Global Energy Subsidies

August - 2021

The Al-Attiyah Foundation

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INTRODUCTION

GLOBAL ENERGY SUBSIDIES

Energy products are commonly subsidised in both industrialised and developing countries for a host of reasons, even as governments face increasing pressure for energy policy to converge around efficiency, sustainability, affordability, and access. What is the status and amount of these subsidies?

What are the different types, and what impact do they have on energy supply, demand, and greenhouse gas emissions? What policies are being adopted to reduce or restructure subsidies, and what are the barriers? What role can subsidies play in the global energy transformation?

THE ABDULLAH BIN HAMAD AL ATTIYAH FOUNDATION

Energy Industry Report

This research paper is part of a 12-month series published by The Al-Attiyah Foundation every year. Each in-depth research paper focuses on a prevalent energy topic that is of interest to The Foundation's members and partners. The 12 technical papers are distributed in hard copy to members, partners, and universities, as well as made available online to all Foundation members.

EXECUTIVE SUMMARY

- Energy subsidies are large and varied, with a number of estimates of their magnitude. They affect choices between different energy sources and methods of use, and they affect total production and consumption of energy.
- Current estimates for subsidies are dominated by fossil fuels. Some organisations cover subsidies to renewables and nuclear power too, but these are limited. However, this also needs to be compared to the total amount of energy supplied by each source.
- Energy subsidies arise as a result of deliberate interventions by governments to correct perceived market failures. They are also pursued to provide affordable energy for lower-income members of society, correct markets for unpriced externalities, induce learning to drive down the costs of new technologies, reduce import dependence, enhance energy security, and create employment.
- There are two main forms of subsidies – producer and consumer. Energy producer subsidies are more prevalent in developed markets, while consumer subsidies are more in developing ones. However, they can exist side-by-side in many countries, where a complicated series of subsidies may benefit different stakeholders in a range of ways.
- Subsidising energy may have a negative interaction with environmental policy goals as it can encourage higher use of polluting fossil fuels. If fuels are imported, the subsidy programme can also have a negative impact on the country's balance of payments. Energy subsidies can also lead to a loss of economic efficiency.
- Subsidy reform is imperative to meet oil and gas producers' NDCs under the Paris Agreement. A recent report from the IISD found that reforming fossil fuel consumption subsidies could reduce global greenhouse gas emissions by nearly 5.5 billion tonnes (Gt) of carbon dioxide by 2030, saving governments nearly US$ 3 trillion cumulatively.
- A virtuous circle is an integrated approach to subsidy reform, wherein subsidy reform makes energy efficiency imperative and more attractive, and energy efficiency makes subsidy reform more politically feasible.
- Subsidies to clean-tech can help new, rapidly-growing industries like hydrogen to overcome the incumbent advantage currently held by fossil fuels. Government support can allow a new technology to reach sufficient scale for commercial deployment, allowing a country to better meet its carbon targets. Mechanisms are required to phase out expensive subsidies as new technologies approach standalone commercial viability.

WHY DO ENERGY SUBSIDIES MATTER?

Energy is a crucial input to the global economy, about 73% of greenhouse gas emissions are related to the energy sector, and energy poverty affects between 1-3 billion people worldwide, depending on definitions. Energy subsidies change choices between different energy sources and methods of use, and they affect total production and consumption of energy. They have very important distributional effects, and can both ameliorate and exacerbate income inequality. They represent a severe burden on the budgets of numerous governments, which might be better spent on health, education or other methods of alleviating poverty and improving human wellbeing. On the other hand, some form of subsidies is widely judged as essential to encourage the development and uptake of new clean energy sources.

Phasing out energy subsidies has often proved to be extremely difficult, because of the political strength of affected groups, whether consumers or corporations. Reform policies have sometimes led to political unrest and economic distress. The optimal choice and design of energy subsidies is therefore a key regulatory, political and economic question, with major environmental ramifications.

ENERGY SUBSIDIES

A number of estimates exist for the world's energy sector subsidies, but not all cover the total range of subsidies, i.e. to fossil fuels, renewables, nuclear power and electricity, and covering both producer and consumer subsidies. Estimates are large and varied, and dominated by fossil fuels. Variations arise from different definitions for subsidies, the policies underpinning the criteria of defining a subsidy, calculation methods, and their geographic scope, i.e. the number of countries covered. This leads to a wide range of estimates for subsidies.

The International Renewable Energy Agency (IRENA) estimates total, direct subsidies to the energy sector at; US$ 634 billion in 2017, dominated by subsidies to fossil fuels, which account for around 70%, or US$ 447 billion of the total[i]. The International Energy Agency (IEA) meanwhile, which tracks global fossil fuel consumption subsidies for 42 predominantly non-OECD countries, reported subsidies of US$ 357 billion in 2017, US$ 472 billion in 2018, and US$ 312 billion in 2019[ii]. The International Institute for Sustainable Development (IISD) estimates global fossil fuel subsidies (production and consumption) at US$ 372 billion in 2019, and renewable energy subsidies at US$ 100 billion for the same year[iii], although it does not define its geographic scope.

Global financial organisations like the International Monetary Fund (IMF), on the other hand, estimate fossil fuel subsidies of US$ 4.9 trillion in 2015 and US$ 5.3 trillion in 2017[iv] across 191 countries, based on an externalities approach that includes climate and health impacts, unlike the more conventional price-gap approach adopted by the IEA. The price-gap approach is primarily driven by changes in fossil fuel prices, but also due to some structural reforms.

On the other hand, differing from both the IMF and the IEA, the OECD examines the impact of individual programmes on subsidies for fossil fuels, from tax exemptions to financial support during periods of low prices, to drive its estimates across 36 OECD countries, plus Argentina, Brazil, China, Colombia, India, Indonesia, Russia, and South Africa.

The lack of a systematically applied, standardised definition of an energy subsidy, despite the prevalence of subsidies in the energy system, has contributed in large part to the wide variance in estimates.
A systematic definition can contribute to a systematic methodology to calculate subsidies, lessening variance in estimates. Apart from the IMF definition, which indicates the use of both a price-gap and inventory approach in calculating subsidies, all others are based on only one of the two.

