Empty promises

G20 subsidies to oil, gas and coal production

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Report
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Cover image: Part of the coal loading facility at Kooragang Island, New South Wales, Australia. Eyeweed.

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Acronyms

APEC	Asia-Pacific Economic Cooperation countries
boe	barrels of oil equivalent
bbl	barrel of oil
BRICS	Brazil, Russia, India, Indonesia, China and South Africa
CO^2	carbon dioxide
CCS	carbon capture and storage
CTI	Carbon Tracker Initiative
C20	the civil society process that parallels the G20
EBL	energy-backed loan
EHR	enhanced hydrocarbon (oil or gas) recovery
EIA	US Energy Information Administration
EV	electric vehicle
GHG	greenhouse gas
G20	Group of 20 of the world's major economies
IEA	International Energy Agency
IJ	Infrastructure Journal
IMF	International Monetary Fund
IPCC	Intergovernmental Panel on Climate Change
IRS	US Internal Revenue Service
LCOE	levelised cost of electricity
LNG	liquefied natural gas
MDB	multilateral development bank
NOC	national oil companies
NOx	nitrogen oxide
OECD	Organisation for Economic Co-operation and Development
PV	photo-voltaic (as in crystalline silicon photo-voltaic projects)
R&D	research and development
SOE	state-owned enterprise
SOx	sulphur oxide
T&D	transmission and distribution (for the power sector)
UNFCCC	United Nations Framework Convention on Climate Change
WTO	World Trade Organization

About this report

This report is a compilation of publicly available information on subsidies to fossil fuel production. For the purpose of this report, fossil fuel production subsidies include: 'national subsidies', 'state-owned enterprise investments' and 'public finance'. Our aim is to use this information as a baseline for tracking progress in the phase-out of fossil fuel production subsidies as part of the wider global energy transition.

This research builds on 19 desk-based Country Studies and Data Sheets (see Appendix 1) that were completed for each of the G20 member countries (not including the European Union), and on work completed for an earlier report *The fossil fuel bailout: G20 subsidies to oil, gas and coal exploration*, published in 2014.

Chapter 1 reviews the role of fossil fuel subsidies in locking in emissions and driving the use of unburnable carbon. Chapter 2 examines the shifting economics of fossil fuel production, and Chapter 3 sets out the methodology used in this report to identify and estimate subsidies to fossil fuel production as well as raising issues of data transparency.

Chapters 4, 5 and 6 outline key findings on national subsidies, investment by state-owned enterprises, and public finance, respectively, for fossil fuel production. Chapter 7 discusses the primary beneficiaries of subsidies to fossil fuel production. Chapter 8 provides a summary of the support to fossil fuel production identified in each G20 country. Finally, Chapter 9 sets out conclusions and recommendations.

Glossary

Production subsidies: government support for fossil fuel production. For the purpose of this report, production subsidies include national subsidies, investment by state-owned enterprises (SOEs) (domestic and international) and public finance (domestic and international) specifically for fossil fuel production.

Fossil fuel production: production in the oil, gas and coal sectors. This includes access, exploration and appraisal, development, extraction, preparation, transport, plant construction and operation, distribution and decommissioning (see Figure 14). Although subsidies for the consumption of fossil fuels can support their production (see Box 4), this report excludes such subsidies as well as subsidies for the consumption of fossil fuel-based electricity.

National subsidies: direct spending, tax and duty exemptions and other mechanisms (such as forms of capacity mechanisms – See Box 3) provided by national and sub-national governments to support fossil fuel production.

State-owned enterprise (SOE) investment: A SOE is a legal entity created by a government to undertake commercial activities on its behalf. SOEs can be wholly or partially owned by governments. It is difficult to identify the specific component of SOE investment that constitutes a subsidy, given the limited publicly available information on government transfers to SOEs (and vice-versa), and on the distribution of investment within their vertically integrated structures. Therefore, this report provides data on total investment by SOEs in fossil fuel production (where this information is available from the company), which are presented separately from national subsidies. For the purpose of this report, 100% of the support provided to fossil fuel production through domestic and international investment by an SOE is considered when a government holds >50% of the shares.

Public finance: includes the provision of grants, equity, loans, guarantees and insurance by majority government-owned financial institutions for domestic and international fossil fuel production. Public finance is provided through institutions such as national and multilateral development banks, export credit agencies and domestic banks that are majority state-owned. The transparency of investment data for public finance institutions varies. Assessing the portion of total financing that constitutes a subsidy requires detailed information on the financing terms, the portion of finance that is based directly on public resources (rather than raised on capital markets) or that depends on the institutions' government-linked credit rating. Few of the institutions assessed allow public access to this information. Therefore, we report the total value of public finance from majority government-owned financial institutions for fossil fuel production separately from 'national subsidy' estimates. For the purpose of this report, 100% of the support provided to fossil fuel production through domestic and international financing is considered when a government holds >50% of the shares in the bank or financial institution.

Unburnable carbon: Fossil fuels that cannot be burnt if global warming is to be kept below 2°C. According to the Intergovernmental Panel on Climate Change (IPCC) and the International Energy Agency (IEA), three quarters of existing proven fossil fuel reserves must be left in the ground to meet the internationally agreed goal of holding a global average temperature rise to no more than 2°C (IPCC, 2014).

Carbon lock-in: Once certain carbon-intensive development pathways are chosen and capital-intensive investments are made, fossil fuel dependence and the carbon emissions that come with it can become 'locked in', making a transition to lower-carbon development pathways difficult and increasing the risk of exceeding climate limits (Erickson, 2015).

Stranded assets - in the context of greenhouse gas (GHG) emissions: Fuel energy and generation resources that, at some time prior to the end of their economic life (as assumed at the investment decision point), are no longer able to earn an economic return (i.e. meet the company's internal rate of return), as a result of changes in the market and regulatory environment associated with the transition to a low-carbon economy (CTI, 2014).

Executive summary

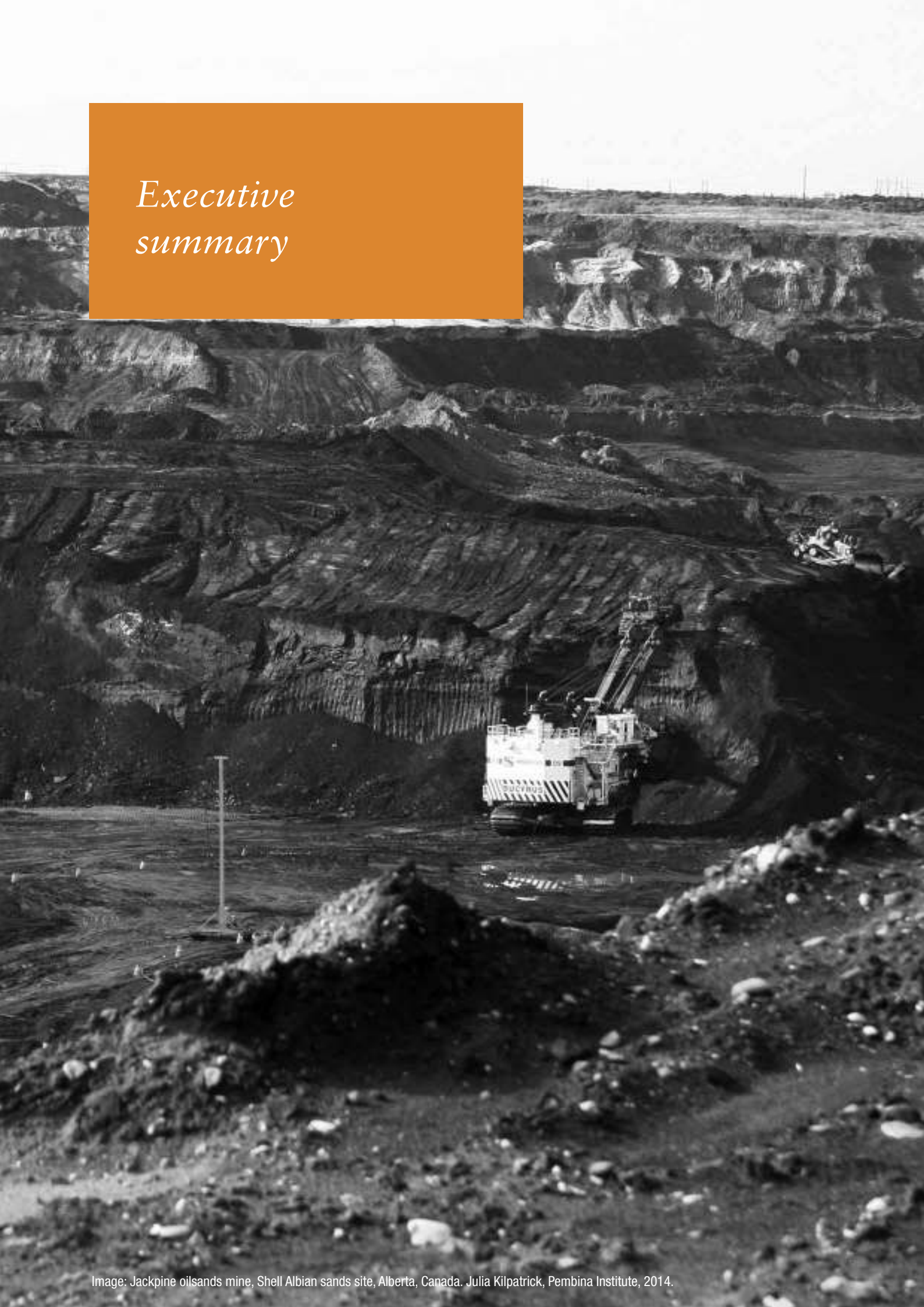


Image: Jackpine oilsands mine, Shell Albian sands site, Alberta, Canada. Julia Kilpatrick, Pembina Institute, 2014.

Introduction

G20 country governments are providing $452 billion a year in subsidies for the production of fossil fuels. Their continued support for fossil fuel production marries bad economics with potentially disastrous consequences for the climate. In effect, governments are propping up the production of oil, gas and coal, most of which can never be used if the world is to avoid dangerous climate change. It is tantamount to G20 governments allowing fossil fuel producers to undermine national climate commitments, while paying them for the privilege.

This report documents, for the first time, the scale and structure of fossil fuel production subsidies in the G20 countries. The evidence points to a publicly financed bailout for some of the world's largest, most carbon-intensive and polluting companies.

It finds that, by providing subsidies for fossil fuel production, the G20 countries are creating a 'lose-lose' scenario. They are pouring large amounts of finance into uneconomic, high-carbon assets that cannot be exploited without driving the planet far beyond the internationally agreed target of limiting global temperature increases to no more than 2°C. At the same time, they are diverting investment from economic low-carbon alternatives such as solar, wind and hydro-power.

The scale of G20 fossil fuel production subsidies calls into question the commitment of governments to an ambitious deal on climate change. Several countries have scaled up their pledges to reduce greenhouse gas emissions, but continued subsidies for fossil fuel production raise serious concerns about these pledges and could undermine the prospects for an ambitious climate deal. As well as phasing out national subsidies, G20 governments have a tremendous opportunity to meet the climate challenge by shifting the investment of state-owned enterprises and public finance away from fossil fuel production, towards clean energy. It is one thing, however, for nations to make pledges, it is another for them to take the most important and necessary step: withdrawing their support from the fossil fuel industry.

Background

The world already has a large stockpile of 'unburnable carbon'. If countries intend to meet their commitments to the 2°C climate target, at least three quarters of the existing proven reserves of oil, gas and coal need to be left in the ground (see Chapter 1). Yet governments continue to invest scarce public resources in fossil fuel production, even though the phase-out of these subsidies is widely agreed to be critical for progress on climate change and low-carbon development.

Support for fossil fuel production also adds to the risks of 'carbon lock-in'. Once carbon and capital-intensive investments are made, the transition to climate-compatible pathways becomes much more difficult because of the long time horizon over which the investments operate (Erickson, 2015).

Back in 2009, leaders of the G20 countries pledged to phase-out 'inefficient' fossil fuel subsidies. Indeed, few subsidies are more inefficient. Yet the evidence presented in this report points to a large gap between G20 commitment and action. That gap is reflected in $452 billion in average annual subsidies from G20 governments to fossil fuel production in 2013 and 2014. To put this figure in context, it is almost four times the amount that the International Energy Agency (IEA) estimates was provided in all global subsidies to renewables in 2013.

Current market conditions reinforce the case for the phase-out of fossil fuel production subsidies (see Chapter 2). The glut in fossil fuel supplies, falling demand and moves towards energy efficiency have driven oil, gas and coal prices to multi-year lows. Take coal, for example. There has been a slow-down in global demand (and in China in particular), with half of the world's coal output found to be unprofitable in 2015. Without government support for production and wider fossil fuel subsidies, large swathes of today's fossil fuel development would be even less profitable, particularly for coal and for new hard-to-reach oil and gas reserves. Directing public resources towards these sectors with rising emissions and falling returns represents, therefore, a double folly.

Definitions

The analysis of subsidies presented in this report is consistent with the definition of subsidies provided by the World Trade Organization (WTO) that has been agreed by 153 countries (see Chapter 3).

We identify three types of fossil fuel production subsidies:

- national subsidies delivered through direct spending and tax breaks of $78 billion
- investments by majority state-owned enterprises (SOEs) that account for another $286 billion
- public finance from majority government-owned banks and financial institutions that amounts to another $88 billion per year on average in 2013 and 2014.

We discuss these three forms of support separately in the report, as gaps in publicly available information make it impossible to confirm whether all or only a proportion of public finance and SOE investment constitute subsidies.

This research builds on 19 desk-based country studies (see Appendix 1 and Chapter 8), and on work completed for an earlier report *The fossil fuel bailout: G20 subsidies to oil, gas and coal exploration*, published in 2014.

Key findings

While the pattern of support varies, all G20 countries subsidise fossil fuel production.

The following are among the key findings from our review of national subsidies alone in 2013 and 2014 (see Chapter 4).

- Russia had significant national subsidies for fossil fuel production of almost $23 billion annually on average in 2013 and 2014. This is in addition to the SOE investment and public finance provided by their majority state-owned enterprises and state-owned banks.
- The US provided more than $20 billion in national fossil fuel production subsidies each year, despite calls from President Barack Obama to eliminate industry tax breaks.
- The UK continued to encourage offshore oil and gas in the North Sea, resulting in national subsidies to fossil fuel production of an annual average of $9 billion in 2013 and 2014. This is despite recent pledges by the UK government in support of the Friends of Fossil Fuel Subsidy Reform. The UK is also one of the few G20 countries that is increasing its fossil fuel subsidies while cutting back on support for the renewable energy investments that are needed to support a low-carbon transition.
- Australia and Brazil provided national subsidies of $5 billion on average annually, including for the development of fossil fuel resources in increasingly remote and challenging areas (inland and offshore).
- China provided national subsidies of just over $3 billion annually on average in 2013 and 2014, including grants for coal producers, and support to research and development for fossil fuel production (including for carbon capture and storage).

Investment by SOEs represents a major source of support for fossil fuel production by a number of G20 countries (see Chapter 5). The report finds that SOE investment in China's fossil fuel production activities, for example, was extensive both domestically and internationally and more than double that found in any other G20 country. On average, Chinese SOEs invested $77 billion a year in fossil fuel production in 2013 and 2014. Russia and Brazil each also have very high levels of SOE investment in fossil fuel production, particularly for oil and gas, providing $50 billion and $42 billion respectively over the same time period.

In some countries where national subsidies cannot be identified (such as Indonesia and Saudi Arabia) there is significant annual SOE investment in fossil fuel production, with an annual average of almost $45 billion in 2013 and 2014 from Saudi Aramco. In addition, a number of G20 majority-owned SOEs operate overseas, meaning that they may be reaping double benefits from domestic support and from the national subsidies of other G20 governments.

Domestic and international public finance also played a significant role in supporting fossil fuel production in 2013 and 2014 (see Chapter 6). Japan provided the largest annual public financing for fossil fuels – an annual average of $19 billion. China provided the second largest amount of public finance at $17 billion a year, and Korea provided $10 billion, largely for investments overseas. Other G20 countries providing high levels of public finance for fossil fuel production abroad included Canada, Germany, Italy, the UK and the US, each providing between $2 billion and $6 billion a year. The UK alone is providing $5.5 billion in international public finance to fossil fuel production across 40 countries, 10 of which are other members of the G20. The emerging economies within the G20 deployed more domestic public finance for fossil fuel production, with Argentina, Brazil, India, Russia and Saudi Arabia providing between $2 billion and $7 billion a year, most of which went to production within their own borders.

Much of the international public finance from G20 countries goes to other G20 countries, driving further fossil fuel production within the G20. In particular, oil and gas 'megaprojects', for the production of liquefied natural gas (LNG), refineries, pipelines and fossil fuel extraction accounted for a significant amount of the G20 public finance for 2013 and 2014. These projects often experience significant cost overruns and are facing increasing challenges as fossil fuel development encounters greater economic and environmental risk.

Collectively, the G20 countries hold between 36% and 75% of the shares of the major multilateral development banks (MDBs) such as the World Bank Group and the European Investment Bank. Through all MDBs the G20 provided an additional $5.5 billion a year in public finance for fossil fuel production in 2013 and 2014.

The scale and persistence of subsidies to fossil fuel production begs the question: who benefits from the financial transfers? (see Chapter 7). The answer is clearly not the tax-payers of G20 countries. In reality, the beneficiaries include global energy companies that face increasingly tight margins, but it is rare for governments to provide the information needed to link specific companies to the subsidies they receive.

At present, the UK's field allowances to oil and gas development in the North Sea are the only fossil fuel production subsidies in the G20 for which detailed information is available in terms of both who benefits (private companies and SOEs) and the level of benefit they receive. The UK government discloses the full list of companies that have been granted this sub-set of national subsidies, valued at $4.5 billion over five years (2009 to 2014). Of these, a significant portion went to international companies including: Total (France), Apache (US), ENGIE (formerly GDF Suez – France), Statoil (Norway), Ithaca (Canada) and Taqa (Abu Dhabi). In another example, our research found that BP had the potential to realise major tax benefits by writing off large portions of its

multi-billion US-dollar settlements arising from the 2010 Deepwater Horizon oil spill in the Gulf of Mexico. State-owned energy enterprises also capture a large share of the financial benefit. Given the political influence of global energy companies, both private and state-owned, there is an urgent need to establish an independent audit of beneficiaries in every G20 country.

A robust understanding of the comparative impact of subsidies on investment for both fossil fuels and cleaner alternatives will require far greater transparency across the energy sector. Nonetheless, the potential to transfer significant volumes of investment away from fossil fuels and towards alternative energy services and other public goods is significant, and the energy transition will only be accelerated through the removal of fossil fuel subsidies.

Recommendations

Governments in the G20 and beyond should act immediately to phase-out subsidies to fossil fuel production. This report sets out five recommendations to ensure that the G20 governments, in particular, keep their promises (see Chapter 9). These are:

- Adopt strict timelines for the phase-out of fossil fuel production subsidies (and remaining subsidies to consumption) with country-specific and measurable outcomes. The first step would be to eliminate all subsidies to exploration and coal by 2020.
- Increase transparency through a publicly disclosed, consistent reporting scheme for all national subsidies for fossil fuels, strengthening the existing inventory created by the Organisation for Economic Co-operation and Development (OECD) and expanding it to include all countries (using the OECD's existing model for tracking agricultural subsidies).
- Increase the transparency of reporting on investment in, and finance for, fossil fuels by state-owned enterprises and majority publicly owned financial institutions.
- Work closely with international institutions and processes, such as the G20 and Asia-Pacific Economic Cooperation (APEC), the OECD, the United Nations Framework Convention on Climate Change (UNFCCC) and the Sustainable Development Goals (SDGs) to eliminate any incentives for fossil fuel production and to monitor reforms so that no new incentives are established.
- Shift subsidies from fossil fuel production to support wider public goods, including through support for the transition to low-carbon energy systems and universal energy access.

1.

Carbon lock-in, unburnable carbon and fossil fuel subsidies

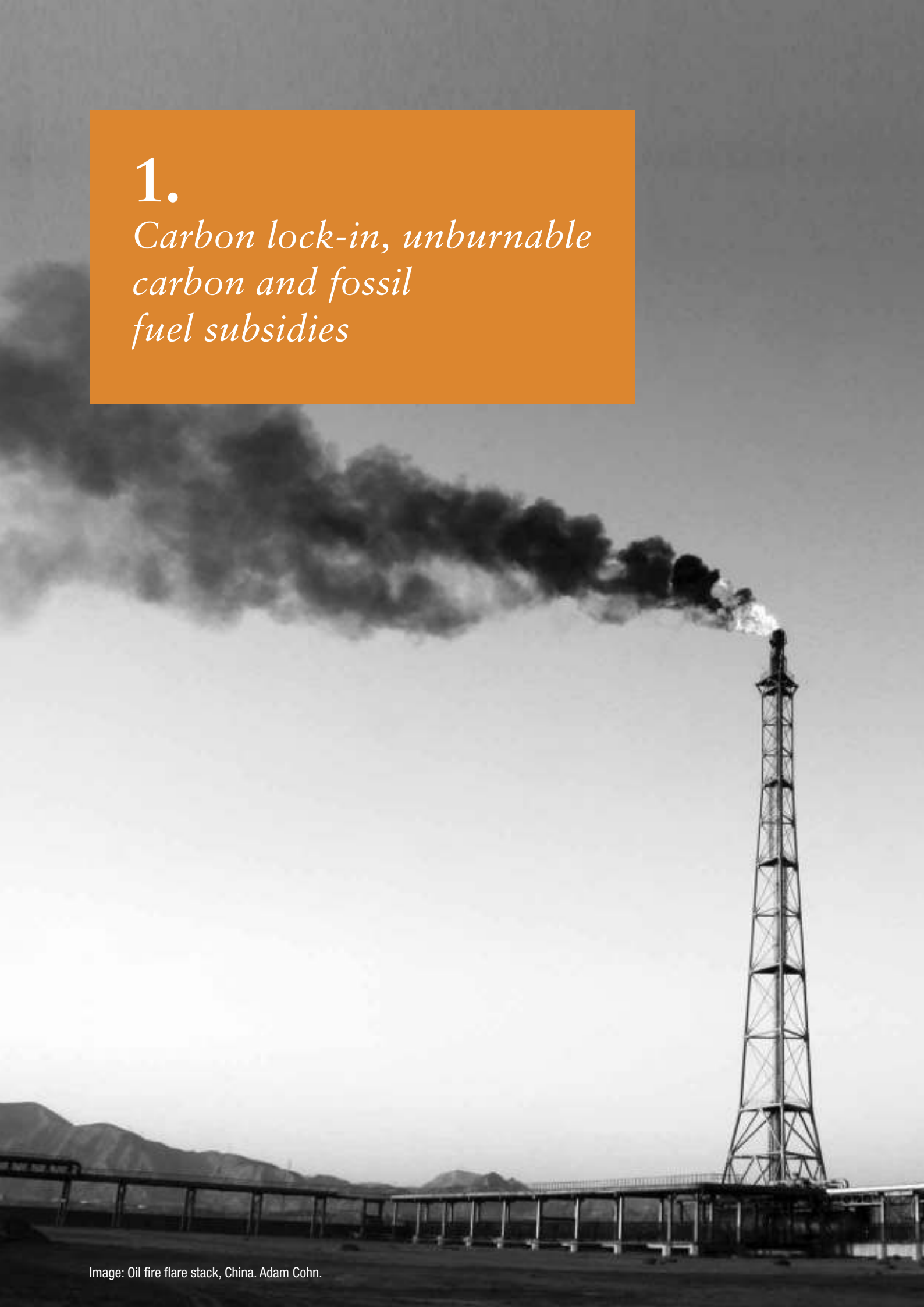


Image: Oil fire flare stack, China. Adam Cohn.

