kitson, L., Merrill, L., Beaton, C., Sharma, S., McCarthy, A., Singh, C., … Chowdhury, T. T. (2016). *Gender and fossil fuel subsidy reform: Current status of research*. Winnipeg: IISD.

Kojima, M. (2011, December). The role of liquefied petroleum in reducing energy poverty. Extractive Industries for Development Series, 25, 34–36. Washington, D.C.: World Bank.

Kojima, M., & Koplow, D. (2015, March). *Fossil fuel subsidies approaches and valuation* (Energy and Extractives Global Practice Group, 7220). Washington, D.C.: World Bank.

Koplitz, S. N. (2017). Burden of disease from rising coal-fired power plant emissions in Southeast Asia. *Environmental Science & Technology, 51*(3), 1467–1476.

Kowsari, R., & Zerriffi, H. (2011). Three dimensional energy profile: A conceptual framework for assessing household energy use. *Energy Policy, 39*(12), 7505–7517.

Kusumawardhani, N., Hilman, R., Laan, T., Warda, N., & Nurbani, R. (2017). Gender and fossil fuel subsidy reform: An audit of data on energy subsidies, energy use and gender in Indonesia. *Energy Research and Social Science, 40*, 205–210.

Laan, T., Beaton, C., & Presta, B. (2010). *Strategies for reforming fossil-fuel subsidies: Practical lessons from Ghana, France and Senegal*. Winnipeg: IISD.

Laderchi, C. R., Olivier, A., & Trimble, C. (2013). *Balancing act: Cutting energy subsidies while protecting affordability*. Washington, D.C.: World Bank.

Lee, K., Miguel, E., & Wolfram, C. (n.d.). *Environment & energy*. Retrieved from https://www.povertyactionlab.org/evaluation/demand-and-costs-rural-electrification-kenya

Lontoh, L., Beaton, C., & Clarke, K. (2015). *Indonesia energy subsidy review* (Vol. 2). Geneva: IISD-GSI.

Martinez, N., Oliver, P., & Trowbridge, A. (2017). *Cost-benefit analysis of off-grid solar investments in East Africa*. Washington, D.C.: U.S. AID.

Masera, O. R., Saatkamp, B. D., & Kammen, D. M. (2000). From linear fuel switching to multiple cooking strategies: A critique and alternative to the energy ladder model. *World Development, 28*(12), 2083–2103.

Mayer, K., Banerjee, S. G., & Trimble, C. (2014). *Elite capture: Subsidizing electricity use by Indian households*. Washington, D.C.: World Bank.

Merrill, L. (2014). *Power, gender and fossil-fuel subsidy*. Winnipeg: IISD.

Merrill, L., Bassi, A. M., Bridle, R., & Christensen, L. T. (2015). *Tackling fossil fuel subsidies and climate change: Levelling the energy playing field*. Copenhagen: Nordic Council of Ministers.

Merrill et al. (2017). *Making the switch: From fossil fuel subsidies to sustainable energy*. Copenhagen: Nordic Council of Ministers.

Morimoto, R., & Hope, C. (2001). *The impact of electricity supply on economic growth in Sri Lanka*. (Research Papers In Management Studies WP 24/2001). Retrieved from https://www.jbs.cam.ac.uk/fileadmin/user_upload/research/workingpapers/wp0124.pdf

Muller, C., & Yan, H. (2018). Household fuel use in developing countries: Review of theory and evidence. *Energy Economics, 70*, 429–439. Retrieved from https://doi.org/10.1016/J.ENECO.2018.01.024

Nguyen, T., Bridle, R., & Wooders, P. (2014). *A financially sustainable power sector: Developing assessment methodologies*. Winnipeg: IISD.

Organisation for Economic Co-operation and Development. (2015). *Companion to the inventory of support measures for fossil fuels 2015*. Paris: OECD.

Organisation for Economic Co-operation and Development. (2018). *Companion to the inventory of support measures for fossil fuels 2018*. Paris: OECD.

OECD Development Assistance Committee. (n.d.). *OECD DAC statistics*. Retrieved from https://stats.oecd.org/qwids/

Parikh, J., Chandrasekhar, Khedkar, G., Rahiman, R., Dhingra, M., & Puri, R. (2014). *Report on evaluation of the scheme for kerosene free Delhi*. Retrieved from http://irade.org/KFD Report_final.pdf

Pradiptyo, R., Susamto, A., Wirotomo, A., Adisasmita, A., & Beaton, C. (2016). *Financing development with fossil fuel subsidies: The reallocation of Indonesia's gasoline and diesel subsidies in 2015*. Winnipeg: IISD.

Sadeque, Z. K. (2014, March 25). *Why do more than 50,000 families in Bangladesh buy a solar home system every month?*. Retrieved from https://blogs.worldbank.org/energy/why-do-more-50000-families-bangladesh-buy-solar-home-system-every-month

Samal, D. P. (2015, January 6). *Now, subsidized 5 kg LPG cymlinders for BPL families.* Retrieved from http://www.dnaindia.com/locality/bhubaneshwar/now-subsidised-5-kg-lpg-cylinders-bpl-families-49822

Schwanitz, V. J., Piontek, F., Bertram, C., & Luderer, G. (2014). Long-term climate policy implications of phasing out fossil fuel subsidies. *Energy Policy, 67*, 882–894. Retrieved from https://doi.org/10.1016/j.enpol.2013.12.015

SEforALL. (2017). *Missing the mark. Gaps and lags in the disbursement of development finance for energy access*. Vienna: SEforALL.