The three commonly used approaches to calculating subsidy levels[v] are:

1. Inventory Approach: A programme-specific estimation where sources of energy subsidies are identified and quantified, also known as programme-by-programme accounting
2. Price-gap Approach: An approach that identifies producer and consumer support estimates based on comparing actual prices to a reference price
3. Total Support Approach: An approach that identifies consumer and producer support levels, typically to-date, by combining the above two approaches

Table 1 Definitions of energy subsidies

Organisation	Definition	Countries Covered	Calculation Method Used	Focus
World Trade Organisation (WTO)	A financial contribution by a government or any public body within the territory of a Member [of the WTO], or when "there is any form of price support… (where) a benefit is thereby conferred".	164 member countries	Unclear	• Dispute settlements • Impact of energy subsidies on trade
International Energy Agency (IEA)	Any government action directed primarily at the energy sector that lowers the cost of energy production, raises the price received by energy producers or lowers the price paid by energy consumers. It can be applied to fossil and non-fossil energy in the same way.	42, predominantly non-OECD	Price-gap approach	• Subsidy analysis • Trends, magnitude, incidence over time
Organisation for Economic Co-operation and Development (OECD)	Both direct budgetary transfers and tax expenditures that in some way provide a benefit or preference for fossil fuel production or consumption relative to alternatives.	36 OECD countries plus Argentina, Brazil, Colombia, China, India, Indonesia, Russia, and South Africa	Inventory approach	• Subsidy policy reform
World Bank (WB)	A deliberate policy action by the government that specifically targets fossil fuels, or electricity or heat generated from fossil fuels.	189 member countries	Unclear; broad overview of approaches to calculation	• Supports countries in subsidy measurement
International Monetary Fund (IMF)	Pre-tax consumer subsidies arise when the prices paid by consumers, including both firms (intermediate consumption) and households (final consumption) are below supply costs including transport and distribution costs. Producer subsidies arise when prices are above this level. Post-tax consumer subsidies arise when the price paid by consumers is below the supply cost of energy plus an appropriate "Pigouvian" (or "corrective") tax…	191	Total support approach	• Focus on unpriced negative externalities • Subsidy reform

These calculation methods have implications for the scope of what could be considered a subsidy. Also, as they cast a wide net over what encompasses a subsidy, they can potentially be divided into descriptions of how subsidies are created or conveyed (as in the WTO and OECD definitions), or how subsidies impact the sector (such as the IEA and IMF definitions). The distinction in definitions (on the one hand, as the conferring of benefits on a specific group, and on the other, the price impact of such benefits), then, has implications over what approach to apply in calculating subsidies.

Typically, energy producer subsidies are more prevalent in developed markets, while consumer subsidies are more so in developing ones. However, they can exist side-by-side in many countries, where a complicated series of subsidies may benefit different stakeholders in a range of ways. For example, the IEA, OECD, and IMF definitions cover both producer and consumer subsidies. Even though the IMF is notable as the only organisation that takes negative externalities into account in the calculation of energy subsidies, it's worth noting that its definition is not a focused, narrow definition of an energy subsidy, but rather a broad definition of subsidies in general.

Additionally, there are two distinct notions of energy - typically, fossil fuel - consumer subsidies. One is a narrow measure, known as pre-tax subsidies. Pre-tax consumer subsidies reflect the difference between the amount consumers pay for fuel use and the opportunity cost of supplying that fuel. The other is a broader measure, known as post-tax consumer subsidies. Post-tax subsidies reflect the difference between actual consumer fuel prices and how much consumers would pay if prices fully reflected supply costs, plus the taxes needed to reflect environmental costs[vi]. International debate has tended to focus on the narrower notion of pre-tax subsidies, usually in the G20 context.

Figure 1 Historic fossil fuel consumption subsidies by the IEA [vii]

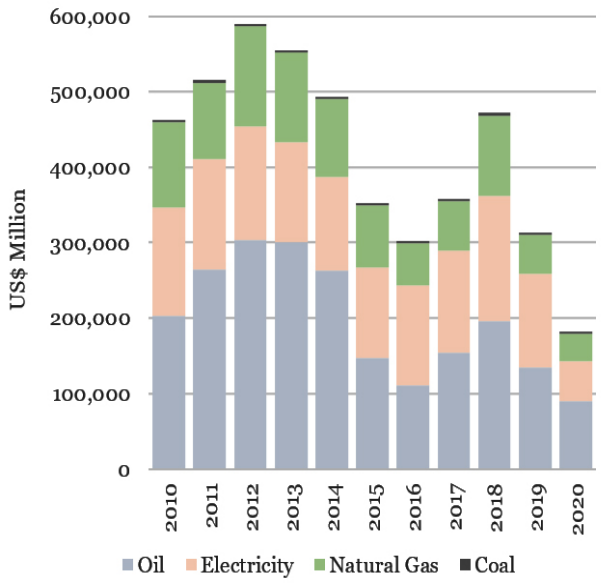
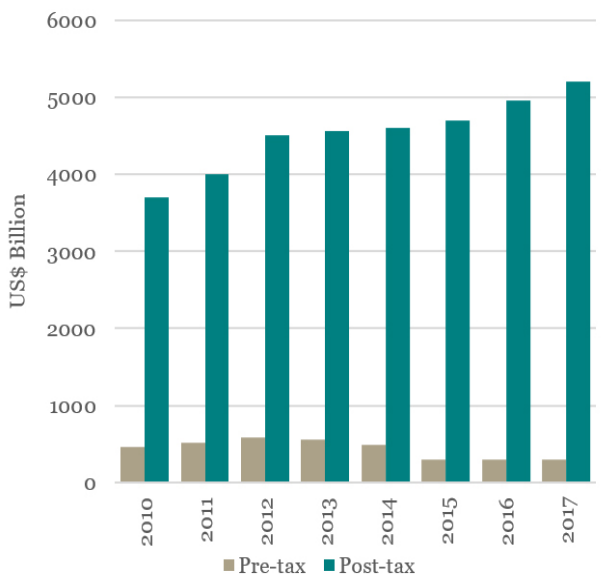


Figure 1 shows the IEA's fossil fuel consumption subsidies from 2010 onwards. Lower oil prices in the mid-2010s reduced subsidies to ~US$ 300 billion in 2016, before escalating to US$ 472 billion in 2018. In 2020, the fall in fossil fuel prices and energy use brought the value of these subsidies down to a record low, just above US$ 180 billion, 40% lower than 2019 levels. Note that the IEA's price-gap approach to calculating consumption subsidy levels is based on the pre-tax notion, therefore not reflecting the full price of negative externalities generated during production, manufacture and consumption.

The IMF on the other hand, accounts for post-tax subsidies in its estimates (Figure 2). Post-tax fossil fuel subsidies are 15-20 times larger than pre-tax subsidies, and have increased in recent years (due to rising consumption levels), albeit not sharply, despite progress on fuel price reform and carbon pricing. Post-tax subsidies take into account the significant adverse effects on economic welfare that arise as a result of pre-tax subsidies. These include air pollution from fine particulates (that can result from fossil fuel combustion), broader externalities associated with the use of road fuels in vehicles (such as traffic congestion, accidents, and road damage), and carbon dioxide and other greenhouse gas emissions resulting from fuel processing, transport and combustion.