Carbon lock-in, unburnable carbon and fossil fuel subsidies

At the 2010 United Nations Framework Convention on Climate Change (UNFCCC) negotiations in Cancun, Mexico, governments from around the world agreed to limit global average temperature increase to 2°C – at most – above pre-industrial levels to avoid dangerous climate change (United Nations, 2010), and to consider lowering that threshold to 1.5°C in the future.

Despite this agreement, governments continue to encourage investment in fossil fuel production through subsidies. Indiscriminate support for fossil fuel production risks 'carbon lock-in'; that is, once certain carbon-intensive development pathways are chosen and capital-intensive investments are made, fossil fuel dependence, and the carbon emissions that come with it, can become 'locked in', making a transition to lower-carbon development pathways difficult, and increasing the risk of exceeding climate limits (Erickson, 2015).

In practical terms, this means that if energy investments continue to favour emissions-intensive infrastructure up to 2020, the investment required up to 2035 to achieve low-carbon objectives would increase by a factor of four (IEA, 2013 in Erickson, 2015). IEA analysis from 2012 found that under a pathway consistent with limiting the increase in temperature to 2°C, 'almost four-fifths of the CO^2 emissions allowable by 2035 are already locked-in by existing power plants, factories, buildings' (IEA, 2012). Despite the urgency of the carbon lock-in risk, subsidies to fossil fuel producers persist. These subsidies increase the risk of lock-in, while simultaneously reducing public resources available to support low-carbon alternatives.

Despite the fact that the carbon budget is shrinking every year as more greenhouse gases (GHGs) are emitted into the atmosphere, governments and companies continue to pour hundreds of billions of dollars into efforts to discover and develop new reserves and fossil fuel-producing infrastructure. Although investment in 2015 is expected to decline from 2014 levels, in part due to the current low oil price, companies expected to spend $571 billion in 2015 to find and develop new oil, gas and coal resources (OGJ, 2015).

In addition to the risk of carbon lock-in, a significant portion of subsidies to fossil fuel producers supports exploration for new fossil fuels; yet according to the Intergovernmental Panel on Climate Change (IPCC), as of 2014, at least three quarters of proven reserves of oil, gas and coal are unburnable – they must stay in the ground in order for there to be a two-in-three chance of remaining below the 2°C climate change threshold (IPCC, 2014). Fossil fuel subsidies can tip the balance for an entire project from unviable to viable, unlocking vast reserves of carbon that would otherwise remain in the ground. For example, economic analysis of Russia's Yamal liquefied natural gas (LNG) project indicated that without tax breaks and other government support the project would not have been economically viable (Lunden and Fjaertoft, 2014).

Over the past decade, as more of the globe's available carbon budget has been consumed, the percentage of unburnable total fossil fuel reserves has grown rapidly. Proven global oil, gas and coal reserves have risen due to ongoing exploration efforts by international fossil fuel companies and state-owned enterprises to expand reserves. At the same time, the carbon budget (the amount that can be burnt without a high probability of exceeding 2°C of warming) has shrunk as a result of GHG emissions (see Figure 1). As the global carbon budget shrinks, fossil fuel extraction and production is becoming more energy- and emissions-intensive. BP has stated that 'it is likely that the carbon intensity of our upstream (production) operations will continue to trend upwards as we move farther into more technically-challenging and potentially more energy intensive areas'; and the Carbon Disclosure Project has found that major oil and gas companies (ExxonMobil and Shell) are emitting more GHG emissions, despite producing less oil and natural gas (Cama, 2014; BP, 2013). In its disclosures, Shell acknowledges that it expects both absolute emissions and the intensity of emissions per barrel produced from Shell's operations to grow as the company produces more oil and gas from unconventional sources (CDP, 2014).[1]

Recent analysis indicates that, globally, at least three quarters of already-discovered fossil fuel reserves must stay in the ground to have a good chance of limiting global warming to 2°C. Further, the research indicates that 'development of resources in the Arctic and any increase in unconventional oil production are incommensurate with efforts to limit average global warming to 2°C' (IPCC, 2014; McGlade and Ekins, 2015).

The increasing carbon intensity of fossil fuel production alongside the mounting evidence that most fossil fuels – especially those that are most carbon-intensive – must remain in the ground, means that unburnable carbon is an important climate issue for policy-makers. It is also an important financial issue: according to the Carbon Tracker Initiative (CTI), as much as 80% of the coal, oil and gas reserves of listed companies (such as Peabody Coal and ExxonMobil) are poised to become stranded assets (meaning assets that cannot be burnt) as the world moves to limit dangerous global warming (CTI, 2013).

Yet, as this report finds, governments have continued to provide subsidies for fossil fuel exploration and production despite their previous commitments to phase-out subsidies for fossil fuels and the spectre of unburnable carbon and stranded assets (See Chapters 4, 5 and 6).

1 Exxon Mobil and Shell are respectively the largest and third largest private oil and gas companies in terms of production expenditure (Table 9).

CTI defines stranded assets as fuel energy and generation resources that, as a result of regulatory changes linked to the transition to a low-carbon economy, at some time prior to the end of their economic life are no longer able to earn an economic return (CTI, 2014). Assuming that appropriate market and regulatory action is taken in response to the latest climate science, the currently assumed value represented by these reserves of fossil fuels can never be brought to market; nor is carbon capture and storage (CCS) likely to be a viable solution for this problem (see Box 1).

Fossil fuel subsidies have a significant impact on increasing climate risks, and the risk of carbon lock-in. However, the precise climate impacts of subsidies – particularly producer subsidies – remain poorly understood. Recent research by the Global Subsidies Initiative finds that the removal of fossil fuel subsidies across 20 countries between now and 2020 could lead to average national emissions reductions of about 11% against a business-as-usual scenario. This research also found that if 30% of the savings from subsidy removal are redirected to renewable energy and energy efficiency, the national average emission reduction estimates increase to 18% (Merrill et al., 2015).

Research completed at Laval University and the University of Oxford found that subsidies for fossil fuels could have been responsible for up to 36% of global carbon emissions between 1980 and 2010 (Stefanski, 2014).

These subsidies to high carbon activities come at the same time that governments around the world are setting national policy to limit GHG emissions. Governments responsible for 54% of global GHG emissions have expressed their support for the establishment of a carbon price (World Bank, 2014). Yet fossil fuel subsidies function as a negative carbon price, encouraging more production and consumption of fossil fuels and thereby driving emissions (OECD, 2009). Governments are paying fossil fuel producers to undermine those very governments' own climate policies, along with their peoples' and ecosystems' health.

Additionally, once exploration is complete and production infrastructure is in place for a given project, the marginal cost of producing fossil fuels drops to the operating cost – which can be relatively cheap. Thus, once initial investments in production infrastructure are made, an overproduction of fossil fuels beyond climate limits becomes much more likely, because producers seek to recoup massive infrastructure investments by producing as much as possible, even if their profit levels are less than expected, or simply to limit their losses (Kretzmann, 2012). Furthermore, new supplies tend to decrease prices, which in turn drives more global consumption (Erickson and Lazarus, 2014).

Recent research indicates that, in certain oil-producing countries, measures that influence supply may be critically important for climate action (Fæhn et al., 2013). Given the significant climate impacts of fossil fuel subsidies, phasing out subsidies can play an important role in addressing the urgent challenge of climate change. In September 2009, leaders of the Group of 20 (G20) countries, the world's major economies, pledged to phase-out inefficient fossil fuel subsidies (G20, 2009).[2] The G20's commitment was reiterated in the Communiqué from the 2015 Energy Ministers' Meeting, which stated:

> *'We welcome the progress being made by a number of countries to rationalize and phase-out inefficient fossil fuel subsidies that encourage wasteful consumption, which may lead to a reduction in the associated market distortions and environmental damage while taking into account vulnerable groups and their development needs.*
>
> *We encourage the efforts underway in some G20 countries as described in the country progress reports, and the peer review process which is now in place. We encourage more G20 countries to join the peer review process.*
>
> *In the light of the commitment in 2009 and beyond to rationalize and phase-out over the medium term inefficient fossil fuel subsidies that encourage wasteful consumption, while providing targeted support for the poorest, we will endeavour to make enhanced progress in moving forward this commitment in future G20 meetings.'*
>
> *(G20, 2015)*

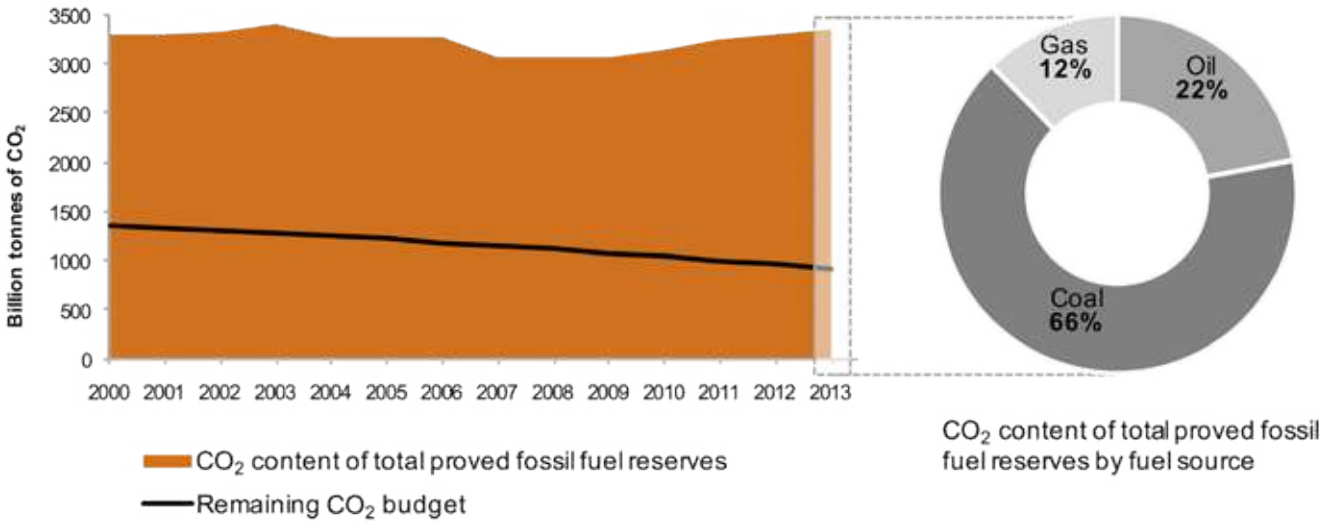
These G20 commitments are an important recognition by world leaders that the hundreds of billions of dollars in national subsidies provided by governments each year to promote the production and use of fossil fuels create an uneven playing field that puts renewable energy sources at a disadvantage and accelerates growth in GHG emissions (OCI, 2012). The newly minted Sustainable Development Goals, adopted in September 2015 (UNDESA, 2015), include a target focused on the rationalisation of inefficient fossil fuel subsidies. Calls to reduce fossil fuel subsidies have been repeated by governments and civil society within international processes such as the United Nations Conference on Sustainable Development, the UNFCCC, by APEC countries, and more recently by the C20 (C20, 2015), the civil society process that parallels the G20. The C20 communiqué, representing nearly 500 civil society

2 G20 nations committed to 'rationalize and phase-out over the medium term inefficient fossil fuel subsidies that encourage wasteful consumption'. This language has been broadly interpreted to mean a phase-out of fossil fuel subsidies.

organisations around the world, urged G20 leaders to 'take immediate action to completely and equitably phase-out fossil fuel subsidies by 2020'. At the June 2015 G7 leaders' summit in Elmau, the G7 countries (a sub-set of the G20) reaffirmed their commitment to national fossil fuel subsidy elimination, as well as continuing discussions on the need to reduce the climate impacts of export credit financing (G7, 2015).

Despite all their pledges and declarations, after six years the G20 countries are struggling to implement their 2009 commitment. Few G20 countries have made progress on the elimination of fossil fuel subsidies. As this report shows, some countries have even introduced new fossil fuel subsidies since then (Koplow, 2012). What little progress has been made has focused on consumer subsidies for fossil fuels, specifically those that lower the price of energy for consumers. In the context of unburnable carbon, however, subsidies that encourage fossil fuel exploration and production are the greatest culprits. These create incentives for corporations to continue to find and develop new oil, gas and coal reserves when proven reserves are already three times the amount that can safely be burnt. Furthermore, the highest cost fields that benefit most from subsidisation often have higher carbon intensity per unit of fuel produced. In order to highlight the current scale of these production subsidies, this report outlines current levels of national subsidies, investment by state-owned enterprises and public finance for fossil fuel production activities specifically in G20 countries.

Figure 1. Carbon content of total proven fossil fuel reserves ($GtCO^2$)



Box 1. Subsidies to carbon capture and storage are subsidies to fossil fuel production

Carbon capture and storage (CCS) is a process in which the CO^2 released from burning fossil fuels is captured, compressed and stored underground in deep geological reservoirs. CCS technology is often held up as a way to allow continued burning of oil, gas and coal, while avoiding the release of GHG emissions to the atmosphere.

However, the application of CCS so far has been extremely limited. The first joined-up CCS project only came on line in Canada in 2014, supported both by government subsidies and through selling the captured CO^2 for enhanced hydrocarbon (oil or gas) recovery (EHR) (MIT, 2015).[a] Such funding is required because CCS currently adds costs to generating power that are too high for the process to be applied in a stand-alone commercial context (Bassi et al., 2015). It is therefore unlikely to capture emissions at a significant scale for at least a decade (McGlade and Ekins, 2015), and even then estimates indicate that it will increase the cost of coal-fired electricity plants by 40% to 63% (OECD, 2015), meaning that coal miners may be out of business before it is commercially viable (Citigroup, 2015). Despite often being characterised as a climate solution, even if CCS were developed at scale (currently far from being economically viable) it is estimated that it would only extend the carbon budget by 12% to 14% by 2050 (CTI, 2013).

As the purpose of this report is to highlight government support for fossil fuel production in the context of unburnable carbon, we include CCS under this umbrella as it supports fossil fuel production both directly (through links to EHR and use of joint infrastructure) and indirectly (by extending the lifespan of fossil fuel use during the time period it will take to make CCS commercially viable).

Direct support to fossil fuel production through CCS occurs in the following situations:

- Most current CCS projects are linked to EHR activities, in order to make the CCS activities economically viable. Within EHR projects, CO^2 that is injected into a geological reservoir for storage is simultaneously used to drive more oil and gas to the surface. In this case, spending on CCS projects at any stage benefits the production of further oil and gas.
- In addition, CCS projects often use the same infrastructure as oil and gas production, meaning there is potential for cross-subsidisation between the two industries. For example, pipelines and platforms may be repurposed for CCS rather than being decommissioned by fossil fuel producers, with liabilities for the decommissioning of hydrocarbon fields potentially being transferred to CCS operators (RAE, 2013).

Indirect support to fossil fuel production through CCS occurs in the following situations:

- Government support to CCS is necessary because the process is not currently commercially viable. This support reduces the risk of investment in fossil fuel production for projects that otherwise would not be developed in a carbon-constrained world. Given the current high costs of CCS, there is a risk that this technological solution to climate change will never become sufficiently commercially viable to offset the risk it creates of lock-in to fossil fuel production.

Note: (a) There are some CCS projects that involve capturing the emissions from a process other than fossil fuel combustion (e.g. biomass combustion or from industrial processes that are not dependent on fossil fuels), which may be stored in reservoirs not linked to extraction hydrocarbons. However, this represents a small minority of CCS projects. See, for example, ZeroCO².NO (2015). Moreover, recent analysis has shown that combining CCS with biomass to create negative emissions processes offers no benefits over timely de-carbonisation of current energy systems and would require the rapid creation of an enormous industry that currently does not exist (Caldecott et al., 2015).

2.
The shifting economics of fossil fuel production

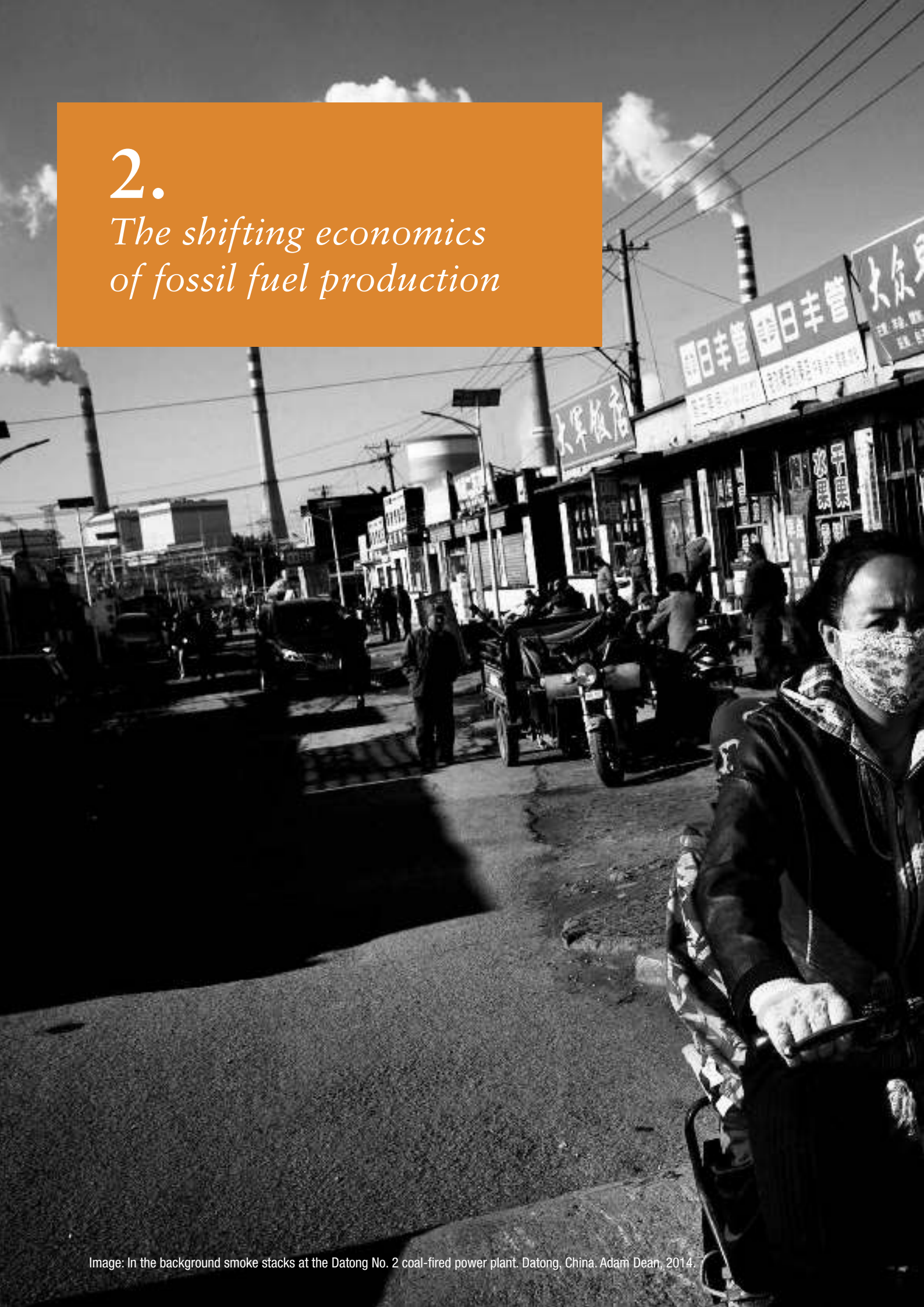


Image: In the background smoke stacks at the Datong No. 2 coal-fired power plant. Datong, China. Adam Dean, 2014.

The shifting economics of fossil fuel production

Government support plays a critical role in the economics of fossil fuel production. Due to falling prices, rising costs, improvements in efficiency, more stringent environmental regulations and greater competition from ever-cheaper alternatives, it may increasingly be government subsidies that sustain fossil fuel production (Lunden and Fjaertoft, 2014; Fulton et al., 2015). On the other hand, if policy were aligned with climate objectives, subsidies would not be focused on producing fossil fuels, but on facilitating the energy transition. Yet, on a global scale, the level of support for incumbent fossil fuels dwarfs that provided to alternatives for energy services (see Chapter 7). These alternatives to fossil fuels include not only renewable energy, but also the complementary technologies that will increase the uptake of the latter and reduce overall energy demand, through efficiency, storage and electrification of vehicles and heating. The following section outlines the drivers that are rapidly transforming the economics of fossil fuel production. Chapter 7 begins to explore how shifting subsidies might further accelerate the energy transition needed to address climate change.