Skutsch, M. M. (2005). Gender analysis for energy projects and programmes. *Energy for Sustainable Development, 9*(1), 37–52. Retrieved from https://doi.org/10.1016/S0973-0826(08)60481-0

Soile, I., & Mu, X. (2015). Who benefit most from fuel subsidies? Evidence from Nigeria. *Energy Policy, 87*, 314–324. Retrieved from https://doi.org/10.1016/j.enpol.2015.09.018

Stevens, L., Leopold, A., Taylor, C. Santangelo, E., & Rosenberg-Jansen, S. (2017). *Poor people's energy outlook 2017: Financing national energy access: A bottom-up approach*. Practical Action.

Sturm, R., Njagi, A. I., Blyth, L., Bruck, N., Slaibi, A., Alstone, P., … Chase, J. (2016). *Off-grid solar market trends report 2016*. Bloomberg New Energy Finance, Lighting Global and Global Off-Grid Lighting Association. Retrieved from https://doi.org/10.1017/CBO9781107415324.004

Sustainable Development Goal Knowledge Platform. (n.d.a). *Sustainable Devbelopment Goal 7: Targets and indicators*. Retrieved from https://sustainabledevelopment.un.org/sdg7

Sustainable Development Goal Knowledge Platform. (n.d.b). *Sustainable Devbelopment Goal 12: Targets and indicators*. Retrieved from https://sustainabledevelopment.un.org/sdg12

The Economist. (2015, May 28). *Problems at the pump*. Retrieved from https://www.economist.com/middle-east-and-africa/2015/05/28/problems-at-the-pump

The Lancet. (2017). *Pollution and heatlh infographic*. Retrieved from https://www.thelancet.com/pb-assets/Lancet/stories/commissions/pollution-2017/Pollution_and_Health_Infographic.pdf?code=lancet-site

Toft, L., Beaton, C., & Lontoh, L. (2016). *International experiences with LPG subsidy reform: Options for Indonesia*. Winnipeg: IISD.

U.S. Agency for International Development. (n.d.). *The role of energy in development*. Retrieved from http://www.energytoolbox.org/library/infra2007/references/energy/The_Role_of_Energy_in_Development.pdf

Venkateswaran, J., Solanki, C. S., Werner, K., & Yadama, G. N. (2018, January). Addressing energy poverty in India: A systems perspective on the role of localization, affordability, and saturation in implementing solar technologies. *Energy Research and Social Science, 40*, 205–210. Retrieved from https://doi.org/10.1016/j.erss.2018.02.011

World Health Organization. (2016). *Burning opportunity: Clean household energy for health, sustainable development, and wellbeing of women and children*. Geneva: WHO.

World Bank. (2015). *Beyond connections: Energy access redefined* (Technical Report 008/15). Washington, D.C.: World Bank.

World Bank. (2018a). *Tracking SDG7: The energy progress report 2018*. Washington, D.C: World Bank.

World Bank. (2018b). *Electricity production from oil, gas and coal sources* (% of total). Retrieved from https://data.worldbank.org/indicator/EG.ELC.FOSL.ZS

World Trade Organization. (n.d.). *Agreement on Subsidies and Countervailing Measures*. Retrieved from https://www.wto.org/English/docs_e/legal_e/24-scm.pdf

Annex 1: Fossil Fuel Subsidies Per Households without Electricity or Clean Cooking Access in Countries with High Energy Access Deficits

	Electricity access[a]	Cooking access[a]	FFS in million USD[b]	FFS as a percentage of GDP[d]	FFS per household without electricity in USD[d]	FFS per household without cooking access in USD[d]
Angola	35%	40%	630	1%	-	-
Cameroon	63%	23%	766c	2%	452	221
Democratic Republic of the Congo	15%	5%	678c	2%	53	48
Ghana	84%	29%	31	0%	24	6
Mozambique	29%	5%	1'048[c]	10%	225	174
Nigeria	61%	6%	2'472	1%	155	66
Tanzania	33%	5%	750[c]	2%	99	72
Zimbabwe	34%	29%	2'701[c]	16%	1'045	998
Bangladesh	75%	17%	1'018	0%	113	34
China	100%	67%	36'784[c]	0%	-	249
India	82%	36%	13'353	1%	268	77
Indonesia	91%	68%	15'550	2%	2'704	752
Pakistan	74%	50%	1'498	1%	200	107
Sri Lanka	100%	17%	64	0%	-	14
Vietnam	98%	59%	102	0%	242	10
Bolivia	92%	83%	570	2%	n.a.	1'109

Sources:

[a] *IEA, 2017d*

[b] *IEA, 2017b*

[c] *IMF, 2015 (if no IEA data)*

[d] *Calculation based on www.data.worldbank.org ; household size based on https://population.un.org/Household/index.html#/countries*

IISD Head Office

111 Lombard Avenue, Suite 325
Winnipeg, Manitoba
Canada R3B 0T4

Tel: +1 (204) 958-7700
Website: www.iisd.org
Twitter: @IISD_news

Global Subsidies Initiative

International Environment House 2
9 chemin de Balexert, 1219 Châtelaine
Geneva, Switzerland

Tel: +41 22 917-8683
Website: www.iisd.org/gsi
Twitter: @globalsubsidies

IISD

Global Subsidies Initiative