The IEA and IMF estimates highlight to a considerable extent the confusion over what is meant by an energy subsidy. Varied estimates therefore fail to accurately depict the size and enormity of actual energy subsidies, which are also prone to underreporting and misreporting by member countries of each organisation. This in turn can affect subsidy removal and reform programmes.

Figure 2 IMF global energy subsidies[viii]



The narrowest and perhaps most common definition for an energy subsidy is a direct cash payment by a government to an energy producer or consumer to stimulate the production or use of a particular fuel or form of energy[ix]. However, a uniform baseline level of costs/prices is crucial, whatever definition is accorded to subsidies. In practice, empirical studies of subsidies often simply assume market prices and costs to simplify the process. This can be difficult in the case where no ready benchmark is available, for instance an isolated domestic gas market.

THE DIFFERENT TYPES OF SUBSIDIES

Table 2 (see the following page) highlights the main types of energy subsidies. All have an impact on costs/prices, either directly in the form of grants and tax exemptions, or indirectly, in the form of regulations that skew the market in favour of a particular fuel and/or energy product.

Implementing subsidies depends on a number of factors. For governments, these include the overall cost of the subsidy programme, the transaction and administration costs, and the impact of subsidy costs on different social groups. The simplest form of subsidy is a per-unit cash payment to producers or consumers, but can entail significant accounting and transaction costs, as well as a direct financial burden on the national treasury.

In countries with largely consumer subsidies, governments prefer to keep subsidies "off-budget" for political reasons, as including them within the budget makes them a target for groups seeking to reduce a country's overall tax burden. This is common practice in some Middle East, Africa, and Asia oil and gas regions where subsidies often take the form of price controls that set prices below full cost.

Some countries also aim subsidies at producers in the form of grants paid for each unit of production, especially if the energy companies are state-owned, or if a producer country is aiming to attract foreign operatorship of its energy assets. Producer subsidies can increase the attractiveness of investments in fossil fuels by reducing the cost of coal, oil, and gas exploration, transport (pipelines, shipping), and processing/infrastructure (LNG terminals, gas sweetening plants, refineries, etc.), contributing to higher production. Carbon capture, utilisation, and storage (CCUS), while often presented as a climate solution, can also function as a fossil fuel producer subsidy, especially in countries where most captured carbon dioxide is injected into wells as a means of extracting more oil.

Preferential tax treatment is one of the more common, implicit, producer subsidies. It can take the form of tax holidays or tax breaks with respect to royalty relief or reduction in other taxes due on extraction or production until a certain production plateau/target is achieved, or federal tax preferences, such as in North America, enabling oil and gas producers to deduct capital expenditures faster or at greater levels, than standard tax accounting rules would typically allow, boosting investment returns. But identifying some tax concessions as a "subsidy" is often problematic, since US tax deductions, for instance, are widely available to manufacturing industries. It is very rare that oil and gas production pays a lower effective tax rate than other businesses, as it is usually liable for royalties, excise taxes, special petroleum taxes and other such levies, even if these can be reduced for more difficult or high-cost fields.

Table 2 Main types of energy subsidies[x]

Type	Examples	How it works		
		Lowers Cost of Production	Raises Price to Producer	Lowers Price to Consumer
Direct financial transfer	Grants to producers	●		
	Grants to consumers			●
	Low-interest or preferential loans	●		
Preferential tax treatment	Rebates or exemptions on royalties, sales taxes, producer levels and tariffs	●		
	Investment tax credits	●		●
	Production tax credits	●		
	Accelerated depreciation	●		
	State-sponsored loan guarantees	●		
Trade Restrictions	Quotas, technical restrictions, and trade embargoes		●	
	Import duties and tariffs		●	
Energy-related Services provided by government at less than full cost	Direct investment in energy infrastructure	●		
	Publicly sponsored R&D	●		
	Liability Insurance	●		
	Free storage of waste or fuel	●		
	Free transport	●		
	Exemption or reduced rates of value-added taxes			●
	Provision to consumers at below-market rates with government or state-owned company paying the difference			●
Regulation of the energy sector	Demand guarantees and mandated deployment rates	●	●	
	Price controls and rate caps		●	●
	Market-access restrictions and standards		●	

THE DIFFERENT TYPES OF SUBSIDIES

In East Siberia, the production/extraction of oil from onshore oilfields, as well as the export through the East Siberia-Pacific Ocean pipeline, has been provided tax holidays since 2007 with respect to the extraction tax typically levied on oilfields. The stated policy objective is to encourage capital investment in and development of onshore oilfields in the harsh conditions of East Siberia that supply oil to the East Siberia-Pacific Ocean pipeline bound for China and other consumers in the Far East. In 2011, the Vankorskoe oilfield, developed by state-owned Rosneft, had its tax holiday terminated due to cumulative production exceeding a threshold of 25 million tonnes.

In 2020, the Russian Ministry of Finance proposed a major overhaul of the current system of tax breaks that are conditional on operational criteria, including reservoir performance, which the Ministry has little control over, or ability to monitor and predict. This system – which includes zero-rate mineral extraction tax for high viscosity oil, as well as export duty tax breaks for brownfields – is proposed to be replaced by wide-scale of use of an excess profit tax (EPT), which is already in place at some fields in Russia[xi].

60% of Russia's total oil production is subject to some form of preferential tax treatment, which may appear to be a form of implicit producer subsidy, the most common globally. However, as noted, this relates to mineral extraction tax, which is not paid by other industries (they, like the oil industry, are liable for ordinary corporate tax). The oil business also pays export taxes on its product for sales outside Russia.

An explicit, pre-existing subsidy, i.e., a direct government payment to reduce the production costs of fossil fuels is less common than tax breaks, but can exist as agency appropriations (targeted spending on oil and gas through either the government budget, or the budgets of individual government agencies), equity infusions, government procurement of energy at above-market rates, or government ownership of strategic and other energy assets that provides returns on investment at rates below-market[xii]. One example is Argentina, which offered guaranteed above-market prices for oil and gas produced from the Vaca Muerta shale[xiii].

FINANCIAL, SOCIAL, ECONOMIC, AND ENVIRONMENTAL

Energy subsidies typically arise as the result of deliberate interventions by governments to correct perceived market failures. They are also pursued to provide affordable energy for lower-income members of society, correct markets for unpriced externalities, induce learning to drive down the costs of new technologies, reduce import dependence, enhance energy security, and create employment.