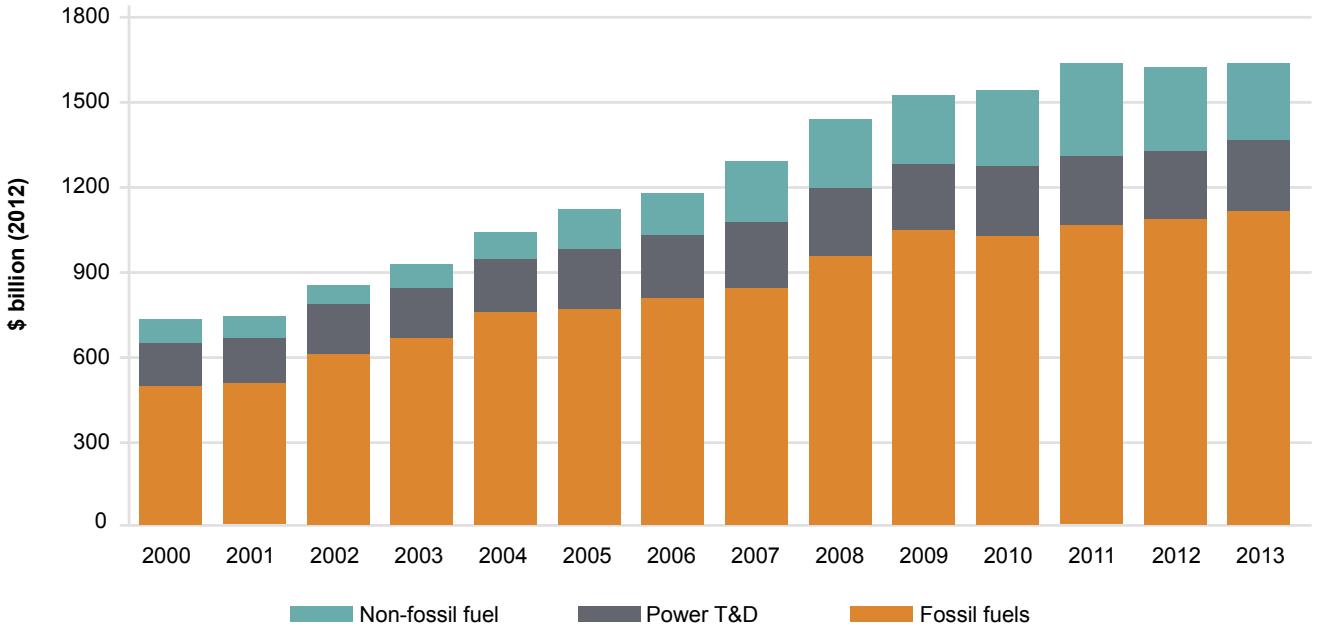
2.1 Fossil fuels

'In the past, oil and gas exploration and extraction have enabled industry giants to command huge market capitalisations, and monopoly utilities have been able to make stable if unexciting returns. In the era that is coming, margins may be much thinner and even more volatile than before, across a complex and splintered energy system.'

(McCrone, 2015a)

Global investment in energy supply from fossil fuels rose rapidly between 2000 and 2009. By 2014 it had reached just over $1 trillion per year, accounting for about 70% of all energy supply investments (see Figure 2) (IEA, 2014a). Meeting the internationally agreed climate target of 2°C should drive a move away from a reliance on fossil fuels, and could lead to a proportion of oil, gas and coal investments becoming 'stranded'. To get a sense of the scale of this potential shift, it was estimated in 2013 that under a global climate deal consistent with a 2°C world, the fossil fuel industry could lose $28 trillion in revenue by 2035, compared with business-as-usual (CTI, 2013). These estimates did not take into account current subsidies. If governments were to remove these, while implementing other climate regulation, the effects could be greater still.

Figure 2. Investment in global energy supply by fossil fuel, non-fossil fuel and power transmission and distribution (T&D)



Notes: Non-fossil fuel includes all renewable technologies, nuclear and biofuels. Power T&D is transmission and distribution for the power sector: this cannot be assigned to either fossil fuel or non-fossil fuel use.
Source: Adapted from IEA (2014a)

2.1.1 Coal

In recent years there has been a significant slow-down in demand for coal globally, particularly in China. Recent official data for China, which accounts for half of world coal demand (see Figure 3), shows that in 2014 coal demand fell for the first time in 14 years (by 2.9%), and continues to decline (Puko and Yap, 2015). This trend is linked to the health impacts of coal-based energy, along with slowing economic growth, improvements in efficiency and the increased use of decentralised and diversified power sources (including gas) (CTI, 2014). Coal also has much higher air pollution impacts and GHG emissions than other energy sources. In the context of a 2°C world, nearly all coal resources would need to be left in the ground (see Chapter 1). All of these factors are starting to be reflected in falling global demand for coal, with prices at their lowest levels ($45/tonne[3]) since the financial crisis in 2009 (InvestmentMine, 2015).

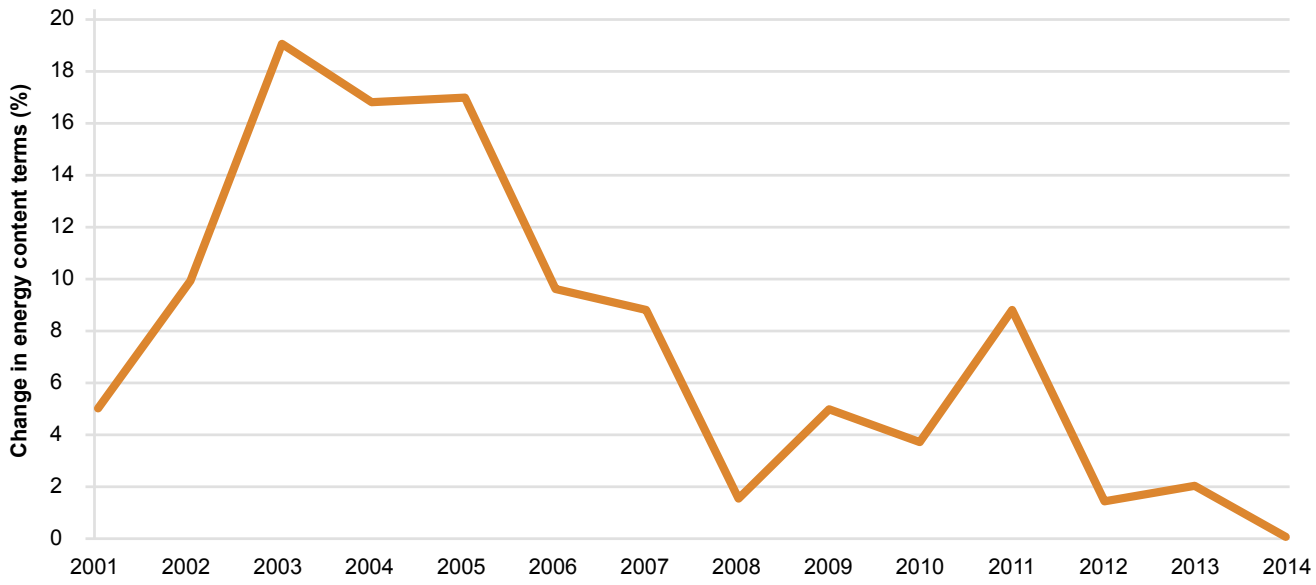
These drivers have significantly affected the economics of coal production. In May 2014, the Queensland Resources Council reported that more than 50% of Australian thermal coal was being produced at a loss. In March 2015, consultants Wood Mackenzie estimated that nearly 17% of US coal production was uneconomic, and as recently as October 2015 Moody's Investors Service estimated that half of the world's coal output was unprofitable (McKracken, 2015; Parker, 2015).

Falling demand has meant that the market value of listed coal mining equities has shrunk from around $50 billion in 2012 to around $18 billion in 2015 (Citigroup, 2015). Large diversified mining companies such as Rio Tinto, Anglo American and BHP Billiton are exiting thermal coal operations or significantly scaling down these activities, with some projects being sold at rock bottom prices (Citigroup, 2015). One mine in Australia (Isaac Plains), valued in 2012 at $628 million, was sold in June 2015 for less than $1 (Stern, 2015). Exports from Australia had previously been affected in 2014, when China raised coal import tariffs with the aim of protecting its domestic miners (Bloomberg News, 2014).

In addition, in recent months a number of financial institutions, including Citigroup and Bank of America, have committed to cut lending to coal mining companies, and Axa, one of the world's largest insurers, announced it would sell $562 million (€500 million) in coal assets by the end of 2015 (Shubber, 2015). According to Citigroup, the survival of the coal sector 'may perversely come down to government intervention' (Citigroup, 2015).

The adverse economic conditions for coal production remain, in spite of subsidies to the sector. Meanwhile, forecasts do not appear to account for the potential impacts of subsidy phase-out. A recent report by the Carbon Tracker Initiative (CTI) showed, for the first time, that eliminating a small sub-set of overall subsidies to coal production – amounting to nearly $8 per tonne in the Powder River Basin (PRB)[4] in the United States and $4 per tonne in Australia – would materially reduce domestic coal demand in the United States (by between

Figure 3. Annual change in Chinese coal consumption (2001–2014)

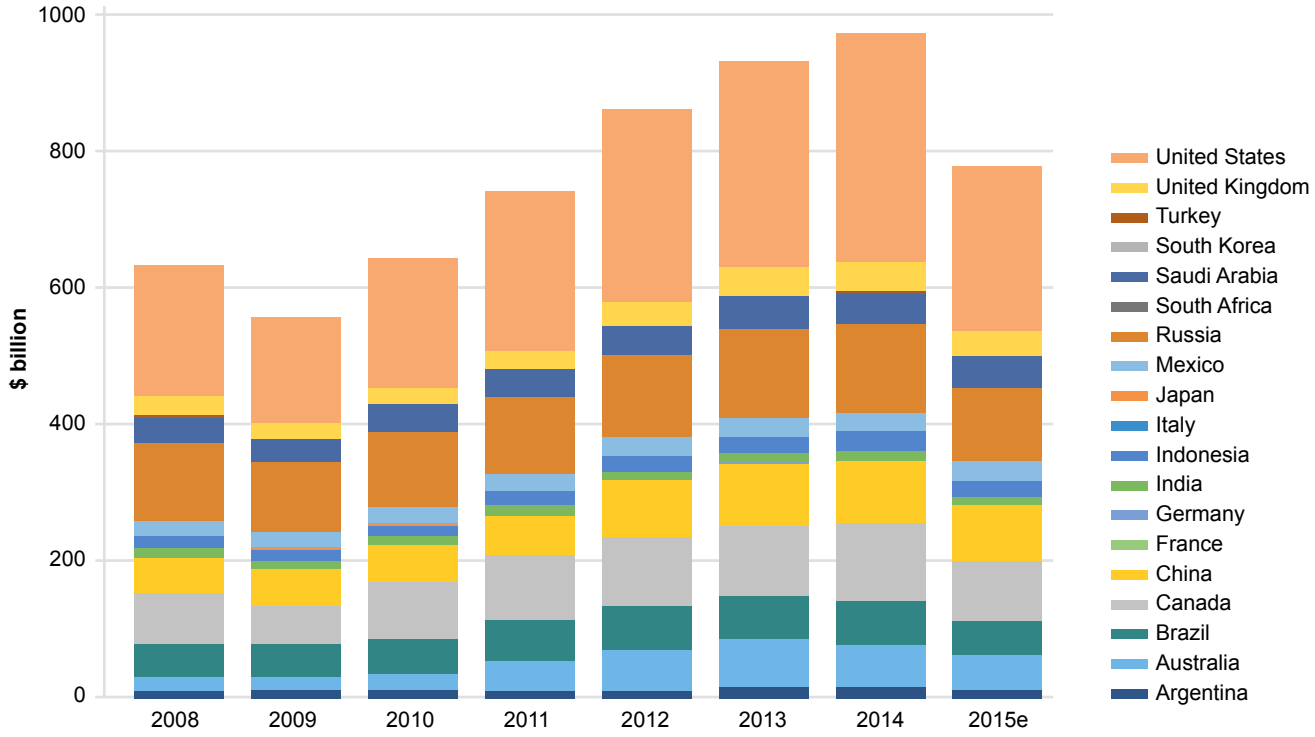


Source: Adapted from EIA (2015a)

3 Prices for coal vary by region, and according to whether they are destined for export. The price used here is the thermal coal Central Appalachian (CAPP) price per short ton (converted to price per tonne).

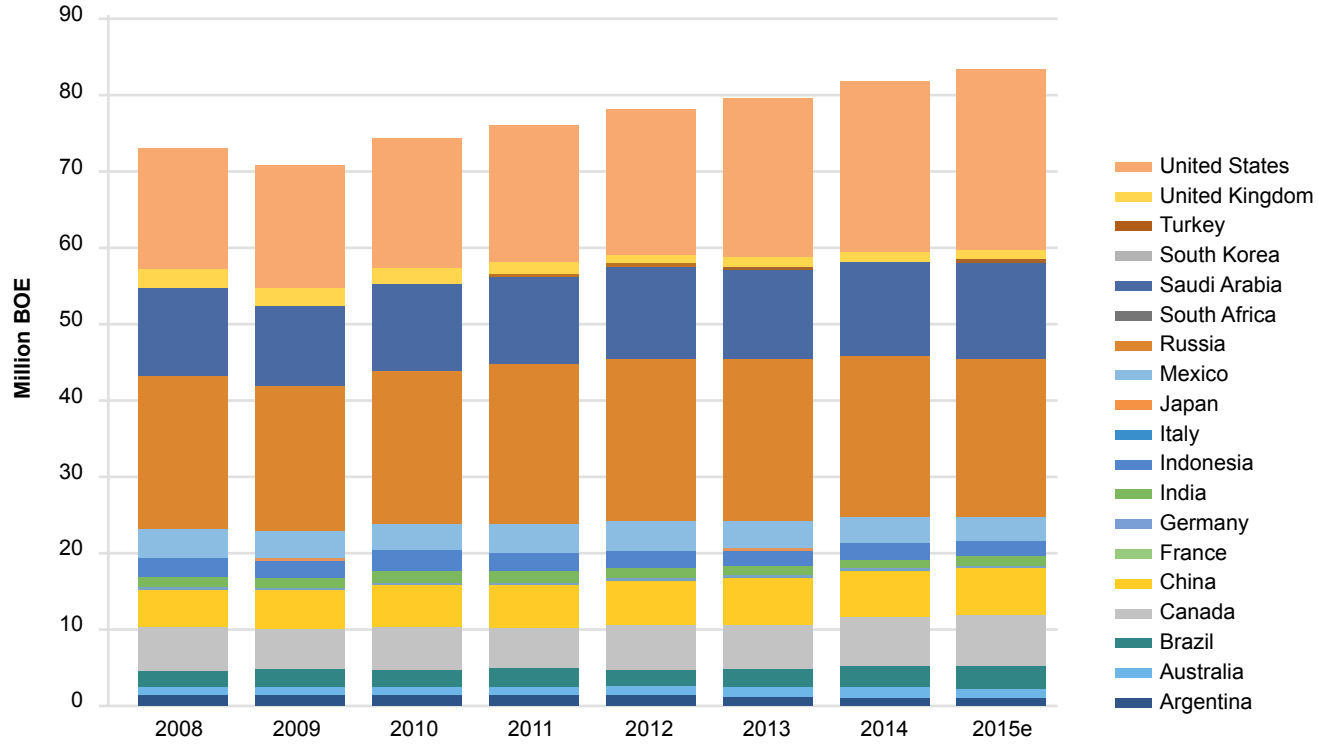
4 The Powder River Basin (PRB) in Montana and Wyoming in the United States was responsible for approximately 40% of the country's coal production in 2014 (US Department of Interior, 2015; EIA, 2015b).

Figure 4. Oil and gas investment in G20 countries ($ billion) (public and private)



Note: Investment includes: exploration expenditure, capital expenditure and operational expenditure.
Source: Adapted from Rystad Energy (2015)

Figure 5. Oil and gas production in G20 countries (million barrels of oil equivalent (mboe)) (2013 and 2014)



Source: Adapted from Rystad Energy (2015)

8% and 29%) and reduce demand for coal exports from Australia (by between 3% and 7%) (CTI, 2015a). In an illustration of the significant potential climate impact of removing production subsidies, the same report found that reducing the PRB subsidies alone would result in cumulative emissions reductions of 0.7 to 2.5 $GtCO^2$ to 2035. For comparison India's CO^2 emissions from fossil fuel combustion and industrial processes were 2.1 Gt in 2013 (Olivier Jos et al., 2014).

2.1.2 Oil and gas

Looking at oil and gas production in the G20 alone, investment in production almost doubled between 2009 and 2014. However, levels of production have risen much more slowly, highlighting the rising costs of accessing and developing new resources (see Figures 4 and 5). In addition, despite oil prices averaging close to $110 per barrel between 2011 and 2014 (at the time of writing crude oil was priced at $44 per barrel (NASDAQ, 2015)), oil companies saw their capital productivity decline sharply (Lewis, 2014). In other words, the profitability of oil and gas production was falling systemically even before the oil price crashed.

A decade of cost escalation, coupled with the recent rapid decline in oil prices (resulting from OPEC's refusal to cut production) (see Figure 6), has seen margins squeezed and led oil and gas companies to scale back both actual and planned investment (Citigroup, 2015; Fulton et al., 2015). A study by Wood Mackenzie estimated that $220 billion of investment has been cut since oil prices began to fall in 2014. It forecast that $1.5 trillion of potential investment globally would be shelved if prices remain below $50 per barrel (Adams, 2015).

The rising average costs of oil and gas production are reflected in the higher break-even prices – the price of oil that is needed to cover the costs of production – of newer and less accessible resources, such as those in the Arctic, tar sands and shale oil. Break-even prices for these are as high as $120 per barrel (see Figure 7). In the light of lower prices, and as the sector begins to rationalise investments, it is anticipated that companies will look to limit their exposure to high-cost and high-risk projects, including resources such as heavy oil and oil sands, non-US shale and LNG (Citigroup, 2015). Some of the projects with the highest break-even costs are already being affected; witness Shell's decision in September 2015 to halt its Arctic oil exploration campaign, having invested $7 billion (Clark, 2015).

There is some debate over what the longer-term impact of the fall in oil and gas prices will be on US shale (and resulting impacts on global shale development more broadly). Some predict that US shale projects will remain the most agile of current higher-cost projects, continuing to offset reduced revenues by cutting costs and focusing drilling on the most lucrative locations. Others believe that the financial position of a number of smaller and highly leveraged companies operating in US shale will become more vulnerable as their hedging positions begin to run out (Citigroup, 2015; CTI, 2015b; Liebreich and Blanchard, 2015).

2.1.3 Utilities

The shifting dynamics in the energy sector have also affected utilities that provide fossil fuel-based electricity and heat. This has been seen most strikingly in Europe, where between 2008 and 2013 the market value of five of the region's largest power producers fell by $112 billion (€100 billion), or 37% (see Figure 8), with the worst performance coming from coal-reliant utilities (CTI, 2015c). Continued reliance on coal-fired generation has meant that these companies, which provide 60% of Europe's power, have been adversely affected by declining renewable energy technology costs, supportive policies for renewable energy, flattening electricity demand and changing customer needs (see Figure 9) (CTI, 2015c). These changing conditions are already altering utility business models in Europe. In 2015, Enel (Italy's largest utility) said that it would phase-out new investments in coal (Politi, 2015). In December 2014, E.ON (Germany's second largest power generator) announced that it would split into two companies: a fossil fuel and nuclear power generator focused on short-term returns, and a growth-oriented company delivering renewable and decentralised generation (see Germany Country Study).

Such restructuring is likely to become more widespread within Europe. The UK government is considering a possible shut-down of all coal-fired power stations by 2023 – a feat which the province of Ontario in Canada achieved in 2014 (Pagnamenta, 2015; Harris et al., 2015). Even in the absence of such measures, the Australian utility Alinta Energy has brought forward its existing plans to close its two coal-fired power stations (from 2018 to 2016), as power demand from industry and the electricity grid has weakened due to increased energy efficiency and the growth in use of roof-top solar PV panels (Argus, 2015).

Looking at a wider set of countries, a study of sub-critical coal-fired power (the least efficient technology) by Oxford University found that it currently accounts for 75% of coal-fired power capacity worldwide. Water scarcity and air pollution concerns mean that Indian, Chinese and Australian power stations appear most at risk of regulation, with the possible stranding of less efficient power generation assets (Caldecott et al., 2015). Section 2.2 below further discusses the impact of renewable power generation on utilities.

2.1.4 Fading licence to operate

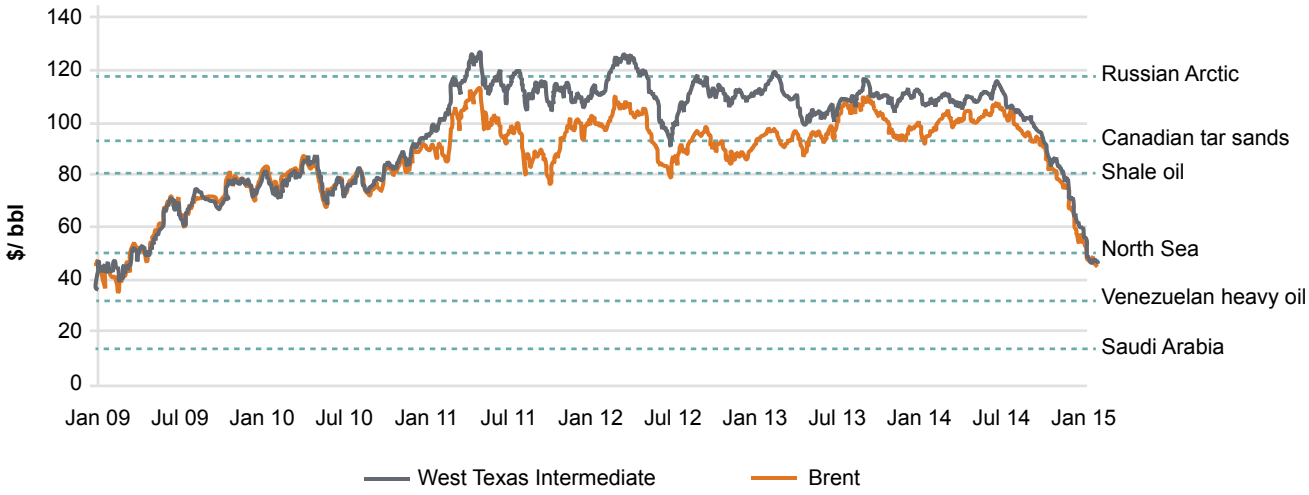
Health

Governments (including countries such as the US and China) are introducing regulatory measures specific to coal and coal-fired power both to reduce carbon emissions and to improve air quality. The US Clean Power Plan focuses on the health impacts of coal-fired power. It is expected to cut soot and smog by 25%, with overall health benefits estimated to amount to between $55 billion and $93 billion by 2030 (HSBC, 2015). In 2014, China announced a ban on the mining, sale, transportation and

Figure 6. Crude oil spot prices ($/barrel) between 1960 and 2015 (line showing average)

Note: Bbl refers to billion barrels of oil
Source: Adapted from World Bank (2015)

Figure 7. Project break-even and crude price



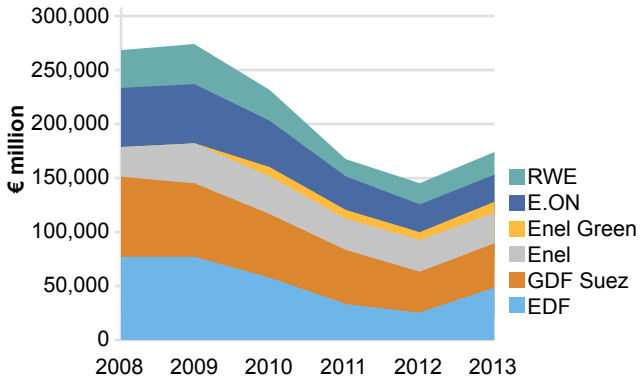
Note: Bbl refers to billion barrels of oil
Source: Adapted from HSBC (2015)

importing of coal with ash and sulphur content exceeding 40% and 3% respectively, with more stringent limits for ash content (20%) for coal due to be transported more than 600 km from the production site or receiving port (Milman, 2014). In Ontario, Canada, a wide range of groups, including the Ontario Medical Association, joined forces to push for a coal phase-out. Much of the initial campaigning focused on the negative health impacts of coal-fired generation (Harris et al., 2015). In the longer term, the use of oil in transport may also face more widespread health-driven regulation, and shipping regulations designed to reduce SOx, NOx (sulphur and nitrogen oxides) and particulate matter are already being introduced (HSBC, 2015).

Divestment

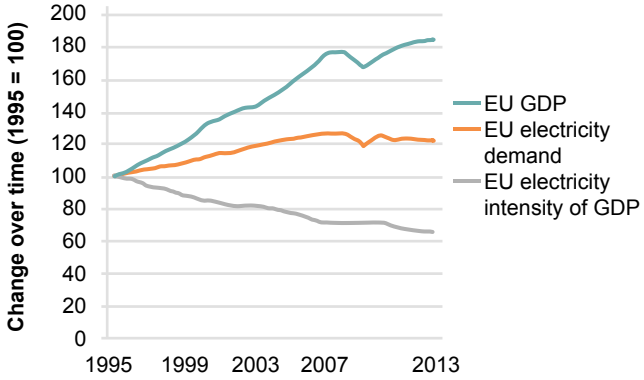
The global divestment movement is adding to the effect of stricter regulations on fossil fuel production. Funds and institutions have begun to withdraw their investments from fossil fuel companies, potentially increasing the cost of capital for these firms. Groups ranging from the Rockefeller Brothers Fund (whose wealth was made through Standard Oil) (RBF, 2014) to Norway's sovereign wealth fund (developed through oil revenues) (Storting, 2015) are beginning to divest from fossil fuel companies. The former is beginning phased divestment of coal and tar sands-related assets, while the latter is divesting from companies that generate more than 30% of their output or revenues from coal-related activities. It is estimated that, as of September 2015, institutions and individuals across 43 countries representing $2.6 trillion in assets have

Figure 8. Market capitalisation of five European utilities between 2008 and 2009



Source: Adapted from CTI (2015c)

Figure 9. EU electricity demand vs. EU GDP and EU electricity intensity of GDP[a]



Note: (a) Electricity consumption patterns shifted in the OECD countries between 2007 and 2014, with demand appearing to have begun to decouple from GDP growth (McCrone, 2015b). Energy use fell by 0.4% while economic growth was 6.3%, and this pattern is reflected across many of the wealthiest OECD countries, including the US, Japan, Germany, France, the UK, Canada and Australia (ibid.).
Source: Adapted from CTI (2015c)

committed to divest from specific fossil fuel companies, particularly those involved in coal and, in some cases, tar sands (Arabella Advisors, 2015).

The impact of the divestment movement is being felt directly by fossil fuel companies. Peabody Coal's 2014 annual report stated that the impact of divestment efforts may adversely affect the demand for and price of its shares, along with its access to capital and financial markets (Peabody, 2015). The breadth of the movement, along with its links to more targeted campaigns around the tar sands and Keystone XL pipeline, further opens up the political space in which governments could actively support the transition away from fossil fuels, including the removal of production subsidies (UBS, 2014b; Whitley, 2015; Kretzmann, 2015).

2.2 Alternatives

A recent report by Citigroup has found that the total investment necessary for the development between 2015 and 2040 of a low-carbon energy system globally ($190 trillion) is slightly lower than under a 'business-as-usual' (high-carbon) scenario (see Figure 10) (Citigroup, 2015). This is because under a low-carbon scenario: 1) shifting away from fossil fuels yields a large ($1.8 trillion) reduction in fuel and capital costs; 2) the cost of renewables falls rapidly;[5] and 3) investments in energy efficiency reduce overall energy use (ibid.). Citigroup's low-carbon energy scenario projects that the overall costs of alternatives decline in the long term although total energy spending rises in the short term, reflecting similar findings by the Climate Policy Initiative and Bloomberg New Energy Finance (Nelson et al., 2014; BNEF, 2015).

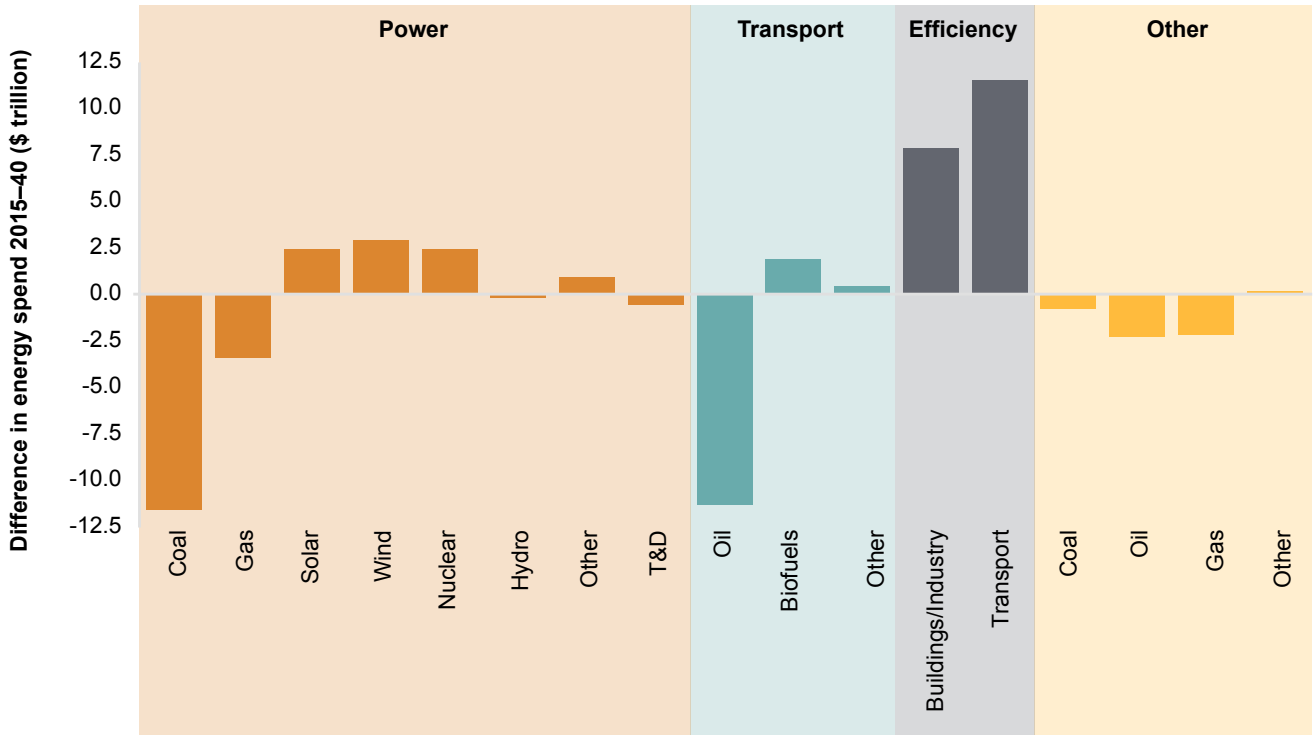
Alternatives to fossil fuels are also increasingly attractive economically in terms of extending energy access to those currently without, discrediting claims by segments of the coal industry that increased production and consumption of coal is the answer to energy poverty (see Box 2).

2.2.1 Renewables

The IEA estimates that, in order to have a 50% chance of staying below the 2°C limit, the share of renewables must increase to between 65% and 80% of global electricity production by 2050 (IEA, 2014b). This shift has begun. Looking only at power generation, in 2014 new investment in renewable power (excluding large hydro) was $243 billion. This was below the $289 billion gross investment in fossil fuel power (including investment to replace retiring fossil fuel generating assets), but far above

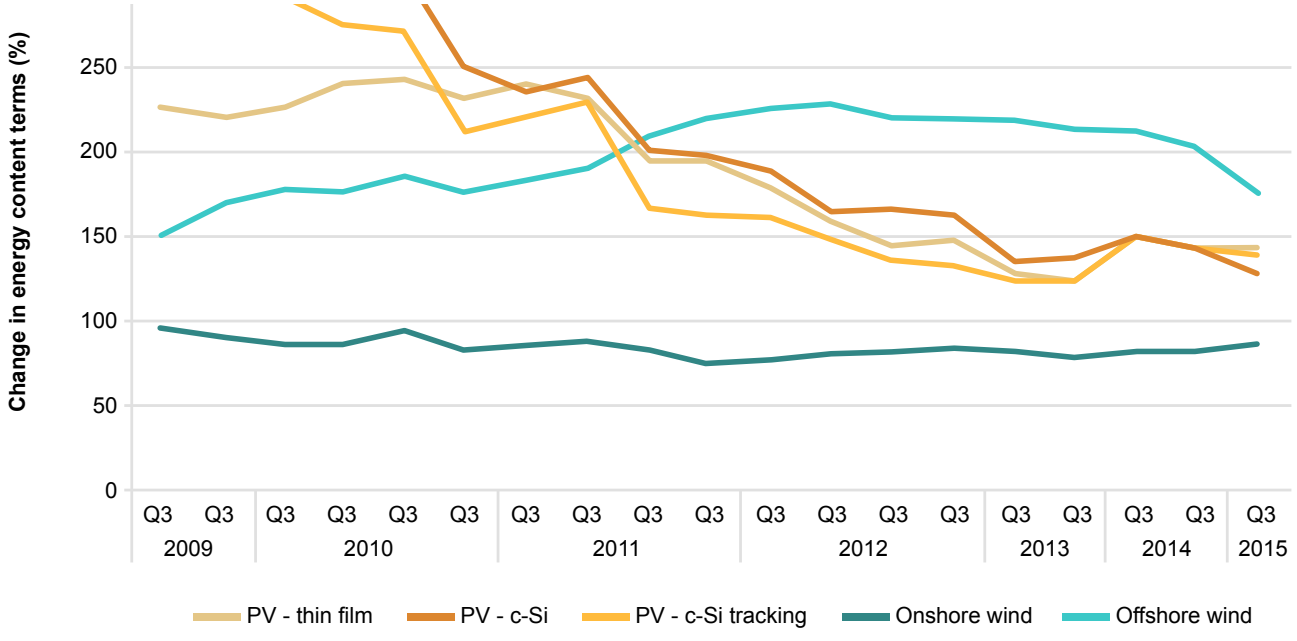
5 The Citigroup projections for renewable energy costs and penetration differ substantially from the IEA's New Policy scenario in that they assume a much faster drop in renewable energy prices, at rates which are more in line with historical experience and current trends. Also, while most examinations of electricity costs focus on upfront capital expenditure, the Citigroup analysis looks at levelised cost of electricity (LCOE) with the aim of capturing both the upfront investment costs and operating costs (including fuel) (Citigroup, 2015).

Figure 10. Difference between projected energy investment under low-carbon and 'business-as-usual' scenarios



Source: Adapted from Citigroup (2015)

Figure 11. Global average levelised cost of electricity for wind and solar PV



Source: Adapted from FS-UNEP (2015)

Figure 12. Weighted average cost by region of utility scale renewable technologies, compared with fossil fuel power generation costs (2013–2014)

Source: Adapted from IRENA (2015)

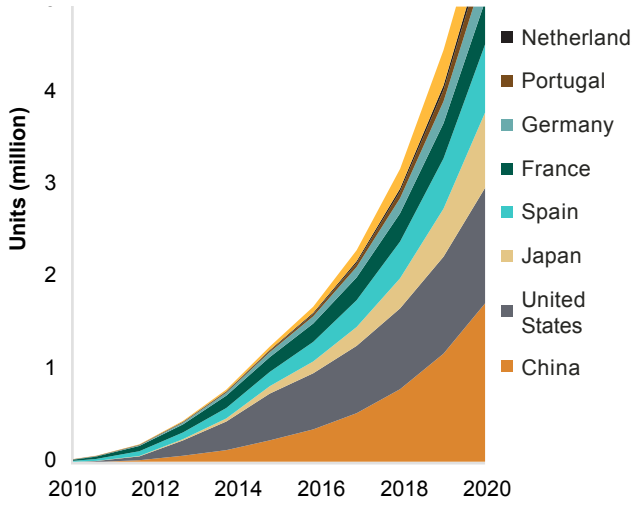
the investment in new fossil-fired power capacity, which was only $132 billion (FS-UNEP, 2015).

In parallel with the shifting investment climate for fossil fuel production, the costs of renewable energy technologies continue to fall rapidly, and the speed of growth in installed capacity of renewables has outperformed predictions every year since 2000 (CTI, 2014). Average global levelised costs per MWh for crystalline silicon photo-voltaic (PV) projects have fallen by 59% in the past five and half years, with the equivalent for onshore wind dropping 11.5% per MWh over the same period (see Figure 11) (FS-UNEP, 2015). In 2014, in most regions of the world, utility scale biomass, geothermal and onshore wind power were already price competitive with fossil fuel power, with solar PV competitive in North and South America, and offshore wind in Asia (see Figure 12) (IRENA, 2015). If fossil fuel subsidies were to be removed, renewable energy would be increasingly competitive with coal and natural gas for power generation, particularly in developing and emerging market countries (Bridle and Kitson, 2014).

This growth in renewable power generation also has significant implications for those managing power grids (including private utilities and governments). They are seeking to manage demand and supply by including an increasing share of variable renewable sources, such as wind and solar, on the grid (Roberts, 2015). This includes investment in and support for a wide range of approaches for integration of renewables including: gas peaking plants, batteries and other storage technologies, demand response, efficiency and interconnectors. Some of this is already taking place in a number of countries through the development of capacity mechanisms, which although aiming to support greater penetration of renewables on the grid, could also lead to the creation of new fossil fuel subsidies (see Box 3).

The rise in renewables could mean shifting roles for utilities, which may increasingly focus on supporting the development of connected homes and the electrification of vehicles, alongside traditional roles of power generation and grid management – 'the need for a cost-effective provider of reliability at the centre' is only growing (Young, 2015; McCrone, 2015a).

Figure 13. Electric vehicle sales targets



Source: Adapted from IEA (2013)

2.2.2 Electrification and storage

While power generation from coal and natural gas faces increasing competition from renewable energy, the challenge to oil – primarily as a transportation fuel – could come increasingly from the falling costs and rising up-take of hybrids, electric and LPG/LNG vehicles. Deutsche Bank estimates that electric vehicles will reach cost parity with conventional diesel and gasoline vehicles within the next 5 and 10 years respectively (Deutsche Bank, 2014). Given the recent scandal over 'defeat' software that enabled Volkswagen and other car-makers to appear to meet diesel emissions regulations, this trend in electrification may accelerate due to shifting consumer demand, new regulations and more robust implementation of existing emission standards (Bershidsky, 2015).

Box 2. Alternatives are more economic than fossil fuels for providing energy access

In 2015, 1.1 billion people around the world lack access to electricity, while 2.9 billion still use polluting fuels like kerosene for lighting and charcoal, biomass and dung for cooking (IEA and World Bank, 2015). Given the scale of the energy access challenge, the Sustainable Development Goals, agreed in September 2015, dedicate an entire goal to ensuring 'access to affordable, reliable, and modern energy for all', underscoring the critical importance of access to modern energy services as a development imperative for the world's poorest (UNDESA, 2015).

The legitimate need for universal access to energy is often used to justify continued public support for fossil fuels. For example, the World Coal Association has stated that coal has a 'vital role' in 'delivering energy to the 1.3 billion people who lack access' (WCA, 2012). Peabody Energy (the world's largest coal company) launched an 'Advanced Energy for Life' campaign which claimed that the company was using 'clean coal' to end energy poverty and increase energy access. This claim earned a rebuke from the British Advertising Standards Authority for being misleading (Urbaniak, 2014).

The reality is that in order to achieve universal electricity access, distributed power systems – not centralised fossil fuel projects – are often best placed to reach those without access. It is estimated that 84% of those people who lack access to electricity are located in rural areas, often far away from the existing grid, and where the cost of grid extension may be prohibitive (IEA, 2011; ETA and CTI, 2014).

A recent working paper focusing on the energy access challenge in sub-Saharan Africa underscores this point. When it comes to basic levels of energy access for the poorest, distribution challenges are much more significant than generation challenges (Hogarth and Granoff, 2015). Distributed renewable energy will play an increasingly important role in delivering first-time energy access to those who currently lack it. The IEA estimates that to achieve universal electricity access by 2030, 59% of those receiving access would do so through mini-grid or off-grid solutions, more than 90% of which would be powered by renewable energy sources (IEA, 2011). Recent analysis also suggests that distributed energy options may be even less expensive to deploy than has been assumed in previous IEA scenarios (Craine et al., 2014).

This falling cost of electric vehicles is significantly dependent on the falling cost of batteries and wider charging infrastructure. By 2013, average battery cost was around $500 to $650 per kWh, and is predicted to fall to $200/kWh by 2020, as scaled-up battery manufacturing drives both technical improvements and economies of scale (Electrification Coalition, 2013; IEA, 2013; LeVine, 2015).[6] For example, in 2014 the electric car company Tesla announced its decision to build a battery 'gigafactory' in Nevada to complement its automotive operations (Ayre, 2014).

Transportation accounts for 55% of global oil demand, with more than three quarters of this demand coming from road transport (IEA, 2014b). In one scenario developed by the European Commission, an aggressive penetration of electric vehicles (EVs) could lead to global oil demand peaking by 2030 and consistently falling thereafter (Polinares, 2012).

The expected rapid decline in battery cost by more than 50% by 2020 should not just spur EV sales (see Figure 13), but could also lead to exponential growth in demand for stationary batteries to store excess power, which in turn will facilitate reliance on variable renewables (UBS, 2014a). It has been forecast that the payback period for combined systems that include batteries, electric vehicles and solar home systems could be as low as six to eight years by 2020 (ibid.). This could significantly reduce dependence on fossil fuels for energy services, with the payback period being shortest in countries with high fuel and electricity prices, or in which financial mechanisms are developed to spread up-front costs.

Taken together, these trends across coal, oil and gas production, electric utilities and alternatives to fossil fuels illustrate the shifting economics of fossil fuel production and the potential role of fossil fuel production subsidies in propping up increasingly uneconomic industries. These trends underscore how moving subsidies and government support away from fossil fuel production might further accelerate the energy transition needed to address the urgent challenge of climate change.

6 PwC projects a cost of $300–$325/kWh by 2020 (Electrification Coalition, 2013); Tesla projects $150/kWh, which is also the US Department of Energy target (LeVine, 2015).

Box 3. Capacity mechanisms: creating new fossil fuel subsidies?

With renewables accounting for an increasing share of electricity generation, many governments have become concerned about the ability to balance supply and demand when the sun is not shining and the wind is not blowing. In response, renewed interest in 'capacity mechanisms', which offer extra payments to operators that can either turn up their supply or turn down their demand, has emerged.[a]

Capacity markets and other mechanisms that allow generators that only operate in times of peak demand to recover their fixed costs[b] exist around the world. Although they may appear to provide a solution for governments seeking to balance the objectives of increasing renewable energy with ensuring security of supply, they have also tended to result in large payments to fossil fuel-fired generation. The European Commission has accordingly noted that careful design of capacity mechanisms is needed to ensure that they do not 'contradict the objective of phasing out environmentally harmful subsidies including for fossil fuels' (European Commission, 2014).

Poorly designed capacity markets, particularly in the absence of emission limits or pricing, can actually undermine rather than boost the integration of renewables, especially when governments often overestimate demand. Indeed, the UK's first annual capacity market auction has received criticism for discriminating against low-carbon options, overestimating future supply needs, favouring fossil fuels and delaying coal-plant decommissioning (Littlecot, 2014). In addition, Germany is in the process of establishing a capacity reserve under which 2.7 GW of coal-fired generation will receive (currently undefined) payments for staying available as back-up capacity until 2021, although the grid is reportedly sufficiently supplied until 2020 (ENTSOE, 2015).

Rather than supporting incumbent fossil fuel generators, capacity mechanisms should be designed to support G20 government goals of clean, secure energy. As a first step, mechanisms should embrace new low-carbon developments in demand-side management, interconnectors, storage solutions and energy efficiency as they materialise, and not extend the lifetime of unnecessary fossil fuel generation through capacity payments. In addition, alternatives that can be implemented in the near term include allowing generators to charge a premium rate for providing power during times of generation scarcity.

Notes:

(a) There are three different ways in which countries are balancing electricity demand and supply:

Energy-only markets: Rather than providing compensation for capacity, in energy-only markets back-up generators are allowed to charge a premium rate during times of generation scarcity to recover their costs. Examples of such markets in G20 countries include the Electric Reliability Council of Texas (ERCOT) in the United States and National Electricity Market (NEM) in Australia.

Capacity markets: In a capacity market governments determine how much capacity is necessary to ensure peak demand can be met and then that quantity is auctioned in the market. The United Kingdom provides an example of a G20 country that uses capacity auctions to ensure generation adequacy. In the US as well several such mechanisms exist, including PJM (13 Eastern states plus the district of Columbia), New York Independent System Operator (NYISO), Independent System Operator New England (ISO-NE) and the Midcontinent System Operator (MISO).

Capacity reserve: when governments establish a capacity reserve they identify and pay specific power stations the amount necessary to keep them available for when demand is high. Such a capacity mechanism is in place, but subject to review, in Western Australia, and Germany is currently in the process of establishing a capacity reserve.

(b) The so-called 'missing money' problem arises because peak-load generators are rarely able to recover capital outlay because electricity prices are defined by the wholesale market on the basis of higher loads.