Subsidising energy may have a negative interaction with environmental policy goals as it can encourage higher use of polluting fossil fuels. If fuels are imported, the subsidy programme can also have a negative impact on the country's balance of payments. Energy subsidies can also lead to a loss of economic efficiency in one or more of the following ways:

- Lowering end-use prices leads to higher energy use and reduces incentives to conserve or use energy more efficiently, leading to a disregard for energy efficiency. In the GCC countries, high per capita energy use is a direct consequence of subsidised energy supply, with price reform measures having limited impact on energy efficiency.

- Consumer subsidies could undermine energy producers' return on investments (by reducing the price received by producers), and lower the incentive to invest in new energy projects and infrastructure. This can lead to an over-reliance on dirtier or outdated technology, as in Iraq, where under-investment in new generation sources and/or efficiency reform measures in the electricity sector is largely due to under-pricing and poor collection rates.

FINANCIAL, SOCIAL, ECONOMIC, AND ENVIRONMENTAL

- Producer subsidies protect producers from competitive market pressures, reducing the incentive to minimise costs, and therefore resulting in less efficient technology operations. For example in India, subsidies for coal production have hampered efforts to improve productivity and efficiency.

- Direct financial transfers, such as grants and tax exemptions act as a drain on government finances. For example, Iran spends over a third of its budget in explicit and implied subsidies, leading to acute pressure on the country's finances, especially during periods of uncertain prices.

- Price caps can lead to physical shortages as demand rises. This can result in a need for costly rationing arrangements. For example in Cuba, energy is rationed due to a decline in subsidised oil shipments from Venezuela.

- Increased energy use as a result of consumer subsidies can reduce the amount of energy available for export or boost demand for imports, negatively impacting the country's balance of payments. Up to 2018, Iran was obliged to import more than 40% of its gasoline needs, costing it billions of dollars to meet strong demand for the subsidised fuel.

- Subsidies on fuel products may have the unintended effect of encouraging smuggling and illegal diversion of subsidised fuels to neighbouring countries where subsidies do not exist. This is commonplace in several parts of Africa, Asia, and the Middle East. For example, fuel smuggling to neighbouring countries costs Libya over US$ 750 million each year[xiv], harming the economy and weakening the fabric of the petroleum sector.

- Subsidies to fossil fuels can inevitably undermine investment, development, and commercialisation of new, lower-carbon technologies that could be economically more attractive. For example, heavy subsidies and lack of subsidy reform of the oil and gas sector in Kuwait has crippled the growth of renewable ambitions. In this way, existing subsidies have "locked-in" fossil fuels to the exclusion of other, more environmentally friendly ones.

- Subsidies can also increase the price gap between fossil fuels and renewable energy adoption. For example, in Egypt, the under-pricing of gas was a serious problem for the country's wind power ambitions. Pricing natural gas at the mid-range of its acceptable market value was found to bring wind power down to similar costs.

- Energy subsidies can exacerbate income inequality. Middle-class consumers, who own cars, refrigerators, air-conditioning units and similar goods, consume more energy than lower-income citizens, and therefore benefit more from energy subsidies if they are not targeted. As a politically-influential bloc, the middle class are often able to prevent reform of subsidies, even when these are defended with "pro-poor" arguments. India, for instance, has sought to tackle this by encouraging wealthier citizens to give up their entitlement to subsidised LPG.

- In a related way, leading corporations, whether state-owned or private, can also become reliant on subsidies and able to block their reform. This can be done by support for politicians (for example campaign donations), their importance as employers, and their technocratic knowledge of the energy system which obscures a proper understanding of the subsidies by non-experts. This situation can apply to nuclear, electricity and renewable companies as well as to fossil fuel corporations. For instance the nuclear lobby is often perceived as a powerful political actor in France and Japan.

The energy efficiency impact of subsidies extends to price volatility, demand, and energy prices, making subsidies distortionary. They lead to wasteful consumption, as, for different reasons, they tend to favour the rich over the lesser-privileged, who they are typically intended for. These rising costs have a direct correlation to the amount of greenhouse gases emitted.

Figure 3 CO_2 emissions per capita, 2018[xv]

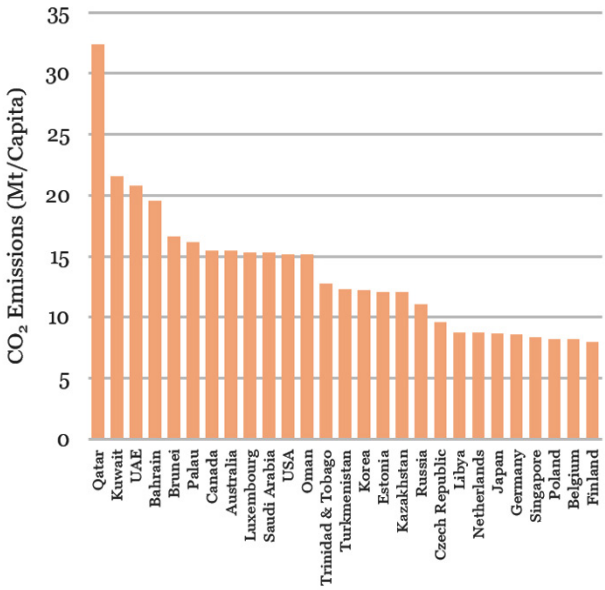
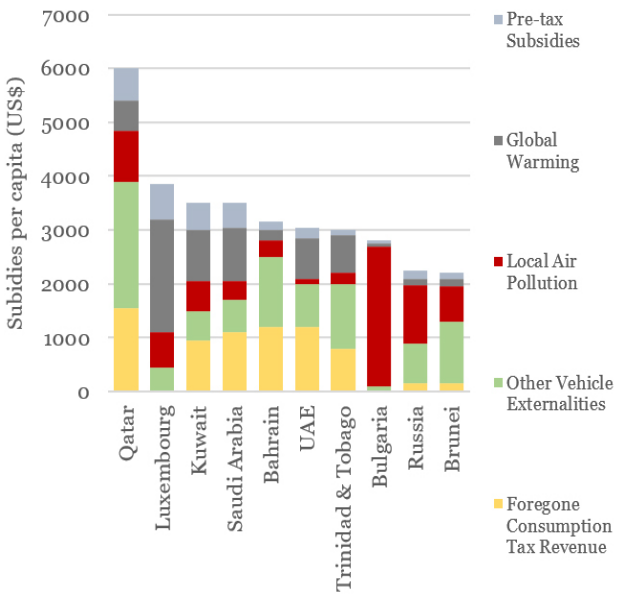


Figure 4 Subsidies per capita[xvi]



FINANCIAL, SOCIAL, ECONOMIC, AND ENVIRONMENTAL

Figure 3 and Figure 4 highlight the per-capita subsidies and carbon dioxide emissions of major world economies. More than half of global fossil fuel subsidies are accounted for by 11 of the major hydrocarbon-producing countries of the world, including the GCC. These countries provide lower prices to end-users, increasing the consumption of subsidised fuels, which result in higher airborne emissions of noxious and greenhouse gases.

Fossil fuel subsidies are not inherently good or bad. There are instances in which subsidising them can bring environmental benefits. For example, encouraging the use of oil products can curb deforestation in developing countries, where poorer households use firewood. This could boost carbon sinks and potentially offset the emissions from fuel combustion. Subsidies for fuels can also reduce indoor pollution, by encouraging inhabitants to lessen reliance on traditional energy sources like wood, crop residues, and straw for cooking and heating purposes.

Whether a subsidy is good or bad depends partly on its ability to mitigate climate change. Typically, this can be measured if the energy source supported by a subsidy is more or less carbon-intensive than the alternative. However, numerous empirical studies have provided strong evidence that the subsidies to fossil fuel consumption globally do, in fact, contribute overall to higher greenhouse gas emissions.

SUBSIDY REFORM IS IMPERATIVE TO MEET ENERGY TRANSFORMATION GOALS

A recent report from the IISD found that reforming fossil fuel consumption subsidies could reduce global greenhouse gas emissions by nearly 5.5 billion tonnes (Gt) of carbon dioxide by 2030 (compared to total emissions of 36.4 Gt in 2019), saving governments nearly US$ 3 trillion cumulatively[xvii].

The study concluded that the gradual removal of consumer fossil fuel subsidies would not be sufficient alone to reduce global greenhouse gas emissions in line with Nationally Determined Contributions (NDCs) to the Paris Agreement, and would require pairing with a fossil energy tax and/or concerted investment (from subsidy savings and tax revenues) in energy efficiency and renewable energy from 2021 almost to double emission reductions to 10.4 billion tonnes.

Table 3 Major fossil fuel subsidisers' emissions reduction targets as part of their NDCs

Country	Emissions reduction	Carbon tax / cap
China	Peak CO2 by 2030 Carbon intensity -60-65% below 2005 by 2030	Build on emissions trading pilots
US	GHG -26-28% on 2005 by 2025	No use of international C markets
EU	-40% on 1990 by 2030	Emissions trading scheme active. No use of international C markets
India	GHG intensity -33-35% on 2005 by 2030	Coal and oil taxes
Russia	-25-30% on 1990 by 2030	Cap-and-trade system now abandoned
Saudi Arabia	-130 Mt CO_2e on BAU by 2030	×
UAE	23.5% on BAU, or 73 Mt by 2030	×
Qatar	Not specified	×
Kuwait	Not specified	×
Oman	-2% on BAU by 2030 (-1.8 Mt)	×
Bahrain	Not specified	×
Iran	-4% on BAU by 2030 -8% on BAU by 2030 with end of sanctions and provision of finance	Allows for carbon credits

Currently, 32 world countries account for 77% of global carbon dioxide emissions, 72% of global GDP, and 72% of the global population, and include GCC hydrocarbon giants like Saudi Arabia and the UAE, other OPEC producers like Nigeria, Iran, and Iraq, and large non-OPEC producers like the US. Some of these are the biggest subsidisers of fossil fuel in the world, like Iran.

Fossil fuel subsidy reform across these countries could lead to average annual emission reductions of 6% by 2030, and in smaller countries like Venezuela, Iraq, and

SUBSIDY REFORM IS IMPERATIVE TO MEET ENERGY TRANSFORMATION GOALS

Algeria, national emissions could be reduced by 20% from fossil fuel subsidy reform alone.

Reforming fossil fuel subsidies is also an opportunity for governments to reallocate fiscal resources into development in ways that are more environmentally friendly and sustainable. Reform can eradicate or considerably lessen fiscal liability, reallocate capital expenditure more efficiently, spur investment in the renewables sector, reduce corruption, and help a country align with its NDCs. If done correctly, fossil fuels subsidy reform can have powerful fiscal, economic, environmental and social benefits.

Currently, more countries have committed to increasing subsidies to renewable energy than reforming fossil fuel subsidies. However, this approach could cancel out the benefit of renewable energy if fossil fuels and energy overall continue to be under-priced. Apart from Europe, where significant renewable subsidies exist, few estimates for other geographies exist, given the dominance of fossil fuels in the world energy system, which presents an additional challenge for reform to meet energy transition goals. Mandates for renewable energy adoption, which could effectively equate to subsidies, are hard to quantify, contributing further variance in estimates. Available data for renewable energy subsidies is partial, collected on a different basis (to fossil fuels) and difficult to compare.

The IEA, which typically tracks fossil fuel consumption subsidies, in its World Energy outlook, takes a price-gap approach to estimating renewable energy subsidies, while IRENA calculates renewable energy subsidies by applying a hybrid approach that captures tax expenditures (where possible), alongside

a price-gap analysis to capture deployment policies like mandates and auctions.

Data is limited for renewable energy (i.e. for renewable power generation and biofuels) subsidies, but exists for a few geographies. In Germany, an electricity surcharge that funds the deployment of renewable power generation is one of the main subsidies for renewable energy there. This surcharge is calculated using a price-gap approach. Renewables in Germany also receive implicit subsidies, such as guaranteed priority grid access, the monetary value of which is hard to assess. In the UK, feed-in-tariffs (FiTs), contracts for differences (CfDs), renewables obligation certificates, and renewable heat incentives, are all examples of subsidies to the renewable energy sector. In the US, production and investment tax credits for wind and solar support deployment of renewable energy. In China, solar PV and wind power benefit from FiTs to accelerate their deployment, and Japan too utilises FiTs to support renewable deployment (primarily solar PV) in an effort to reduce its reliance on fossil fuel imports.

However, the data across these countries is difficult to compare as they all apply different methodologies to calculate subsidies (Table 4). The EU has been trying to catalogue financial support for renewable power, with estimates for both total cumulative support payments and support to newly commissioned projects based on premiums over wholesale prices[xviii].

Recent work also includes tax expenditures, direct transfers, and R&D expenditure. Still, a systemic approach to calculate the level of global renewable energy subsidies in a streamlined, comparative manner does not yet exist.