3.
Methodology: Identifying and quantifying subsidies to fossil fuel production

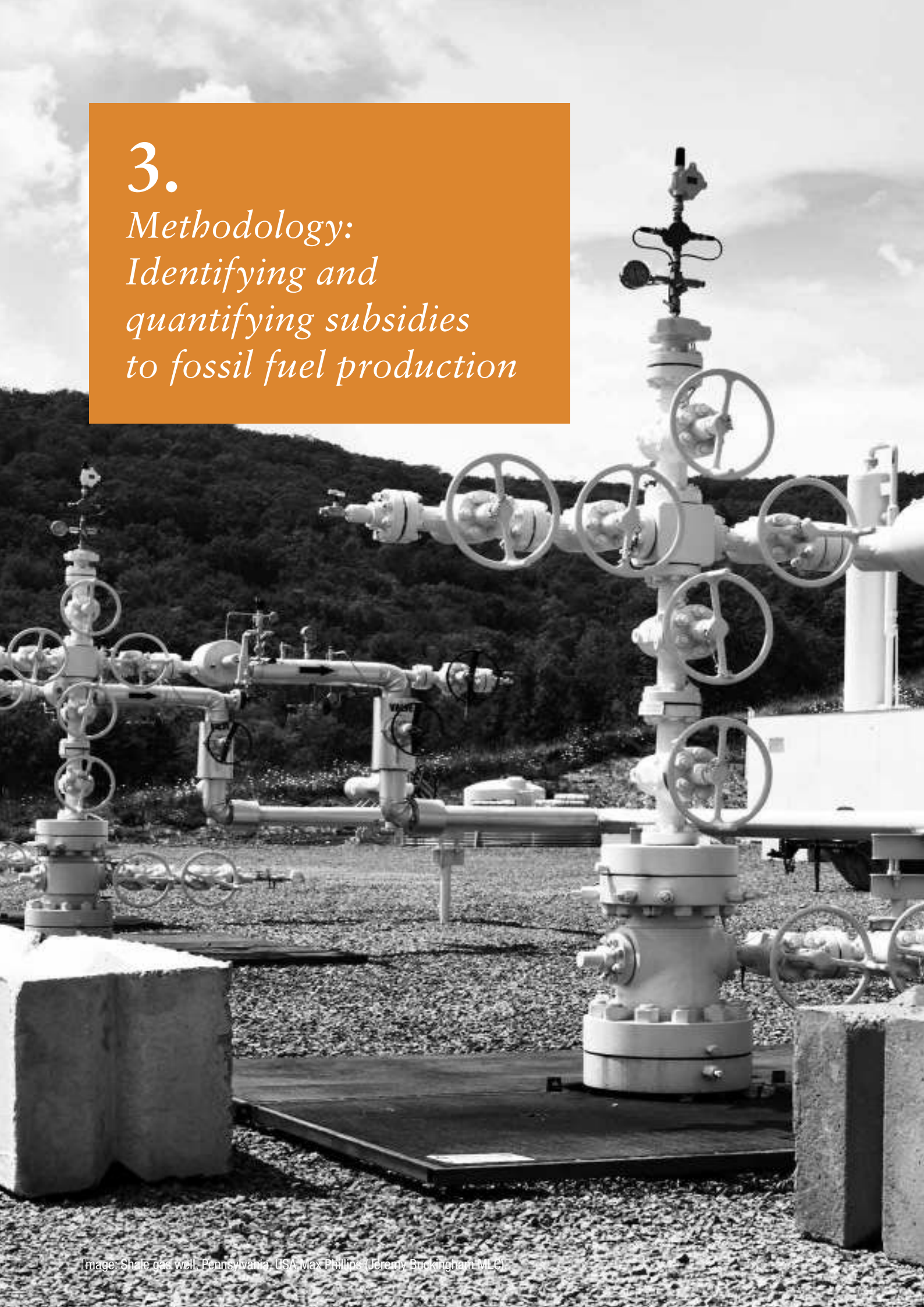


Image: Shale gas well, Pennsylvania, USA, Max Phillips (Jeremy Buckingham MLC)

Methodology

This report reviews fossil fuel production subsidies, including national subsidies, public finance and investment by state-owned enterprises (SOEs), across G20 countries in 2013 and 2014. Our aim is to repeat this work regularly, using these figures as a baseline for understanding progress towards a phase-out. This will not be easy, as data remain difficult to obtain.

The following chapter describes the challenges in determining a common and adequate definition of subsidies. It covers some of the difficulties in finding publicly available and comparable information on fossil fuel production subsidies, and outlines the approaches used in our analysis to address these challenges. In order for governments to be fully accountable for phasing out fossil fuel subsidies, including those used to support production, more transparent and comparable information is urgently required.

3.1 Defining subsidies

Although G20 governments have vowed to eliminate fossil fuel subsidies, they have not set a definition for these subsidies, and individual G20 countries and international organisations use different definitions, and include different types of subsidies, in their current estimates (IISD, n.d.; Whitley and van der Burg, 2015). For example: 'The UK defines fossil fuel subsidies as government action that lowers the pre-tax price to consumers to below international market levels' (UK DECC, 2015), a definition which primarily excludes the subsidies which are directed towards fossil fuel production (see Box 4).

Nonetheless, there is an internationally agreed definition of subsidies. In its Agreement on Subsidies and Countervailing Measures (ASCM) the World Trade Organization (WTO) defines a subsidy as 'any financial contribution by a government, or agent of a government, that is recipient-specific and confers a benefit on its recipients in comparison to other market participants' (WTO, 1994).

This definition (WTO, 1994) includes:

- direct transfer of funds (e.g. grants, loans and equity infusion), potential direct transfers of funds or liabilities (e.g. loan guarantees)
- government revenue that is otherwise due is foregone or not collected (e.g. fiscal incentives such as tax credits)
- government provision of goods or services other than general infrastructure, or purchase of goods, below market-value
- income or price support.

This definition of subsidies has been accepted by the 153 member states of the WTO, and we have used this as a basis for identifying subsidies to the production of coal, oil and gas.

Reflecting the categories under the WTO definition of subsidies, this report divides 'fossil fuel production subsidies' into three categories, and reviews where they directly benefit fossil fuel production:

- 'national subsidies', such as direct spending by government agencies and tax breaks to companies;
- 'investment by SOEs' both domestically and internationally; and
- 'public finance' including support from domestic, bilateral and multilateral international agencies through the provision of grants, loans, equity and guarantees (see Glossary).

This report provides 'national subsidy' estimates separately from the high-level figures for 'public finance' and 'SOE investment' because understanding the share of these that constitutes a subsidy (including comparisons with other market participants and market values), requires information that is not publicly available (see further details below and also in Chapter 7).

In spite of these data gaps, it is critical to track government support through public finance and SOE investment. This is because governments exert significant control over these channels of support for fossil fuel production, and have the potential to set different objectives for public finance and SOE investment as part of the wider energy transition.

Both limited transparency and the difficulty in accessing comparable information creates significant barriers to estimating production subsidies. The following section lays out the specific challenges in identifying and quantifying production subsidies and the methods used in this report to overcome them. See sections 3.6 and 3.7 for more on the challenges of collecting information on the subsidy components of SOE investment and public finance.

3.2 Transparency and data limitations

This report is a compilation of publicly available information on production subsidies. However, limited transparency and wide variations in data availability pose major obstacles to the identification and estimation of fossil fuel subsidies. In practice, the ways in which subsidies are financed and recorded in government budgets vary across countries and can change over time (OECD, 2015).

Five countries in the G20 and APEC have recently (in 2014) embarked on the first fossil fuel subsidy peer review process, which aims to provide a platform for countries to provide feedback on each other's subsidy estimates and progress on phase-out.[7] Although the peer review process may not produce a standardised method and format for fossil fuel subsidy tracking, it could help to improve wider

7 The first peer review of fossil fuel subsidies has been completed for Peru, and parallel processes are under way or planned for New Zealand and the Philippines (through APEC), and for China, Germany and the US (through the G20) (APEC, 2014; White House Office of the Press Secretary, 2014; G20, 2014).

transparency on fossil fuel subsidies and accountability for their phase-out.

The OECD *Inventory of Support Measures for Fossil Fuels 2015* and the *Companion* to the inventory (OECD, 2015), which survey consumption and production for the OECD countries and BRICS countries (Brazil, Russia, India, Indonesia, China and South Africa), provide a basis for the G20 and APEC peer review processes (ibid.). Beyond the OECD inventories (which were used in the national subsidy estimates in this report) and parallel estimates on fossil fuel subsidies by the IEA and IMF,[8] a sub-set of G20 governments have produced their own accounts. Canada, for example, has prepared a *Study of Federal Support to the Fossil Fuel Sector*; France has completed a review of the environmental impacts of energy-related tax concessions; and an inventory of UK energy subsidies was compiled as part of a parliamentary enquiry (Office of the Auditor General of Canada, 2012; Cour des Comptes, 2013; UK Parliament, 2013). The EU Directorate Generals (DGs) for Energy and Environment have also commissioned fossil fuel and energy subsidy inventories for all EU member states (Oosterhuis et al., 2014; Alberici et al., 2014). There has also been a call for governments to integrate tax expenditures with subsidies in their annual budgets, although Germany is the only country doing this effectively (Kojima and Koplow, 2015).

Although most existing fossil fuel subsidy inventories do not cover public finance and investment by state-owned enterprises, the OECD has stated that it would seek to expand its own inventory to include risk transfers, concessional loans, injections of funds (as equity) into state-owned enterprises and market price support, and it is currently undertaking research to that end (OECD, 2012, 2015; Lucas, 2015). As with our own research, there are likely to be barriers to this work due to data limitations and calculation complexity, as government budgets are often not transparent about transfers to state-owned enterprises, or about the proportions of public finance which are based directly on public resources (as opposed to that raised on capital markets) or dependent on the institutions' government-linked credit rating. See sections 3.6 and 3.7 for more on how we sought to address these data collection challenges.

3.3 Defining fossil fuel production

This report reviews fossil fuel production subsidies, as these have a significant climate impact through their role in 'locking in' high-carbon energy systems and unlocking unburnable carbon. For the purpose of this report, production in the oil, gas and coal sectors includes: access, exploration and appraisal, development, extraction, preparation, transport (to utilities and refineries), plant construction and operation (utilities and refineries), distribution (fuel products and fossil fuel-based electricity)[9] and decommissioning (see Figure 14). Each stage of fossil fuel production involves a wide range of government support measures provided through national subsidies, public finance and investment by SOEs (see Table 1).

Although subsidies to the consumption of fossil fuels also support fossil fuel production both directly and indirectly (see Box 4), this report is focused on fossil fuel production, as there is a particular lack of transparency around production subsidies. Therefore, this report specifically excludes support to consumption of fossil fuels and consumption of fossil fuel-based electricity. For more information on subsidies to fossil fuel consumption, see the IEA subsidy price gap calculations, and extensive research by the Global Subsidies Initiative (IEA, 2015; GSI, 2015).

In the process of this inventory, the research team has in many instances faced a choice as to whether to include a particular measure in the total estimate as a subsidy to fossil fuel production, or to exclude it as a subsidy to consumers. In each case our decision has been driven by the incidence of the benefit – focused on the specific stage of production or consumption that is the recipient of support.

In addition to excluding fossil fuel consumption subsidies, the report has limited coverage of a sub-set of the following stages of fossil fuel production, for these reasons:

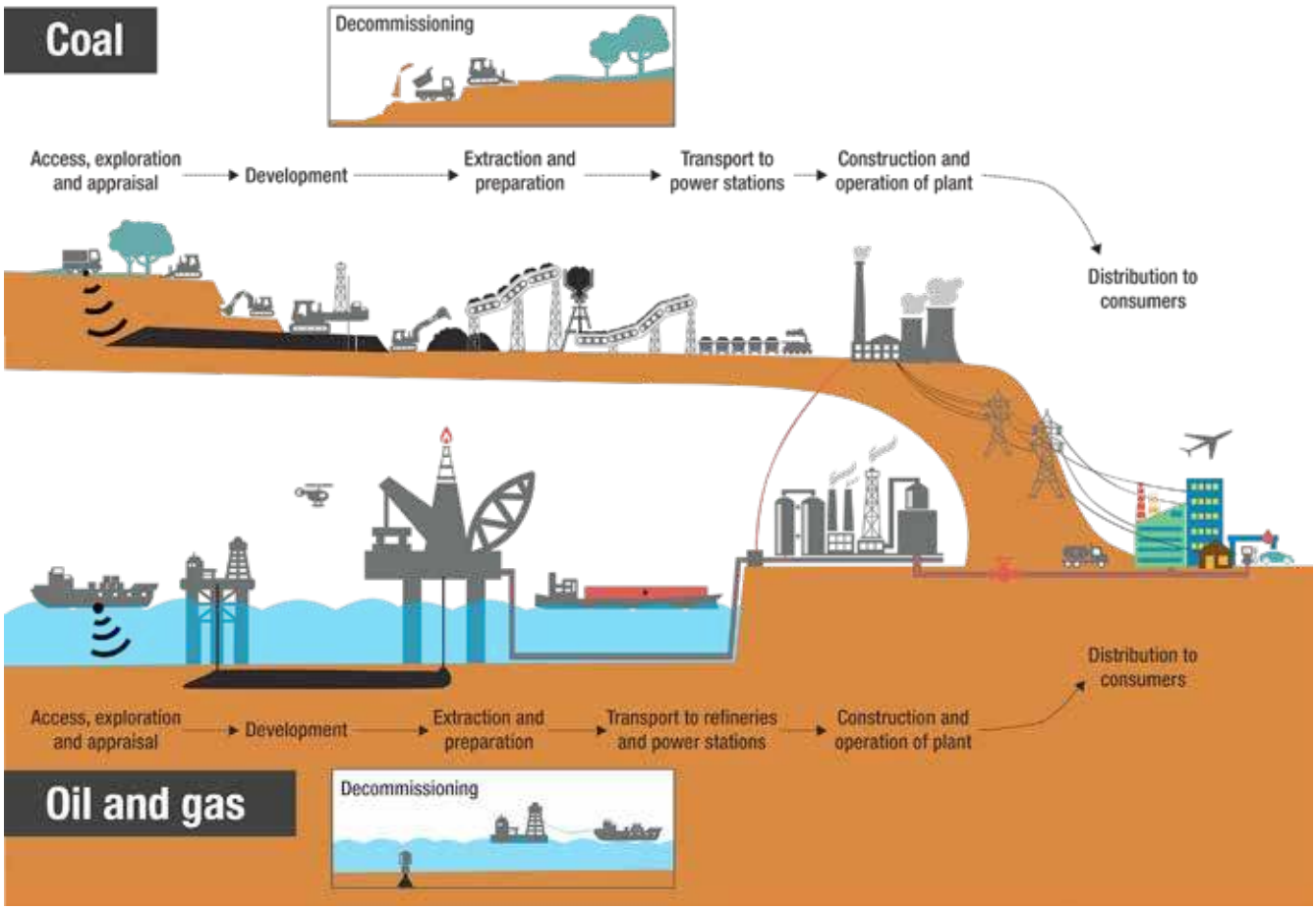
- Transport and distribution (through international shipping). Although approximately 42% of all of sea-borne freight by mass is used for moving oil, gas, coal and petroleum products (UNCTAD, 2014), and international shipping is exempt from all taxes on fuels, the distributed nature of the industry makes it challenging to identify subsidies to these activities. Nonetheless, there is some evidence of public finance for international shipping of fossil fuels (for example, China ExIm Bank (Chexim) financing oil tankers), and this could be an area for further research in the context of fossil fuel production subsidy inventories (Trade Finance, 2013).
- Distribution (of fossil fuel-based electricity). This often takes place through grid systems that are also distributing non-fossil based electricity (nuclear, wind, solar, etc.). Where a grid is primarily fossil fuel-based, any support to distribution is discussed in the relevant country studies. However, we did not undertake the pro-rata calculations that would be needed to include this support (which at times may be significant) in the overall estimates of production subsidies.

8 Each of these covers different groups of countries and types of subsidies. A recent comparison of the OECD, IMF and IEA datasets can be found in Whitley and van der Burg, (2015); Kojima and Koplow, (2015).

9 Production subsidies to all electricity production are included where the company's generating mix is >95% fossil fuel-based.

- Decommissioning (of power plants, refineries, pipelines and offshore rigs). There is currently relatively limited government support to these activities. However, this may increase in the future in the context of regulations linked to addressing climate change.
- Plant construction, operation and distribution for petrochemicals. This use of fossil fuels has a much smaller impact than burning them to provide energy services, therefore coverage of these activities is limited.

Figure 14. Stages of fossil fuel production



Source: authors, 2015.

Box 4. The role of fossil fuel consumption subsidies in incentivising production

Fossil fuel production and consumption subsidies are interlinked in many ways. In certain cases, governments pass the burden of consumer subsidies on to companies by requiring them to sell refined products, electricity or coal at below market prices. In return, the government may reimburse the companies for some or all of these costs, as in the case of India's oil marketing companies (see India Country Study). Similarly, many governments require companies operating power plants to sell electricity at prices below cost-recovery, and compensate for this by providing these plants with fossil fuel inputs at a price significantly below international benchmarks.

In addition, in return for producers selling their products at regulated domestic prices, governments sometimes offer tax breaks to companies further upstream. This is far less transparent than straight pricing discounts on inputs. Until recently in Russia, for example, gas pipeline and power grid infrastructure had been exempt from property taxes in an effort to keep retail tariffs low despite rising costs (Vedomosti, 2013; Delovoy Peterburg, 2013). Such 'cross-subsidies' and 'swaps' are often negotiated between governments and companies behind closed doors. Often, they remain entirely undocumented, making them challenging to analyse and more subject to corruption.

Source: Ivetta Gerasimchuk and Lucy Kitson, Global Subsidies Initiative

Table 1. Stages of fossil fuel production and (non-comprehensive) examples of government support

Access, exploration and appraisal	• Government-funded R&D for exploration technologies and processes, and for field development • Concessional loans from national development banks to exploration companies • Spending by SOEs and government agencies on seismic surveys and exploratory drilling
Development	• Tax deductions for investment in drilling and mining equipment (see also extraction) • Tax deductions for the field development phase • Government spending and SOE investment on infrastructure (ports, roads, railways and pipelines) that specifically benefits field and mine development
Extraction and preparation	• Price supports (i.e. direct payments to producers linked to the market price of fossil fuels) • Tax and royalty exemptions linked to amount of fuel produced • Tax deductions for investment in drilling and mining equipment (see also exploration) • Investment by SOEs in field operation and maintenance (domestic and international) • Government-provided insurance and indemnification for risks and damages such as oil spills and other pollution • Tax and royalty exemptions linked to the inputs required to produce the fuels (including fuels, property, land, water, pollution etc.)
Transport (to utilities and refineries)	• Tax exemptions related to the transport, import and export of fossil fuels • Government spending on infrastructure (ports, roads, railways and pipelines) that specifically benefits fossil fuel transport (to utilities and refineries) • Investment by SOEs in infrastructure (ports, roads, railways and pipelines) that specifically benefits fossil fuel transport (to utilities and refineries)
Plant construction and operation (utilities and refineries)	• Grants and tax breaks for the construction of plants for heat and electricity generation and refineries • Relief on property taxes and charges for land, water use and pollution for processing facilities and power plants • Tax breaks, exemptions from charges, to inputs during operation phase • Government-regulated price of feedstock (oil, gas and coal) for refining, processing, and electricity and heat generation • Investment by SOEs in plant operation and modernisation (domestically and internationally) • Public finance to refineries and plants generating heat and electricity • Investment in R&D that benefits continued and future operation of plants, including for carbon capture and storage
Distribution (to end-users)	• Government grants for modernisation of distribution and transmission facilities • Government spending on infrastructure (ports, roads, railways, pipelines and power networks) that specifically benefits fossil fuel distribution • Investment by SOEs in infrastructure (ports, roads, railways, pipelines and power networks) that specifically benefits fossil fuel distribution • Investment by SOEs in the marketing of fossil fuels domestically and internationally
Decommissioning	• Government-funded R&D for field and mine decommissioning • Government assumption of liabilities or spending on field and mine decommissioning and severance packages for former employees • Tax deductions or SOE responsibility for costs associated with coal mine closure or oil and gas well abandonment • Government loans to fossil fuel extracting companies (domestic and international) to cover liabilities of mine and field decommissioning

Sources: Bast et al. (2014); Kojima and Koplow (2015); OECD (2015); GSI (2010)

3.4 Timeframes and currency

This report provides average annual values for production subsidies in 2013 and 2014, including national subsidies, public finance and investment by SOEs. The most recent information available on production subsidies varies by data source, both across and within countries. In some cases, values are derived from independent reports that were only published once, meaning that more recent annual estimates are not available.[10] Where information is available in government documents, we have sought to use these and the most recent estimates (as opposed to international sources such as the OECD inventory). In all cases, the year(s) for the estimate is noted in the relevant country section (see Country Studies and Data Sheets).

10 If there is a number available for a subsidy in either 2013 or 2014, but no data are available for the other year, and we know that there was the same subsidy provided in that other year, we have indicated this as 'no data' (as opposed to zero). In those cases the annual average is equal to the number that is available, as opposed to 50% of that number, which would be the case if we knew the same subsidy was not provided in the other year (See Data Sheets for calculations).

Another challenge with annual values is that some information on production subsidies is based on projections of expected future costs to the government (ex-ante), rather than past costs to governments (ex-post). Projections are particularly common with respect to tax expenditures, and retrospective validation is rare. Where subsidy values were projected for 2013 and 2014, and an ex-post estimate was not available, this is indicated in the Country Studies and accompanying Data Sheets.

The exchange rates used to convert local currencies to US dollars for both 2013 and 2014 are average annual values from the US Internal Revenue Service (IRS) for all countries except Indonesia, where an Indonesian government resource was referenced (IRS, 2015; Government of Indonesia, 2015). For projections into 2015 and beyond, the 2014 IRS exchange rate was used.

3.5 National subsidies

This report divides national subsidies into three general categories: direct spending (e.g. government budget expenditure on infrastructure that specifically benefits fossil fuels), tax expenditure (e.g. tax deductions for investment in drilling and mining equipment) and other support mechanisms (e.g. capacity mechanisms – see Box 3). Where information is available, estimates for all of these categories are included in the national subsidy total for each country and in the Country Studies.

This analysis also includes a qualitative review of national subsidies that are more difficult to quantify, including non-market (i.e., subsidised or free) access to land, resources and infrastructure; as well as transfer pricing schemes used by companies to avoid paying taxes and royalties, by 'selling' products to subsidiaries at below-market prices.

Estimates. In most cases, the value assigned for a national subsidy is the number provided by the government's own sources, by the OECD or by an independent research institution. In a number of cases, a national subsidy can be identified but the specific subsidy value has not been published by the government or independent research institutions. Where it was possible to make a reliable estimate based on available data, an amount was included. But in many cases, amounts for these subsidies were not included. As a result, the national subsidies are likely to be underestimates of the actual level of support provided by G20 governments.