Table 4 Selected renewable energy subsidies, US$ billion, 2017[xix]

Country	China	India	Japan	US	EU Bloc*
Subsidies to RE Power Generation	15	2.2	19	6.7	78
Methodology	Inventory	Price-gap	Inventory	Inventory	Total support (Inventory and price-gap)
Subsidies to Biofuels	0.4	0.9	0.3	14.1	12
Methodology	Price-gap	Price-gap	Price-gap	Total support (Inventory and price-gap)	Price-gap

* Germany, Italy, the United Kingdom, and Spain account for nearly 72% of subsidies to renewable energy in the EU

SUBSIDY REFORM IS IMPERATIVE TO MEET ENERGY TRANSFORMATION GOALS

Subsidies for renewable power generation and biofuels could help meet environmental policy goals. However, the extent to which emissions of greenhouse gases are being reduced by the replacement of fossil fuels with renewable energy and biofuels depends on the energy input required for their production, infrastructure, transportation, storage, and in the case of biofuels, conversion to feedstock, and water and soil requirements. This would require measuring emissions throughout the entire life-cycle until end-use.

For example, renewable energy electrolysers demand rare earth elements (REEs) and critical minerals to increase efficiency, placing a question mark over their sustainability.

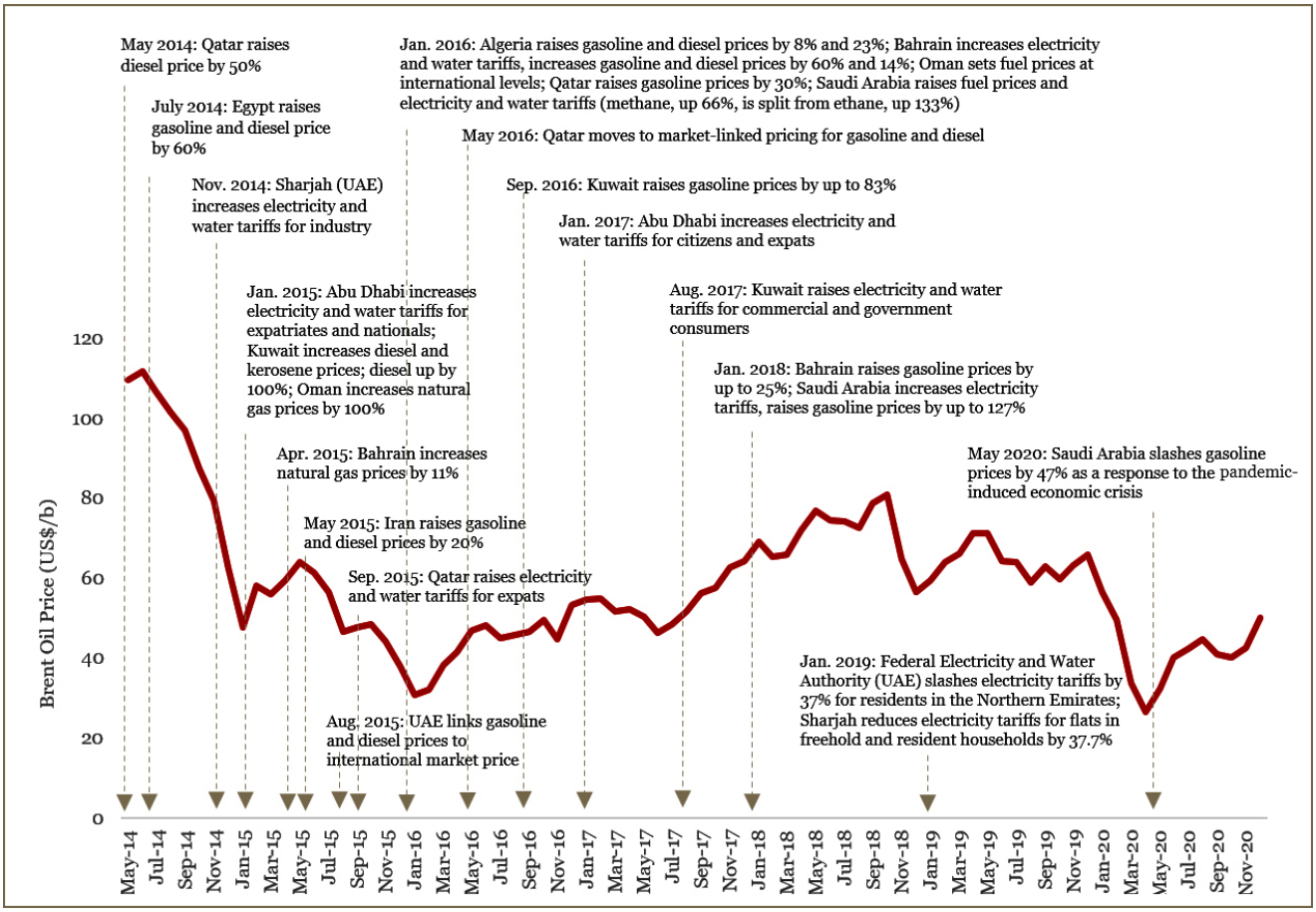
Biofuel subsidies/mandates on the other hand can be a major cause of some of the concerns associated with crop-based biofuel production, such as higher food prices and lower consumer welfare. They can also lead to increased tropical deforestation, and can create new markets for imported food oils.

For example, the diversion of domestically-produced food oils for use as a feedstock for biodiesel – including rapeseed oil in the EU and soybean oil in the US – has raised the price and created imports for palm oil. In Europe, the imposition of the Renewable Energy Directive in 2003 led to a surge in palm consumption as other food oils were diverted for biofuels.

In the long-run, subsidies to renewable sources need to ensure their sustainable use and resource efficiency, meaning they should be considered in connection with sustainability safeguards.

MISMANAGEMENT OF SUBSIDIES CONTRIBUTES TO SLOW-MOVING REFORM

Figure 5 GCC and selected MENA countries energy subsidy reforms and international oil prices[xx]



Reforming subsidies requires an integrated approach, so that they can help steer energy development onto a more sustainable path. Currently, the rigidity and inertia of many subsidy programmes, as well as institutional and political barriers pose a hindrance to reform in countries with heavily subsidised fossil fuels.

In the Middle East oil and gas producing countries, subsidy reform has been slow-moving. This is largely due to the perception of subsidy removal as a threat to the core rentier structure that governs most of these countries. Energy subsidies are a core element of rentier social policy, and risk undermining the rentier economic structure.

Some countries, like Saudi Arabia, the United Arab Emirates, and Bahrain, have imposed a 5% value-added tax (VAT) on goods and services, including energy and food. Bahrain and the UAE have also reformed gasoline and diesel pricing to reflect global prices in an aim to temper the growth of energy wastage and preserve exports.

Countries with larger populations of national citizens such as Kuwait, Oman, and Saudi Arabia, on the other hand, have been slow to move. The imposition of taxes and the retraction of subsidies runs counter to the fabric of the rentier state, as it drastically reduces the influence of oil rents on these country's politics.