Sub-national subsidies (included). Production subsidies also exist at the sub-national level, for example through state and provincial governments. These subsidies will have an impact on the level of overall support provided within a G20 country, and are therefore included within the estimates of national subsidies where information is readily available. It is often difficult to gather information on sub-national support, which means it is likely that some of these measures have been overlooked.

Data collection. The data for national subsidies were sought within government budgets and other government sources where possible. For France, Japan and Korea (Republic of Korea), the majority of national subsidies information is based on the production subsidies outlined in the latest inventory from the OECD, which is the only regularly published resource which includes country-level fossil fuel production subsidy data (OECD, 2015). This inventory was also used as a resource where publicly available information at the national and sub-national level was not available for specific subsidies in other G20 countries.

Comparing countries. Direct comparison of national subsidy values between countries can be challenging. As the OECD emphasises in its *Companion* to the *Inventory of Support Measures for Fossil Fuels*, a significant number of subsidies take the form of tax expenditures that are calculated using a country's benchmark tax regime. Because this can vary widely by country, tax expenditure estimates are not readily comparable across countries (OECD, 2015). Higher reported tax expenditures for some countries may therefore reflect higher levels of taxation or greater transparency in reporting rather than a higher level of support (see also Chapter 7) (ibid.).

Nevertheless, examining the variation across national subsidies can still provide a useful overview of the extent to which different countries prioritise fossil fuel production, in particular where this information might be used for comparisons with support provided to other parts of the energy sector and other sectors across the economy.

3.6 Investment by state-owned enterprises

A number of G20 countries support fossil fuel production through one or more majority state-owned enterprises (SOEs). The wide variety of ways in which SOEs function can have a range of impacts on government budgets, with a number of SOEs depending on budgetary transfers to remain in operation (IMF, 2013; Sdralevich et al., 2014). Majority government ownership of SOEs provides a degree of effective control and government involvement in decision-making and financing. While this will vary by country and institution, the impact is nonetheless significant.

Estimates. The WTO definition of a subsidy includes 'government provision of goods and services other than general infrastructure, or purchase of goods, below market-value' (see section 3.1). Unfortunately, limited publicly available information on government transfers to SOEs

(and vice versa), and on how investment is distributed within the vertically integrated[11] structure of many SOEs, makes it challenging to identify the specific sub-component of SOE investment which constitutes a subsidy. As a result, this report provides data on total investment by SOEs in fossil fuel production (where this information is made available by the company) and these data are presented separately from national subsidies.

Sub-national SOEs (not included). SOEs also exist at the sub-national level, including those established by municipal, state and provincial governments. The investment by these SOEs would have an impact on the level of overall support provided within a G20 country, however due to the challenges of data access, they are not included within the estimates of SOE investment.

Data collection. Data were collected from SOE annual reports and government documents, where available. If the data were not available directly from SOEs or governments, data were collected from other public sources or fee-based sources, including the Rystad UCube (Upstream Database) database.

Double counting. We have taken steps to ensure that production subsidies provided through SOE investment are not double counted with national subsidies and public investment. Where government budgets specify transfers to SOEs, this information is included in the national subsidies section and no SOE investment is counted (see example for Turkey in Table 3). In contrast, where more detailed information is provided for SOE investment than government budget transfers to SOEs, then the SOE investment is counted, while the transfers are excluded from the national subsidies totals (see example for Saudi Arabia in Table 2). A similar approach has also been taken to ensure no double counting between SOE investment and public finance provided to SOEs.

3.7 Public finance

This report reviews where governments provide support for, and take on liability for, fossil fuel production via financial institutions that they have a majority (more than 50%) stake in or fully own. Institutions such as domestic, bilateral and multilateral development banks, export credit agencies and majority state-owned banks provide public finance in the form of grants, loans, equity, insurance and guarantees both domestically and internationally.

Investments by public finance institutions are backed by the government in terms of direct investment using public funds and through creditworthiness. Even where public funds are not deployed directly from government budgets, the high credit ratings of publicly owned financial institutions, and their willingness to invest in the sector linked to government objectives, can reduce the risk to parallel private investors. This often drives private investment in fossil fuel production that would not occur otherwise, regardless of the loan terms, and this leverage effect is the fundamental rationale for public investment in a number of sectors (to act or invest in areas where the private sector is reluctant to do so).

Estimates. The WTO definition of a subsidy includes 'direct transfer of funds' (e.g. grants, loans and equity infusion) or 'potential direct transfers of funds or liabilities' (e.g. guarantees). Unfortunately, the transparency of investment data for public finance institutions varies greatly. Assessing the portion of total financing that constitutes a subsidy requires detailed information on the financing terms provided, let alone which portion of finance is based directly on public resources (as opposed to that raised on capital markets) or is dependent on the institutions' government-linked credit rating. Few of the institutions assessed in this report allow public access to this information, and therefore we report the total value of public finance from majority government-owned financial institutions for fossil fuel production separately from 'national subsidy' estimates.

Additionally, the public finance figures identified in this report are likely to be significant underestimates. It is likely, for instance, that there are greater levels of finance for fossil fuel production domestically in China and from Indian state-owned banks than were identified, as only a portion of state-owned banks were surveyed given the time constraints.

Data collection. In addition to reviewing information made publicly available by majority government-owned financial institutions, and other public sources of information, this report also includes a review of a number of project-finance datasets including: Oil Change International's 'Shift the Subsidies database', and the Infrastructure Journal (IJ) Global database (OCI, 2015; IJ Global, 2015).

Double counting. We have taken steps to ensure that support provided through public finance is not double counted with national subsidies or state-owned enterprise investment. Where government budgets provide information on the use of public finance, this information is included in the national subsidies section and no public finance is counted. In addition, where public finance was provided to a domestic SOE, amounts were included where more information was available. For instance, in Brazil, the financing from the Brazilian Development Bank (BNDES) to Petrobras was excluded in the public finance section because it was a fraction of the overall investment by BNDES.

11 Vertical integration is where the supply chain of a company is owned by that company. Oil companies, both multinational and national, often adopt a vertically integrated structure. This means that they are active along the entire supply chain, from locating deposits, drilling and extracting crude oil, transporting it around the world, and refining it into petroleum products, to distributing the fuel to company-owned retail stations for sale to consumers.

3.8 Beneficiaries

This report also attempts to assess the entities involved in fossil fuel production across the G20 countries. The goal is twofold: to identify the likely significant beneficiaries of production subsidies, and also to gauge the reciprocal benefits that governments may gain from providing these subsidies. The data in this section are not tallied or included in fossil fuel production subsidy estimates.

Data collection for company investments. For upstream oil and gas companies and coal companies detailed information on resources held by specific companies, and their recent investment in fossil fuel production, was collected from the Rystad UCube (Upstream Database) database (for oil and gas) and the Bloomberg Professional service (for coal). Both are fee-based commercial datasets (Rystad Energy, 2015; Bloomberg Finance, 2015).

These data are based on primary sources and are widely used by analysts and industry experts. Although in some cases we noticed discrepancies between oil and gas data from Rystad UCube and that from other sources, UCube data were used across countries as this offered the most consistent methodological approach.

For information on private companies operating in mid- and downstream oil and gas, and fossil fuel-based power generation, these data were collected at country level through annual reports and other publicly available sources of information (see Country Studies and Data Sheets).

Data collection for company payments. There is limited publicly available information on the royalties, fees and taxes that these companies pay to state and national governments in return for exploiting oil, gas and coal resources. As a result, some of these same commercial databases (Rystad and Bloomberg) were also used to provide information where available on government revenue from fossil fuel production.

4.
Findings: National subsidies

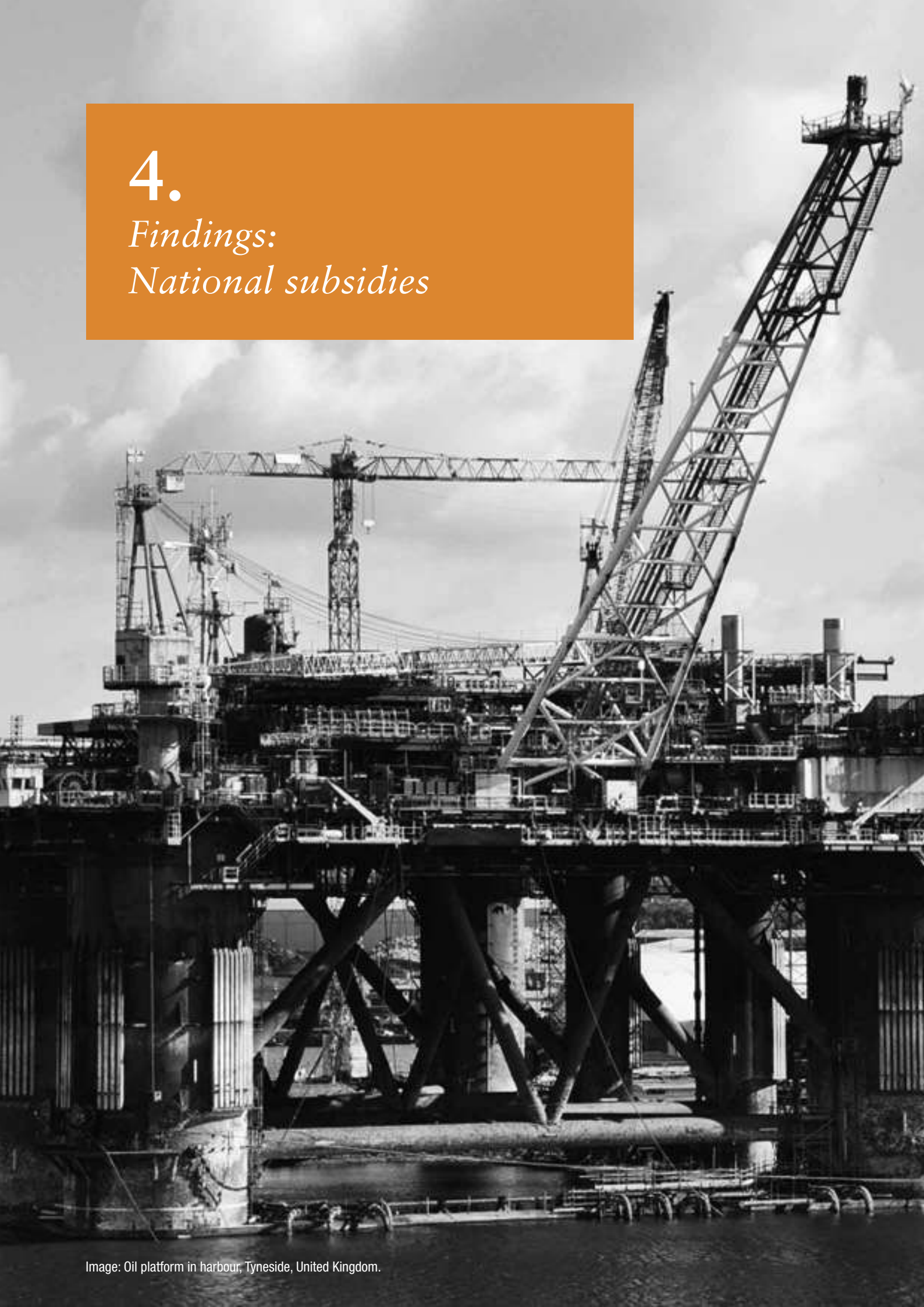


Image: Oil platform in harbour, Tyneside, United Kingdom.

National subsidies

This report divides national subsidies into three general categories: direct spending (e.g. government budget expenditure on infrastructure that specifically benefits fossil fuels), tax expenditure (e.g. tax deductions for investment in drilling and mining equipment) and other support mechanisms (e.g. capacity mechanisms). Where information is available, estimates for all of these categories are included in the national subsidy total for each country and in the Country Studies. Many states, regions and provinces within the G20 countries also provide fossil fuel production subsidies, and these are included in this analysis wherever information is available.

This analysis also includes a qualitative review of national subsidies that are more difficult to quantify. These include non-market (i.e., subsidised or free) access to land, resources and infrastructure, as well as transfer pricing schemes used by companies to avoid paying taxes and royalties by 'selling' products to subsidiaries at below-market prices.

As outlined in Chapter 3 (Methodology), in most cases the value assigned for a national subsidy is the number provided by the government's own sources, by the OECD or by an independent research institution. In a number of cases, a national subsidy can be identified but the government or independent research institutions have not published the specific subsidy value. If a reliable estimate could be made based on available data, an amount was included. But in many cases, amounts for these subsidies were not included. As a result, the national subsidies are likely to be underestimates of the actual level of support provided by G20 governments.

Table 2 provides a summary of national subsidies to fossil fuel production in the G20, estimated at almost $78 billion on average annually in 2013 and 2014. For France, Japan and Korea, the majority of this information is based on the production subsidies outlined in the latest inventory from the OECD (OECD, 2015). This inventory was also used as a resource for the other national subsidy estimates where publicly available information at the national and sub-national level was not available.

Our key findings on national subsidies for fossil fuel production are as follows:

- Russia had significant national subsidies for fossil fuel production of almost $23 billion annually on average between 2013 and 2014. This is in addition to the SOE investment and public finance provided by their majority state-owned enterprises and state-owned banks.
- The US government provided more than $20 billion in national fossil fuel production subsidies each year, despite calls from President Barack Obama to eliminate industry tax breaks.
- The UK continued to encourage offshore oil and gas in the North Sea, resulting in national subsidies to fossil fuel production of $9 billion annually on average between 2013 and 2014. This is in spite of a recent pledge by the UK government in support of the Friends of Fossil Fuel Subsidy Reform (see Box 5).
- Australia and Brazil provided national subsidies of $5 billion on average annually between 2013 and 2014, including development of fossil fuel resources in increasingly remote and challenging areas (inland and offshore).
- China provided national subsidies of just over $3 billion annually on average between 2013 and 2014, including tax breaks for oil, gas and coal producers.

Additional information on national subsidies is included in Chapter 8 (Country Summaries), and a detailed inventory is included in each of the individual Country Studies and accompanying Data Sheets.

Table 2. Average annual national subsidies for fossil fuel production (2013–2014) ($ million)

Country	Sub-sectors included in the calculation of average annual national subsidies [a] (by order of contribution)	Average annual national subsidies (2013–14) [b,c] ($ million)
Argentina	Coal mining; Oil and gas pipelines, power plants and refining; Coal-fired power; Multiple fossil fuels or unspecified; Upstream oil and gas	2,192
Australia	Multiple fossil fuels or unspecified; Coal-fired power; Coal mining; Upstream oil and gas; Oil and gas pipelines, power plants and refining	5,032
Brazil	Multiple fossil fuels or unspecified; Oil and gas pipelines; power plants and refining; Upstream oil and gas	4,949
Canada	Upstream oil and gas; Oil and gas pipelines, power plants and refining; Multiple fossil fuels or unspecified; Coal mining; Coal-fired power	2,738
China	Coal mining; Upstream oil and gas	3,375 [d]
France	Oil and gas pipelines, power plants and refining; Multiple fossil fuels or unspecified	125
Germany	Coal mining; Multiple fossil fuels or unspecified	2,791
India	Coal mining; Multiple fossil fuels or unspecified; Upstream oil and gas; Oil and gas pipelines, power plants and refining; Coal-fired power	103
Indonesia	-	[e]
Italy	Multiple fossil fuels or unspecified; Upstream oil and gas; Oil and gas pipelines; power plants and refining	1,205
Japan	Upstream oil and gas; Oil and gas pipelines; power plants and refining	736
Korea	Coal mining; Coal-fired power; Upstream oil and gas	217
Mexico	Multiple fossil fuels or unspecified;	1,351
Russia	Upstream oil and gas; Oil and gas pipelines, power plants and refining; Coal mining	22,812
Saudi Arabia	Upstream oil and gas; Oil and gas pipelines, power plants and refining	[f]
South Africa	Upstream oil and gas; Multiple fossil fuels or unspecified	20
Turkey	Coal mining; Upstream oil and gas; Coal-fired power; Multiple fossil fuels or unspecified	627
United Kingdom	Upstream oil and gas; Multiple fossil fuels or unspecified; Coal mining	9,047
United States	Upstream oil and gas; Multiple fossil fuels or unspecified; Coal mining; Oil and gas pipelines, power plants and refining; Coal-fired power	20,491
Total average annual G20 national subsidies (2013–2014)		77,811

Notes:

(a) There may be additional sub-sectors where there are national subsidies for fossil fuel production, however data may not be available on the specific subsidies provided in 2013 and 2014. Additional details on the full range of national subsidies to fossil fuel production are available in the Country Studies and Data Sheets.

(b) Government support through national subsidies may already be accounted for in the SOE investment and public finance calculations in Chapters 5 and 6 (see footnotes below on China and Saudi Aramco) – see Chapter 3 for more information on efforts to avoid double counting fossil fuel production subsidies.

(c) National subsidies estimates for France, Italy and Japan rely almost entirely on OECD data.

(d) As China's energy sector is dominated by SOEs that receive direct support from the government, it is sometimes challenging to disentangle support to fossil fuel production that goes to the private sector vs. these SOEs. As a result, identified values for direct spending have not been included in estimates of national subsidies to avoid double counting with SOE investment outlined in Chapter 5 (see China Country Study for more detail).

(e) Cost recovery payments were made to oil and gas producers in Indonesia at a value of $16 billion per year on average across 2013 and 2014 – however, it was not possible to determine what, if any, portion of these payments is a subsidy (with benefits similar to a tax deduction), and therefore these cost recovery payments are not included in the estimates for this report (see Indonesia Country Study for more detail).

(f) Gross Fixed Capital Formation for Oil Sector was $15 billion in Saudi government budgetary expenditure in 2013, with no estimate for 2014. This is likely to include support to Saudi Aramco and therefore has been excluded from national subsidy calculations in order to avoid double counting with SOE investment by Saudi Aramco (see Chapter 5 and Saudi Arabia Country Study).

For additional detail see Country Studies and Data Sheets.

Box 5. Ramping up fossil fuel subsidies in the UK

Despite national and international commitments by the UK government to phase-out subsidies for fossil fuels, the country has recently ramped up support for on- and offshore oil and gas production. At the same time support for renewables and energy efficiency measures (see UK Country Study for more details) has been cut. The context for these reforms has been poor exploration results in recent years, and the industry reporting falling profits (Offshore Energy Today, 2015).

These rising subsidies have resulted directly from calls by the UK's oil and gas industry for increased support and through the 'Wood Review' focused on the North Sea. This consultation was tasked with providing recommendations to the government on how to: 1) best encourage exploration for oil and gas in the UK, and 2) reduce the costs to operators of decommissioning oil and gas rigs that are coming to the end of their productive lives (Wood, 2014).

In April 2015, the Wood Review's recommendations were implemented in full. The changes involved legally obliging the Secretary of State for Energy and Climate Change to 'maximize the economic recovery' of UK oil and gas, including a set of measures designed to reach this objective (HM Government, 2015; HM Revenue & Customs, 2015a; HM Treasury, 2014). These measures include the establishment of a new regulator, the Oil and Gas Authority (OGA), which is tasked with supporting the extraction of three to four billion barrels of oil and gas from the North Sea in the next 20 years, along with the introduction of further tax breaks and new support measures for oil and gas development (Bast et al., 2014).

Unlike many other fossil fuel producers that use royalty payment schemes or production-sharing agreements to derive a direct public benefit from the extraction of fossil fuels (such as Brazil, Russia and the United States), the UK system is based on taxing producer profits. For oil and gas production, the collection by the state of a Supplementary Charge (SC) and Petroleum Revenue Tax (PRT) from fossil fuel producers, in addition to general corporate taxes, is supposed to reflect the public ownership of the resource. However, it also means that any exemptions and reductions in these taxes reduce government revenue and allow private companies to keep a larger portion of the profits derived from the extraction of public resources. Where tax-free allowances and the offsetting of losses means companies are able to show they have made no taxable profits, the UK derives no direct revenue for the extraction of publicly owned resources in that year.

Changes introduced in 2015 include a decrease in the PRT from 50% to 35%, and a decrease in the SC from 30% to 20% (HM Treasury, 2015). In its 2015 Budget the UK government also introduced an Investment Allowance (replacing the existing system of Field Allowances for investment in fossil fuel production), which exempts a portion of oil and gas companies' profits from the SC, thereby reducing the tax rate on that portion from 50% to 30% (HM Revenue & Customs, 2015a). The 2015 Budget further allocated direct funding worth $32 million for seismic surveys in under-explored areas in 2015/2016.

Forecast to cost the UK government $2.7 billion between 2015 and 2020, 'this package of measures will increase the post-tax profits for affected companies' and drive investment that 'is expected to increase oil production by around 15%' (HM Revenue & Customs, 2015a; HM Government, 2015). To put this into context, the changes to just these two measures mean an average of $538 million in foregone revenue a year, which is equivalent to two thirds of the value of the total government revenue from all oil and gas production from 2016 onwards (Office for Budget Responsibility, 2015). In the longer term, government revenues from oil and gas production are forecast to fall below 0.05% of GDP and close to zero from 2025 onwards (ibid.). This is a significant drop. Government revenues from oil and gas stood as high as $16 billion in 2011/12, but have dropped steadily in recent years to $7 billion in 2013/14 and to $4 billion in 2014/15 (HM Revenue & Customs, 2015b).

In addition to the government's efforts to revitalise offshore production, onshore it is 'going all out' for shale gas in the hope that it would be a 'game-changer' for UK energy production (Utility Week, 2014; Reuters, 2015). Although experts suggest that the impact of shale gas on the UK energy industry is likely to be modest (Committee on Climate Change, 2013; Mair, 2015), the UK government has put in place what its Chancellor George Osborne called 'the world's most generous tax regime' designed to boost shale gas developments (Carrington, 2015). This includes a new onshore allowance to incentivise investment, which will work along virtually identical lines to the 'investment allowance' for North Sea oil and gas, mentioned above. However, as of yet the allowance has not been triggered, as strong local opposition has created considerable obstacles to shale gas operations, with local governments issuing moratoria and rejecting planning permission for prospective sites (Bast et al., 2014; Vaughan, 2015). Nonetheless, industrial appeals and recent government moves to centralise the planning decisions for shale gas may expedite future exploration and production activities (Vaughan, 2015; Rudd, 2015).

5.
Findings: Investment by state-owned enterprises

Image: Off shore oil rigs, Mobile Bay, Alabama, United States. Palmer House Photography.

Investment by state-owned enterprises

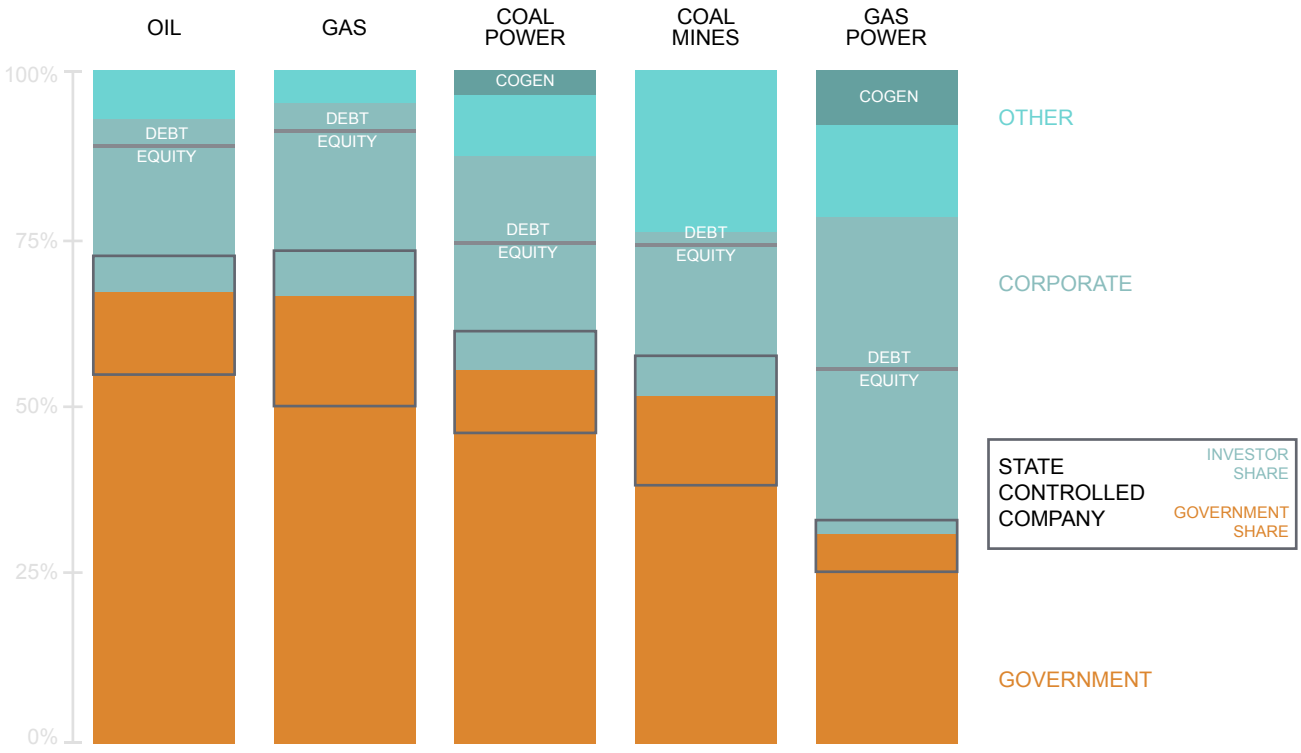
Although oil, gas and coal production is often discussed in the context of private multinational companies (such as BP, Shell or Rio Tinto), governments own more than half of the world's fossil fuel production,[12] and control as much as 70% of oil and gas production through entities that are wholly or majority-owned by governments (see Figure 15) (Nelson et al., 2014). For coal production and coal-fired power plants, government ownership is closer to 60% on average, while it is lower for gas-fired power plants (Nelson et al., 2014). These figures include majority-owned government companies that have private investors.

A number of G20 countries support fossil fuel production through one or more majority SOEs (at the national level – included here – and at the sub-national level – excluded here due to the challenges of data access). Examples of SOE investments include: R&D for new exploration technologies and processes, equipment for operation and maintenance, and infrastructure (ports, roads, railways and pipelines) that specifically benefits fossil fuel production both domestically and abroad.

As outlined in Chapter 3 (Methodology), the wide variety of ways in which SOEs function can have a range of impacts on government budgets, with a number of SOEs depending on budgetary transfers to remain in operation (IMF, 2013; Sdralevich et al., 2014). Majority government ownership of SOEs provides a degree of effective control and government involvement in decision-making and financing. While this will vary by country and institution, the impact is nonetheless significant.

The WTO definition of a subsidy includes 'government provision of goods and services other than general infrastructure, or purchase of goods, below market-value' (see Section 3.1). Unfortunately, limited publicly available information on government transfers to SOEs (and vice versa), and on how investment is distributed within the vertically integrated structure of many SOEs, makes it challenging to identify the specific sub-component of SOE investment which constitutes a subsidy. As a result, this

Figure 15. Government and private investor share of fossil fuel production globally



Note: Equity/debt splits are estimated based on typical debt-equity ratio for asset types. For oil and gas, these numbers include all 2013 production (Rystad). Power data come from Platts and include capacity from the US, EU28, China, India, Russia, Japan, Korea, Indonesia, Ukraine, Australia, and South Africa, which we estimate to account for 93% and 75% of global coal and gas-fired generation capacity. Coal asset ownership is based on a country's 2012 coal production by ownership type. Total production figures were taken from the BP Statistical Review. Bottom-up production data were analysed by CPI and taken from Bloomberg, BankTrack's coal production database, various government and investor reports, and the IEA's 2013 Coal Medium-Term Market Report.
Source: Adapted from Nelson et al. (2014)

12 The Climate Policy Initiative definition of fossil fuel production does not include transport, processing (outside electricity production) or distribution.

report provides data on total investment by SOEs in fossil fuel production (where this information is made available by the company) and these data are presented separately from national subsidies.

Table 3 provides a summary of G20 SOE investment in fossil fuel production, which was $286 billion on average per year in 2013 and 2014. Our key findings on investment by state-owned enterprises are as follows:

- China's fossil fuel production activities through SOEs were extensive both domestically and internationally (see Table 4) and were more than double that found in any other G20 country. On average in 2013 and 2014, Chinese SOEs invested almost $77 billion a year in fossil fuel production.
- Russia and Brazil each also have very high levels of SOE investment in fossil fuel production, particularly focused on oil and gas, providing $50 billion and $42 billion respectively on average between 2013 and 2014.
- In certain countries where national subsidies cannot be identified (i.e. Indonesia and Saudi Arabia), there is significant annual SOE investment in fossil fuel production, with almost $45 billion in average annual investment in 2013 and 2014 from Saudi Aramco.
- India and Korea each have multiple SOEs operating across oil, gas, coal and fossil fuel-based electricity, investing almost $15 billion and nearly $12 billion per year respectively in 2013 and 2014.

Table 3. Average annual investment by SOEs in fossil fuel production (domestic and international) 2013–2014) ($ million)

Country	Sub-sectors included in the calculation of average annual SOE investment (by order of contribution)	Companies included in the calculation of average annual SOE investment	Average annual investment by SOEs (2013-14) ($ million)
Argentina	Upstream oil and gas	YPF	8,236
Australia	-	-	Not applicable [a] (SOEs only at sub-national level)
Brazil	Upstream oil and gas	Petrobras	41,500
Canada	-	-	Not applicable (SOEs only at sub-national level)
China	Upstream oil and gas; Coal mining; Coal-fired power	Sinopec, Petro China, CNOOC, Huadian Resources, China Coal, China Huaneng Group Corporation, China Datang Corporation, China Guodian Corporation, Shenhua Group, China Resources Power	76,512
France	Electricity (fossil fuel-based)	EDF	Not available [b]
Germany	-	-	Not applicable (SOEs only at sub-national level)
India	Upstream oil and gas; Oil and gas pipelines, power plants and refineries; Multiple activities, multiple fossil fuels or not specified; Coal mining; Coal-fired power	ONGC, Oil India, GAIL (India), IOCL, BPCL, HPCL, Coal India, NTPC Ltd., DVC, NLC	14,707
Indonesia	Upstream oil and gas	Pertamina	6,948
Italy	-	-	Not applicable
Japan	-	-	Not applicable
Korea	Upstream oil and gas; Coal mining; Oil and gas pipelines; power plants and refineries	KEPCO, KNOC, KOGAS, KOCOAL	11,625
Mexico	Upstream oil and gas	Pemex	26,850
Russia	Multiple activities, multiple fossil fuels or not specified	Gazprom, Rosneft, Bashneft	49,662
Saudi Arabia	Multiple activities, multiple fossil fuels or not specified	Saudi Aramco	44,745

Table 3. Average annual investment by SOEs in fossil fuel production (domestic and international) (2013–14) ($ million) (continued)

Country	Sub-sectors included in the calculation of average annual SOE investment (by order of contribution)	Companies included in the calculation of average annual SOE investment	Average annual investment by SOEs (2013-14) ($ million)
South Africa	Multiple activities, multiple fossil fuels or not specified	PetroSA, Transnet, Eskom [c]	5,370
Turkey	-	-	[d]
United Kingdom	-	-	Not applicable
United States	-	-	Not applicable
Total average annual G20 SOE investment			286,155

Notes:

(a) Not applicable – where countries do not have national-level SOEs active in fossil fuel production.

(b) Not available – where there is evidence of SOE investment in fossil fuel production, but insufficient data transparency to determine which specific proportion is attributable to fossil fuels as opposed to other forms of energy.

(c) For Eskom, all capital expenditure is included net of spend on the Ingula hydro plant and spend on aforementioned demonstration and pilot projects (already captured in Chapter 4 - National Subsidies). In addition, although Eskom capital expenditure includes some small portion of investment attributable to non-fossil sources (e.g. transmission and distribution investment will also benefit nuclear and renewable assets), given that capacity and generation in South Africa is predominantly fossil-based, it is considered that this will be minimal.

(d) Capital injections to TPAO (Turkey's national petroleum company) and to TKI and TKK (Turkey's state-owned coal enterprises) are included in Chapter 4 on National Subsidies, as no details of their investments in fossil fuel production were publicly available.

Additional information on investment by SOEs is included in Chapter 8 (Country Summaries), and a detailed inventory of SOE investment is included in each of the individual Country Studies and accompanying Data Sheets.

Foreign SOEs benefit from their own government support, but they may also benefit from national subsidies when they operate in G20 countries (see Table 4 for information on the foreign SOEs which are active in each G20 country).

For additional detail see Country Studies and Data Sheets.

Table 4. Foreign SOEs active in fossil fuel production in G20 countries

G20 country of operation	Sub-sectors	Foreign SOEs (and country ownership)
Argentina	Oil and gas	Petrobras (Brazil), Sinopec Group and CNOOC (China), Petronas (Malaysia), Gazprom (Russia)
Australia	Coal	Yancoal (owned by Yangkuang (Mining) Group, China), JOGMEC (Japan)
Brazil	Oil and gas	Sinochem (China), Statoil (Norway – non-G20), ONGC (India)
Canada	Oil and gas; Electricity (fossil fuel-based)	Oil India (India), JOGMEC (Japan), KNOC (Korea) EDF (France)
China	Electricity (fossil fuel-based)	EDF (France), KEPCO (Korea)
France	-	-
Germany	-	-
India	-	-
Indonesia	Oil and gas	CNPC, CNOOC and Petro China (China), JOGMEC (Japan), KNOC (Korea), Petronas (Malaysia – non-G20), Kuwait Petroleum Corp (Kuwait – non-G20)
Italy	-	EDF (France)
Japan	-	-
Korea	-	-
Mexico	Oil and gas; Electricity (fossil fuel-based)	Petrobras (Brazil), KEPCO (Korea)
Russia	Oil and gas	Oil India (India), JOGMEC (Japan)
Saudi Arabia	Oil and gas; Electricity (fossil fuel-based)	Sinopec (China), BAPCO (Bahrain – non-G20), KEPCO (Korea)
South Africa	-	-
Turkey	-	-
United Kingdom *	Oil and gas; Electricity (fossil fuel-based)	KNOC / Dana (Korea)*, TAQA (Abu Dhabi – non-G20)*, Statoil (Norway – non G20)*, Gazprom (Russia), CNOOC, Sinopec (China), NIOC (Iran – non-G20), EDF (France)
United States	Oil and gas; Electricity (fossil fuel-based)	Petrobras (Brazil), Statoil (Norway – non-G20), CNOOC, Sinochem (China), Oil India (India), KNOC (Korea), TAQA (Abu Dhabi – non-G20), EDF (France)

*Note: * Indicates where we know foreign SOEs have benefited from national subsidies in the UK, as the UK is the only country to publish information on companies that receive domestic fossil fuel subsidies (DECC, 2015).*

Box 6. The integral role of SOEs in the energy sector – cost or opportunity?

SOEs dominate the production of fossil fuels (see Figure 15). However, they are a very heterogeneous group, and their operations vary significantly between countries. Some SOEs operate under models similar to privately owned competitors with little or no government oversight, while others may be directed to undertake less commercial activities with the aim of promoting specific government objectives. A sub-set of SOEs provide governments with a significant portion of their revenues (e.g. Saudi Aramco in Saudi Arabia) and support efforts to attract private investment for fossil fuel production (e.g. YPF in Argentina). Some SOEs are mandated with insulating domestic consumers from volatile energy prices (e.g. Petrobras in Brazil), while others try to secure the country's fossil fuel supply by investing heavily abroad (e.g. CIL in India). Because SOE activities abroad have energy security implications, linkage between energy activities and trade initiatives involving other sectors is not uncommon, although evaluating related cross-subsidies to fossil fuel production is very challenging.

In many cases the relationships between SOEs and governments are opaque. However, given the recent global focus on its activities, Petrobras offers some insight into how SOEs involved in fossil fuel production work with governments (see also the Brazil Country Study).

In Brazil, the government holds the controlling interest (50.3%) in Petrobras, the country's largest oil and gas producer, which has activities all along the oil and gas value chain. Until 2015, the government set Petrobras' fuel prices to consumers, which, when below the cost of production, led to substantial balance sheet losses in the company's downstream business unit (Petrobras, 2013a; Millard, 2014). Coupled with these costs, aggressive investment plans to explore for and produce oil and gas from the 'pre-salt' offshore oil and gas fields (very large deposits trapped below 2 km of salt under the seabed, several hundred kilometres off Brazil's southeast coast) contributed to Petrobras being one of the world's most indebted companies and the downgrading of its credit rating in 2013 (Pearson, 2015; Petrobras, 2013b).

Alongside government ownership, the billions of dollars in support to Petrobras by governments (both at home and abroad) through national subsidies and public finance arrangements help to illustrate the level of support that some energy SOEs receive (see Chapters 4 and 6). In addition, Petrobras had to write off $2 billion in 2015 as the result of an ongoing corruption scandal involving a number of high-level politicians. This clearly raises worries that SOEs may not always operate in the public interest, particularly when they are not held publicly accountable.

Taking all of these issues together, phasing out fossil fuel subsidies means tackling some difficult questions regarding the role of SOEs that are focused on fossil fuel production. The wider literature on privatisation and research on SOEs involved in oil production has made some inroads in this area (see Victor et al., 2014). However, there is room for additional research into the governance of SOEs involved in the production of fossil fuels, as well as the links to fossil fuel subsidies more broadly.

Key areas that deserve more research based on more transparent information from SOEs include:

- analysis of the financial viability of SOEs
- the specific levels of subsidies and benefits conferred through state-ownership (alongside national subsidies and public finance)
- the effectiveness of SOEs in achieving national priorities and an assessment of whether alternative approaches could achieve the same goals at lower cost, and environmental and climate impacts
- comparison of different models for SOEs and links to their effectiveness.

This work could also hold lessons for the role of SOEs in the energy transition, i.e. where they may increasingly operate in areas such as renewable energy, energy efficiency, smart grids and electrified transport etc.

6.
Findings: Public finance

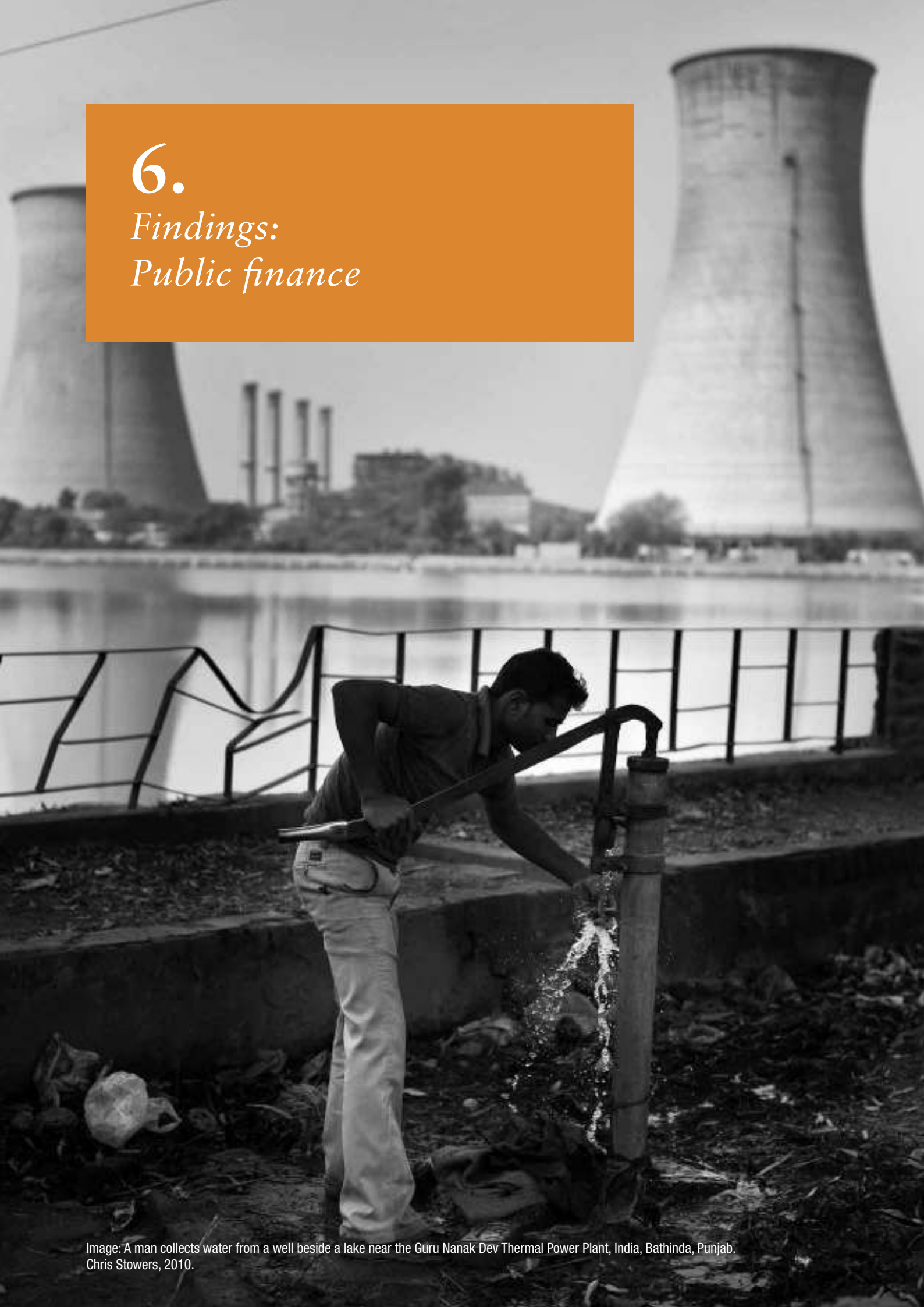


Image: A man collects water from a well beside a lake near the Guru Nanak Dev Thermal Power Plant, India, Bathinda, Punjab.
Chris Stowers, 2010.

Public finance

Governments provide support for, and take on liability for, fossil fuel production via financial institutions such as domestic, bilateral and multilateral development banks, export credit agencies and majority state-owned banks. These institutions provide public finance in the form of grants, loans, equity, insurance and guarantees, both domestically and internationally.

Governments back public finance institutions through public funds and creditworthiness. Even where public funds are not deployed directly from government budgets, the high credit ratings of publicly owned financial institutions, and their willingness to invest in the sector, can reduce the risk to parallel private investors. This often drives private investment in fossil fuel production that would not occur otherwise, regardless of the loan terms. This leverage effect is the fundamental rationale for public investment in a number of sectors (to act or invest in areas where the private sector is not or would not).

As outlined in Chapter 3 (Methodology), the WTO definition of a subsidy includes 'direct transfer of funds' (e.g. grants, loans and equity infusion) or 'potential direct transfers of funds or liabilities' (e.g. guarantees). Unfortunately, the transparency of investment data for public finance institutions varies greatly. Assessing the portion of total financing that constitutes a subsidy requires detailed information on the financing terms provided, let alone which portion of finance is based directly on public resources (as opposed to that raised on capital markets) or is dependent on the institutions' government-linked credit rating. Few of the institutions assessed in this report allow public access to this information, and therefore we report the total value of public finance from majority government-owned (more than 50%) financial institutions for fossil fuel production separately from 'national subsidy' estimates.

Further, the public finance figures identified in this report are likely to be significant underestimates. It is likely, for instance, that there are greater levels of fossil fuel financing domestically in China and from Indian state-owned banks than were identified, as only a portion of state-owned banks were surveyed given time constraints.

Table 5 provides a summary of G20 public finance for fossil fuel production, estimated to average $88 billion annually in 2013 and 2014. Our key findings on public finance to fossil fuel production are as follows:

- Japan provided the largest annual public financing for fossil fuels – an annual average of $19 billion for 2013 and 2014 – and China provided the second largest at almost $17 billion annually – largely for investments overseas.
- Korea also had significant public finance for fossil fuels, especially relative to the size of its economy, in the order of $10 billion annually.
- The emerging economies within the G20 relied more heavily on domestic public finance for fossil fuel production, with Argentina, Brazil, India, Russia and Saudi Arabia providing between $2 billion and $7 billion on average annually in 2013 and 2014.
- Other G20 countries provided higher levels of public finance abroad for fossil fuel production, with Canada, Germany, Italy, the UK and the US all providing between $2 billion and $6 billion on average annually in 2013 and 2014.
- Much of the international public finance from G20 countries goes to other G20 countries, driving further fossil fuel production within the G20 (see Table 6). This is also consistent with findings for SOEs operating internationally (see Table 4).
- In particular, oil and gas 'megaprojects', for the production of LNG and for refineries, pipelines and fossil fuel extraction make up a significant amount of G20 public finance for 2013 and 2014. These projects often experience significant cost overruns and are facing increasing challenges as fossil fuel development encounters greater economic and environmental risk (EY, 2014) (see Chapter 2).
- In addition to public finance through domestic institutions, the G20 countries collectively hold somewhere between 36% and 75% of the shares of the major multilateral development banks (MDBs), through which they provided $5.5 billion in average annual public finance for fossil fuel production in 2013 and 2014 (see Table 7 and Appendix 2).