MISMANAGEMENT OF SUBSIDIES CONTRIBUTES TO SLOW-MOVING REFORM

The Arab revolutions of 2011 led incumbent governments, such as in Jordan, Oman, Syria, and Saudi Arabia, to raise fuel subsidies and other transfer programmes, in the hope of dampening or averting political discontent. More recently, in Oman, protests erupted against the government's introduction of VAT in April 2021 (which was introduced to ensure the Sultanate's financial sustainability), forcing the government to promise additional jobs in the already bloated public sector, and stipends to lower-income Omanis to protect them from the impacts of VAT.

Other examples of mismanaged subsidy reform include the Caracazo riots of 1989 in Venezuela, in response to government policies that translated into a steep increase in prices for road fuels. Gasoline prices rose 100%, and public transportation fares increased 30%, as part of the then-government's measures to introduce tax and subsidy reform to combat Venezuela's economic crisis triggered by the fall in oil prices in the mid-1980s. In 2016, Venezuela hiked gasoline prices up 60-fold, after the country's national currency, the bolivar, lost 98% of its value since President Nicolas Maduro took office in 2013[xxi], threatening another repeat of the Caracazo riots.

In 2019, Iran introduced a surprise overnight price hike to gasoline, increasing rates by 50%, and mandated that drivers would be allowed to purchase only 60 litres a month, or prices would increase by 100%. The move was done to help the country during a dire economic crisis as a result of US sanctions, but was met with widespread protests across 40 cities and towns and violence.

The Sadat Bread Riots of 1977 in Egypt highlighted the inefficacy of the IMF- and WB-mandated subsidy reform programmes that terminated state subsidies on basic foodstuffs, resulting in a mass uprising by thousands of lower-class people. Widespread violence ceased only with the deployment of the army and the re-institution of the subsidies. While not an illustration of the impact removal of energy subsidies has on a country's socio-political milieu, it highlights the disconnect between umbrella policies and actual implementation on ground.

Another example is the Houthi takeover of Yemen, which was prompted in part by the Yemeni government's announcement in 2014 of an increase in fuel prices following pressure from the IMF, which conditioned its financial assistance on these reforms. The decision gave the Houthi movement, with its own axe to grind, a populist issue they needed to seize power by capitalising on palpable frustration among the country's lower-class citizens.

Of note here is that subsidy reform attempts in these oil and gas producing regions are often doled out to reverse an economic crisis, rather than address climate policy goals.

A virtuous circle is an integrated approach to subsidy reform, wherein subsidy reform makes energy efficiency imperative and more attractive, and energy efficiency makes subsidy reform more politically feasible.

Energy efficiency opportunities can have a huge impact on subsidy reform. The IEA, under its Efficient World Scenario, depicts that if all economically feasible energy-efficiency options currently available are taken up by

Table 5 Reforming fossil fuel subsidies requires an integrated approach

An Integrated Approach to Subsidy Reform					
Subsidy Prices		**Subsidy Impacts**		**Building Support**	
Preparing for subsidy reform of fossil fuels requires understanding how subsidies are priced and targeted.		Preparing for the impacts of subsidy reform can protect households from the shocks of price changes.		Building support for political spaces to exist in which subsidy reform policy is possible	
Approach: Internal Planning		Approach: Research & Data		Approach: Consultation & Communication	
Step 1	Governments should plan to ensure subsidy prices for fossil fuels are market based. This includes distribution of subsidies, their size, energy (fossil fuel prices), international price changes, domestic price changes, transparency of price rules, and enforcement.	Step 1	Assessing the fiscal impacts of energy subsidy reform (including in electricity and district heating/cooling relying on fossil fuels) from a macroeconomic context is an essential prerequisite for beginning to implement fossil fuel subsidy reforms.	Step 1	Government bodies, R&D institutions, national oil companies, fossil fuel traders and service companies need to coordinate internally to work together and share subsidy reform relevant data, and make sure they speak with one voice.
Step 2	Governments need to establish pace of reform, i.e. how fast existing prices for subsidised energy change and when. Generally, slower reform is easier to prepare for and gives more room to adapt the reform strategy in light of the real impacts of change. However, fast reform may often be the only option available if subsidy costs need to be reduced quickly, or political opposition is too high to allow for many small changes.	Step 2	Governments need to align their short to medium-term fiscal frameworks with budgetary implications of existing subsidies and their reform. This can include assessing fiscal and debt trajectories, and the impact of energy price adjustments on the fiscal balance during the transition to a fully market-based energy pricing mechanism.	Step 2	Governments should consult with stakeholder groups to assess fossil fuel use patterns, other energy use patterns, reveal perceptions / misconceptions about subsidies. This will build the credibility of the government in the eyes of stakeholder groups who will require government support during and after reform.
		Step 3	Governments of countries where consumer price subsidies are prevalent need to decide which subsidies pose the largest risk to fiscal sustainability of the country, and determine mitigation measures with relevant stakeholders by employing relevant qualitative and quantitative research.	Step 3	All groups together can work collaboratively to assess the impacts and benefits of reform on vulnerable groups and end-users and draw from international comparisons / experiences to develop government plans to initiate reform

2040, global greenhouse gas emissions could be held close to current levels, despite a projected doubling of world economic activity (GDP). This is an important benchmark in the race towards carbon neutrality and subsidy reform in energy.

Clean energy subsidy swaps, i.e. taking some of the savings from subsidy reform and investing them into energy efficiency or renewable energy, is one of the more promising mechanisms to achieve the virtuous circle of energy subsidy reform. In 2015, the government of Indonesia implemented a reform programme redirecting government expenditure on gasoline and other road fuel subsidies into infrastructure, health, education, and regional development, resulting in savings of US$ 15.6 billion, or 10% of all government expenditure. In Africa, countries like Zambia are working with international institutions like the IISD on moving diesel subsidies into solar power, and electricity subsidies to energy efficiency at mines.

Closer to the region, in 2014, Morocco began reducing petroleum and diesel subsidies while simultaneously increasing electricity prices, limiting fossil fuel subsidies to only butane gas. Savings from the elimination of fossil fuel subsidies are being directed into the government's ambitious renewable energy plans, which are underpinned by programmes such as the national solar pumping programme, which encourages the use of solar pumps, in place of fossil fuel-powered ones for irrigation in agricultural settings.

India has committed to phasing out its fossil fuel subsidies since 2009, and by 2018, these were almost entirely eliminated. From 2014 to 2017, India's subsidy support to petroleum products fell by ~75%, while support for renewable energy increased almost 6 times

to US$ 2.2 billion[xxii]. Between 2015 and 2016, subsidies to kerosene cost the Indian government US$ 1.8 billion, representing almost 42% of all fuel subsidies. Kerosene use in India is strongly linked to the electrification rate, decreasing as access to electricity increases. Studies have compared the cost of solar lanterns to household expenditure on kerosene for lighting, concluding that if kerosene subsidies were maintained, most basic solar lamps would be marginally cheaper. However, if kerosene subsidies were removed, solar lighting would become the cheapest lighting source by far[xxiii].

Support for clean-tech energy can play an influential role in the virtuous circle. Since 2019, a wave of political support has emerged for the hydrogen economy. The attractiveness of hydrogen as a completely clean-burning fuel that can replace fossil fuel energy as an industrial feedstock, be converted to electricity through fuel cells, burned for heat, or stockpiled in tanks as a form of energy storage has led to the release of a number of national hydrogen strategies. Countries with such strategies include Australia, Canada, Chile, Finland, France, Germany, Japan, Norway, Portugal, Spain, as well as the European Union.

These policies are underpinned by funding for hydrogen, much of it as part of Covid-19 recovery packages. For example, Germany plans to invest US$ 10.5 billion of its recovery spending in renewable hydrogen to help increase the country's hydrogen capacity to 5 GW by 2030 and 10 GW by 2040. France, meanwhile, has committed US$ 8.2 billion to help the country reach 6.5 GW of renewable hydrogen capacity by 2030[xxiv].

These large subsidies to hydrogen, particularly to renewable (or green), can be regarded as an attempt to address the under-pricing of pollution from fossil fuels, even in geographies like the EU. Pricing pollution directly could better address this failure, but as discussed earlier, it may be politically easier, at least in the initial stages of subsidy reform, to introduce subsidies to clean-tech energy over an increased taxation over polluting ones. They also recognise that, at the current stage of development, that even the EU's carbon price (around €56/tonne CO_2 in August 2021) is not sufficient to close the cost gap between low-carbon hydrogen and fossil fuels.

Subsidies to clean-tech can also be justified by their ability to help new, rapidly-growing industries like hydrogen to overcome the incumbent advantage currently held by fossil fuels. Government support can allow a new technology to reach sufficient scale for commercial deployment, an approach which has been very successful with solar and wind power.

However, governments should be cautious with their use of subsidies, especially for clean-tech that still requires fossil fuel inputs. For example, renewable-powered hydrogen production can require natural gas for renewable firming, pollution costs of which need to be accounted for. Blue hydrogen, currently the lowest-cost low-carbon hydrogen form, is produced from fossil fuels and accompanied by CCUS. This can reduce emissions at the point of capture, but methane emissions that escape the process could undermine carbon emissions savings. Indirectly, revenue from such subsidies could prop up methane production.

Table 6 Summary of main challenges with subsidies to clean-tech energy and their mitigation

Challenge	Mitigation
Lack of transparency	Governments of countries with national clean-tech energy mandates should routinely publish data on subsidies accorded to the sector to measure and monitor their objectives and costs, and critically evaluate performance
Subsidising clean-tech in sectors with existing low-carbon alternatives	Mismanagement of subsidies can promote clean-tech energy in sectors that already have cost-effective low-carbon solutions. For example, home heating can be decarbonised effectively with electric heat pumps and low-carbon power. In such a case, subsidies should be targeted to sectors that have fewer alternatives for decarbonisation, such as heavy industry and transport.
Negative environmental impacts across full life-cycle of certain clean-tech	For example, technologies such as CCUS or blue hydrogen (utilising CCUS). Subsidies to such technologies can indirectly support negative environmental impacts across the life-cycle of the technology.

CONCLUSION

The relationship between energy subsidies and the global energy transformation requires evaluation along several axes. First, it needs to ascertain whether a specific subsidy, fossil fuel or not, is seeking to address a market distortion. If so, policymaking needs to focus on the best method to remedy that distortion, in the form of trade instruments, industrial policy, or regulatory instruments, such as green certificates, emissions limitations, and/or renewable energy quotas. Second, it needs to establish whether the subsidy itself is creating a market distortion. In this case, governments and policymakers need to either eliminate the subsidy, countervail it, or induce reform.

The market-distorting effects of fossil fuel subsidies operate either by altering the price at which conventional energy inputs are consumed, or by distorting the price of energy-intensive products sold in the global market. Such subsidies almost always contribute to externalising the environmental costs of polluting forms of energy. Renewable energy subsidies, if implemented without reforming fossil fuel ones, fail to adequately correct the market distortion created by fossil fuel subsidies. Also, this leads to additional market distortions and environmental costs.

Subsidy reform is politically-challenging, given that it may affect some combination of powerful vested interests, middle-class consumers, and lower-income citizens. Careful communication, phasing and provision of alternatives (such as better public transport) can help. Direct payments to low-income citizens, as implemented in Brazil, Iran, Saudi Arabia and elsewhere, can compensate for higher energy bills as well as being better-targeted at those most in need.

If implemented correctly, fossil fuel subsidy reform can have powerful impacts. It can lead to increased subsidies for renewable energy, which are a more proactive and encouraging approach to an accelerated energy transformation than carbon prices or taxes. Carbon pricing systems have led to emissions reductions in many countries, but direct clean energy subsidies can achieve faster scale-up and reduction of costs to commercially competitive levels.

The global energy transformation requires a reconfiguration of energy systems, mobility, and heavy industry for the full market penetration of net-zero carbon technologies and systems. Existing systems of energy infrastructure and trade can cause countries to remain "locked-in" using high-carbon energy sources, resulting in suboptimal levels of energy efficiency and innovation. This suggests that government-level interventions to increase the rate of innovation are necessary to support an effective energy transition. Increased government and organisational investment support for renewables and clean-tech can prove to be the backbone of a systemic transformation.

APPENDIX

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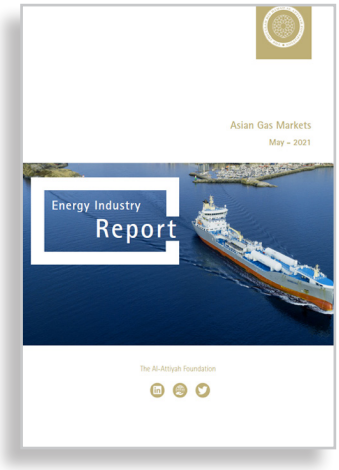

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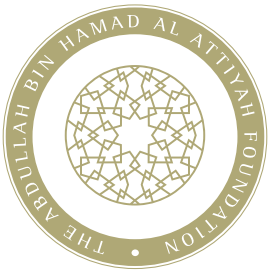

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