In spite of current high levels of public finance for fossil fuel production, from 2013 a number of countries and public finance institutions have established limits on international coal finance with the aim of addressing climate change (see Box 7).

At the same time, two new international institutions – the New Development Bank and the Asian Infrastructure Investment Bank – are scheduled to begin operations in 2016, and could be significant new sources of public finance for fossil fuels. The New Development Bank currently has $50 billion in capital, expected to rise to $100 billion over time, and is 100% owned by G20 countries (Brazil, Russia, India, China and South Africa each owns 20% of shares). The Asian Infrastructure Investment Bank has $100 billion in capital and is 79% owned by G20 governments (with China having 30% ownership).

Additional information on public finance is included in Chapter 8 (Country Summaries), and a detailed inventory is included in each of the individual Country Studies and accompanying Data Sheets, as well as the MDB Data Sheet.

Table 5. Average annual public finance for fossil fuel production 2013-2014 ($ million)

Country	Financial institutions included in the calculation of average annual public finance (excepting list of MDBs – see Table 6)	Sub-sectors included in the calculation of average annual public finance (by order of contribution)	Average annual domestic public finance	Average annual international public finance	Average annual financing via shares in MDBs	Average annual public finance (2013-14) ($ million)
Argentina	BICE, Government of Argentina	Multiple or undisclosed fossil fuels	2,135	N/A	33	2,168
Australia	EFIC	Upstream oil and gas; Coal mining; Oil and gas pipelines, power plants and refineries; Coal-fired power	67	91	104	262
Brazil [a]	BNDES, Banco do Brasil	Upstream oil and gas; Oil and gas pipelines, power plants and refineries; Multiple or not specified fossil fuels; Coal-fired power	3,230	2	50	3,282
Canada	EDC	Upstream oil and gas; Oil and gas pipelines; power plants and refineries; Coal-fired power	447	2,088	176	2,711
China [b]	CDB, ChExim, ICBC, Bank of China, Sinosure (see China Country Study and Data Sheet for full list of state-owned banks)	Upstream oil and gas; Oil and gas pipelines, power plants and refineries;Coal-fired power; Coal mining	91	16,379	152	16,623
France	COFACE, Proparco	Oil and gas pipelines, power plants and refineries; Upstream oil and gas; Coal-fired power; Coal mining	–	570	812	1,382
Germany	KfW IPEX, KfW Entwicklungsbank, DEG, Euler Hermes	Oil and gas pipelines, power plants and refineries; Coal-fired power; Upstream oil and gas; Multiple or unspecified fossil fuels; Coal mining	43	1,704	848	2,595
India	SBI, SBI Capital Markets, Bank of Baroda, Corporation Bank, Central Bank of India, Punjab National Bank (see India Country Study and Data Sheet for full list of state-owned banks)	Coal-fired power; Oil and gas pipelines, power plants and refineries; Upstream oil and gas; Coal mining	1,565	388	149	2,103
Indonesia	Bank Mandiri	Upstream oil and gas, Oil and gas pipelines, power plants and refineries, Coal-fired power	43	–	73	116

Table 5. Average annual public finance for fossil fuel production 2013-2014 ($ million) (continued)

Country	Financial institutions included in the calculation of average annual public finance (excepting list of MDBs – see Table 6)	Sub-sectors included in the calculation of average annual public finance (by order of contribution)	Average annual domestic public finance	Average annual international public finance	Average annual financing via shares in MDBs	Average annual public finance (2013-14) ($ million)
Italy	SACE, CDP	Oil and gas pipelines power plants and refineries; Upstream oil and gas; Coal mining	–	1,510	757	2,267
Japan	JBIC, NEXI, JOGMEC, JICA, DBJ	Oil and gas pipelines, power plants and refineries; Upstream oil and gas; Coal-fired power; Coal mining	351	18,238	440	19,029
Korea	KExim, K-sure, KDB, KFC	Oil and gas pipelines, power plants and refineries; Upstream oil and gas; Coal-fired power	40	10,322	83	10,445
Mexico	Banobras, Nafinsa, Bancomext	Upstream oil and gas; Oil and gas pipelines, power plants and refineries; Coal-fired power; Coal mining	421	–	28	449
Russia	VTB Bank, Vneshcombank, Sberbank, Government of Russian Federation, EXIAR	Coal mining; Upstream oil and gas; Oil and gas pipelines, power plants and refineries; Coal-fired power; Multiple or unspecified fossil fuels	5,722	846	118	6,686
Saudi Arabia	Ministry of Finace, NCB, Public Investment Fund, Saudi Fund for Development	Oil and gas pipelines, power plants and refineries	6,949	132	69	7,150
South Africa	DBSA, IDC, ECIC	Oil and gas pipelines, power plants and refineries; Coal-fired power	70	322	33	425
Turkey	Halkbank, Ziraat Bankasi, Vakifbank	Coal-fired power; Upstream oil and gas; Oil and gas pipelines, power plants and refineries	1,020	250	40	1,310
United Kingdom	RBS, UKEF, DFID, CDC, BIS	Multiple or unspecified fossil fuels; Upstream oil and gas; Oil and gas pipelines, power plants and refineries; Coal-fired power; Coal mining	72	4,626	817	5,515

Table 5. Average annual public finance for fossil fuel production 2013-2014 ($ million) (continued)

Country	Financial institutions included in the calculation of average annual public finance (excepting list of MDBs – see Table 6)	Sub-sectors included in the calculation of average annual public finance (by order of contribution)	Average annual domestic public finance	Average annual international public finance	Average annual financing via shares in MDBs	Average annual public finance (2013-14) ($ million)
United States	USExIm, OPIC	Upstream oil and gas; Oil and gas pipelines, power plants and refineries; Coal-fired power; Coal mining	–	2,992	743	3,735
Total average annual G20 public finance						88,252

Notes:

(a) Several projects from BNDES financed the state-owned Petrobras and therefore have been excluded from public finance calculations to avoid double counting with SOE investment by Petrobras (see Chapter 5).

(b) Some projects that were identified from Chinese state-owned banks (Bank of China, CDB, Chexim, and CITIC Bank) financed projects that wholly or in part funded state-owned enterprises covered in the SOE investment totals (China Huadian Group, CNOOC, CNPC, and Shenhua) and therefore have been excluded from public finance calculations to avoid double counting with SOE investment (see Chapter 5).

For additional detail see Country Studies and Data Sheets.

Table 6. Destination for G20 international public finance for fossil fuel production (other G20 countries in bold)

Argentina	Not applicable
Australia	Papua New Guinea
Brazil	**Argentina**
Canada	**Brazil**, Chile, Colombia, Egypt, **Germany**, Hong Kong, **India, Mexico**, **Russia**, **Saudi Arabia**, **Turkey, United States**
China	Angola, **Australia, Brazil**, Columbia, Costa Rica, **India**, **Indonesia**, Kazakhstan, Kyrgyzstan, Luxembourg, **Mexico**, Mongolia, Morocco, Norway, Papua New Guinea, **Russia**, Serbia, Singapore, Switzerland, Trinidad and Tobago, Turkmenistan, **United Kingdom, United States,** Uzbekistan, Venezuela, Viet Nam, Zimbabwe
France	**Argentina, Australia**, **India, Russia, South Africa,** Tunisia, Viet Nam
Germany	**Australia, Brazil, China,** Greece, **India**, Israel, Jordan, Kazakhstan, Kosovo, Norway, **Russia**, **Saudi Arabia**, Singapore, Switzerland, United Arab Emirates, Viet Nam
India	**Australia,** Nigeria
Indonesia	Not applicable
Italy	Bulgaria, **Indonesia**, Nigeria, Oman, **Turkey**, Viet Nam
Japan	**Australia**, Bangladesh, **Brazil, Canada**, Ghana, **India, Indonesia**, Iraq, **Italy,** Jordan, Kuwait, Malaysia, Mongolia, Morocco, Mozambique, Norway, Panama, Papua New Guinea, Qatar, **Russia, Saudi Arabia**, Tanzania, Thailand, **Turkey**, Turkmenistan, United Arab Emirates, **United Kingdom, United States,** Uzbekistan, Viet Nam
Korea	**Australia**, Chile, **Indonesia**, Iraq, Jordan, Malaysia, **Mexico**, Morocco, Nigeria, Norway, Oman, Saudi Arabia, Spain, Sweden, **Turkey**, Turkmenistan, United Arab Emirates, **United Kingdom, United States**, Uzbekistan, Viet Nam
Mexico	Not applicable
Russia	Belarus, Bosnia and Herzegovina, Ecuador, **India**, Kazakhstan, Slovakia, Tajikistan
Saudi Arabia	Egypt, Oman
South Africa	Ghana, Mozambique, Rwanda, Tanzania, Zambia
Turkey	Azerbaijan
United Kingdom	Afghanistan, **Australia,** Bangladesh, Bosnia and Herzegovina, **Brazil, Canada, China**, Czech Republic, Egypt, **France, Germany,** Ghana, Greece, Iraq, **Italy**, Kazakhstan, Malaysia, **Mexico,** Netherlands, Nigeria, Norway, Oman, Pakistan, Panama, Portugal, **Korea, Russia, Saudi Arabia**, Singapore, Slovakia, Spain, Switzerland, Tanzania, **Turkey**, United Arab Emirates, **United States**, Viet Nam, Yemen
United States	**Argentina, Australia,** Colombia, Jordan, **Mexico**, Mongolia, Netherlands, Nigeria, **Russia, Saudi Arabia**, Spain, Togo, **Turkey**, United Arab Emirates, **United Kingdom**

Table 7. Multilateral development bank finance for fossil fuels, (average annual in 2013 and 2014) (see also Appendix 2)

Institution	Fossil fuel finance ($ million)	Percentage ownership by G20 governments
African Development Bank	254	36
Asian Development Bank	941	65
European Bank for Reconstruction and Development	968	68
European Investment Bank	3,500	64
Inter-American Development Bank	1	75
World Bank Group	3,092	54 to 79

Box 7. International finance to coal-fired power and opportunities to limit production subsidies

International public finance for coal-fired power is a flashpoint in the production subsidies discussion. Support to coal mining and coal-fired power from public finance institutions is often provided at highly preferential terms – and averaged more than $9 billion per year between 2007 and 2014 (Bast et al., 2015). While this finance continues to be provided at a significant level, a number of countries and public finance institutions have recently established limits on finance for coal-fired power projects. The US was the first to move in 2013, when the US Treasury Department announced guidelines that greatly restricted international coal finance from US public finance institutions (US Department of the Treasury, 2013). These guidelines affected US participation in multilateral development banks, and eventually included the Overseas Private Investment Corporation (OPIC) and the US Export-Import Bank (ExIm). Also in 2013 the World Bank, European Investment Bank and European Bank for Reconstruction and Development all announced curbs on coal finance. In 2014, Germany announced some partial restrictions on coal finance, and French President François Hollande announced that France would end export credits for coal-fired power projects (Rose, 2014) – a decision that was recently upheld in the face of intense lobbying by fossil fuel producers (Barbière, 2015).

Also in 2014, the Netherlands, the UK and the US tabled a proposal that would limit OECD export credit agency support for coal.[a] Between 2007 and 2014, these agencies provided $34 billion in coal finance (for coal mining and coal-fired power). In these discussions, Japan (the world's largest provider of public finance for coal between 2007 and 2014) alongside Australia and Korea, resisted any limits on export credits for coal from the OECD countries (Dixon, 2015; Canfin, 2015).

However, recent developments may change the tone of the forthcoming OECD discussions in November 2015. Earlier this year, the US and China released a joint presidential statement on climate change (White House, 2015). In this statement, China pledged to strengthen its own regulations 'with a view to strictly controlling public investment flowing into projects with high pollution and carbon emissions both domestically and internationally' (ibid.).

From 2007 to 2014, China was the second largest provider of international public finance for coal-fired power, behind Japan (Bast et al., 2015). Japan has argued that it should be allowed to continue to provide finance for coal-fired power projects (including export credits), because if it stops, China will step in and provide finance for less efficient coal-power technologies (Dixon, 2015). This is in spite of a recent statement to an adviser to the Japanese government that the country 'will have difficulty in exporting coal technologies' (Lewis and Volcovici, 2015).

While China's plans to restrict public investment in high-emitting infrastructure have yet to be set out, there is a possibility that they could also apply to new China-based multilateral financial institutions, including the Asian Infrastructure Investment Bank and the New Development Bank.

The growing tide of institutions and governments restricting international public finance for coal-fired power is an encouraging story of reform on one significant form of producer subsidy.

Note: (a) Export credit agencies typically provide government-backed loans, credits and guarantees for international operations by corporations (or investors) from the home country.

Box 8. China's oil-backed loans

Though not reflected in the public finance totals in this report, a form of China's international public finance is through 'energy-backed loans' (EBLs) that indirectly support fossil fuel production. Also known as 'oil-backed loans' or 'oil for loans,' EBLs are a form of financing that must be repaid either with direct shipments of oil or gas, or via withdrawals by Chinese SOEs from cash accounts set up to receive the proceeds of fossil fuel sales by the loan recipient (Lee et al., 2014; Shea, 2014).

For example, in September 2013, government officials in Niger signed a $1 billion loan from Chexim to finance a broad range of development projects. Niger will repay the loan through sales of oil produced by a Chinese oil and gas SOE – the China National Petroleum Corporation – operating in Niger (Agence France-Presse, 2013; Trade Finance, 2013).

Similarly, in July 2014, China reportedly extended a $4 billion credit line to Venezuela to support a fund for infrastructure and economic development, in return for crude oil and oil products. The agreement will see around 100,000 barrels of oil per day go to China (Bureau UK, 2014; Buitrago, 2014).

Most Chinese EBLs have similar structures and characteristics:

- They are brokered directly with a national government or a state-owned energy company, often involving the China Development Bank (CDB) (Shea, 2014).
- The loans are secured with revenue earned from the production of oil and natural gas in the recipient country, or through oil and gas deliveries to China's national oil companies (NOCs) such as the China National Petroleum Corporation and Sinopec (Downs, 2012).
- In the case of oil or gas deliveries, this may be stipulated as a specified amount per month, vary according to global energy prices, or depend on other contractual terms. China's NOCs deposit payments (or values equivalent to deliveries) into accounts at the China Development Bank held by the companies making the deliveries (Downs, 2012).
- The borrowers must maintain a balance in their accounts sufficient to cover any payments owed to the China Development Bank, and the bank periodically withdraws the interest, principal and other fees it is owed from the accounts (Downs, 2012).

These agreements allow China to use its surplus reserves of dollars to build up a buffer of long-term oil and gas supplies, generally at stable prices against the volatile global energy market.

As is often the case in export credit and development finance arrangements, EBLs may also include provisions stipulating that the beneficiary country must: employ Chinese companies and workers, and import and use Chinese construction machinery, equipment and raw materials (Downs, 2011; Lee et al., 2014). As a result, China's largest corporations win export contracts to sell other Chinese goods and services to the borrowing countries as part of the loans (Shea, 2014).

The strategy of employing EBLs provides the Chinese government with significant influence over the fossil fuel resources of the countries to which it is making loans. These include smaller economies such as Angola, Bolivia and Ecuador, as well as larger ones such as Brazil, Kazakhstan, Turkmenistan and Venezuela. In the case of Ecuador, since the recent $7.53 billion loan,[a] Chinese financing now exceeds 25% of the country's annual GDP. China is buying 83% of Ecuador's oil production, while its loans-for-oil projects in the country have a clause allowing China to seize part of Ecuador's assets in case of repayment failure (Zuckerman, 2015).

It is possible that EBLs are driving some borrowing countries to exploit more of their oil and gas resources, as they are insulated from wider market forces (Hill, 2014), and because long-term agreements reduce the flexibility of future governments to respond to changing market conditions.

Note: (a) Contracted to support Ecuador in light of the recent drop in global crude oil prices.

7.
Public versus private benefits from fossil fuel subsidies

Image: A shepherdess watches over her flock of sheep grazing near a coal-fired power plant, Indonesia, Jepara. Kemal Jufri.

Public versus private benefits from fossil fuel subsidies

Subsidies are among the more common public policy instruments in current use, and governments generally use subsidies as part of wider economic policies to support specific businesses, markets, sectors or regions. In the specific case of energy subsidies (of which fossil fuel production subsidies are a sub-set) their use has been historically linked to supporting energy security, domestic energy production and access to energy. In recent years, however, accounting for the full economic, social and environmental costs of fossil fuel subsidies has led to calls for their removal (from the G20 among others) (Whitley and van der Burg, 2015).

Although subsidies are often framed as reducing costs to consumers or producers, subsidies primarily change the way in which costs are distributed between different types of groups including producers, consumers and parts of government (Beaton et al., 2013). As political interests often determine who receives subsidies and at what scale, the interests of those who benefit from subsidies can become entrenched over time and create significant barriers to their reform (see Box 9).

The primary beneficiaries of government support for fossil fuel production (domestically and internationally) are private and state-owned companies. However, it is challenging to determine exactly how company (and project) profitability is shaped by production subsidies. This is, in part, the result of issues of commercial confidentiality, whereby certain details of company income and tax payments remain undisclosed. It is also, however, the result of a significant lack of transparency in the fossil fuel production subsidies provided by governments (see Chapter 3). Although the repeated calls from oil and gas companies for 'incentives' in light of falling prices may provide some indication, it is currently very challenging to determine the level of dependence of these private actors on public support (see Canada and UK Country Studies).

As has been outlined in this report, the sheer level of subsidies to fossil fuel production indicates that they are likely to have a significant role in shaping parallel private investment in these activities. However, the paucity of publicly available information makes it challenging to understand:

- the relative contributions of public and private actors to fossil fuel production (through subsidies and investment), in other words,
  - who spends more?
- the relative benefit to private companies from fossil fuel production subsidies (profitability) as opposed to that to governments (public benefits – including economic),
  - who earns more?
- the effectiveness of fossil fuel production subsidies, i.e. how does government support compare with government returns (public benefits – including economic),
  - do governments spend more than they get back? (see Box 10)

Overall, there is significant scope for governments to disclose more detailed information about the beneficiaries of national subsidies, investment by state-owned enterprises and public finance across all stages of fossil fuel production (see Table 8). Currently the UK's national subsidies to oil and gas development in the North Sea are the only fossil fuel production subsidies in the G20 for which detailed information is available in terms of both the beneficiaries (private companies and SOEs) and the level of benefit conferred. The UK government discloses the full list of companies that have been granted field allowances in the North Sea, a sub-set of national subsidies valued at $4.5 billion over five years (2009 to 2014). Of these, a significant portion went to international companies including: Total (France), Apache (US), ENGIE (formerly GDF Suez – France), Statoil (Norway), Ithaca (Canada) and Taqa (Abu Dhabi) (Bast et al., 2014) (see Table 9).

7.1 Upstream oil and gas

Although outside the UK there is limited publicly available information on expenditure and profits by oil, gas and coal companies, refineries and fossil-fired electricity and on corresponding government income, we were able to obtain this information for **upstream oil and gas** using the Rystad Ucube database.

Table 8. G20 fossil fuel production subsidies by activity (average annual in 2013 and 2014)

$ million	Coal mining	Coal-fired power	Upstream oil and gas	Oil and gas pipelines, power plants and refineries	Multiple activities, multiple fossil fuels or not specified	Total annual average 2013-2014
G20 fossil fuel production subsidies (including national subsidies, SOE investment and public finance)	19,007	17,224	226,814	53,708	131,992	452,207

Table 9. Value of new UK field allowances granted between September 2009 and September 2014

Operator	Headquarter country	Value ($ million)	Number of fields	Fossil fuel	Type
Total	France	838	3	Oil and gas	DWG and SFA
Apache	United States	200	4	Oil and gas	SFA
GDF Suez	France	407	3	Oil and gas	SWG and SFA
Statoil	Norway	407	1	Oil and gas	UHO
Premier	United Kingdom	305	4	Oil and gas	SFA
Ithaca	Canada	291	5	Oil and gas	SFA
Taqa	Abu Dhabi	267	4	Oil and gas	SFA
Centrica (including HRL)	United Kingdom	229	4	Oil and gas	SFA
Enquest	United Kingdom	229	4	Oil and gas	SFA
Maersk	Denmark	229	3	Oil and gas	SFA
Talisman	Canada	215	4	Oil and gas	SFA
Dana	United Kingdom	153	2	Oil and gas	SFA
Encana	Canada	153	2	Oil and gas	UHO
Nexen	Canada	153	3	Oil and gas	SFA
ConocoPhillips	United States	114	2	Oil and gas	SFA
Chevron	United States	76	1	Oil and gas	SFA
Iona	Canada	76	1	Oil and gas	SFA
Perenco	United Kingdom	76	1	Oil and gas	SFA
EOG	United States	38	1	Oil and gas	SFA
Endeavour	United States	24	1	Oil and gas	SFA
Wintershall	Germany	24	1	Oil and gas	SFA
Total		4,504	54		

Note: New national subsidies introduced in the UK in 2015 include investment allowances which apply to investment expenditure on a field incurred on or after April 2015, and are activated by production income from the field, and cluster area allowances which apply only on capital expenditure incurred on or after 3 December 2014 (both of which fall broadly outside the timeframe of this report – 2013 and 2014).
Source: Bast et al., 2014

Our key findings for investment and profit for the top 20 upstream private oil and gas companies, and G20 government income from oil and gas, were:

Between 2013 and 2014, global investment in fossil fuel production by the top 20 private oil and gas companies (representing 23% of global production) averaged $414 billion per year, with average profits (based on free cash flow) of $35 billion per year (Table 11). The level of private expenditure is almost double the total fossil fuel production subsidies identified in this report for upstream oil and gas ($227 billion) (Table 8).

- Looking at company activity within the G20, we find the private companies with the highest levels of production and investment across several G20 countries are Shell (operating in 14 countries), Exxon Mobil (12 countries), Total (10 countries) and Chevron (8 countries).
- In terms of public benefits, the average percentage of government income from upstream oil and gas revenue was 10% in 2013[13] (Table 12). However, this figure is heavily skewed by Saudi Arabia, which relies almost exclusively on oil and gas revenue for government income. The average share of government revenues from oil and gas was only 5% for the balance of the G20 countries (with 10 of the G20 countries receiving less than 2% of government revenue from oil and gas). These are relatively small shares of total government

13 We review total government revenue and the percentage of total government income from oil and gas for 2013 (and not an average across 2013 and 2014), as comparable data across countries for total government revenue for 2014 were not available at the time of publication of this report.

revenue, which indicate the potential for G20 countries to transition away from fossil fuel-based tax revenues.

- Saudi income from oil and gas was $260 billion, amounting to almost 90% of government revenues. Oil and gas have historically accounted for a large share of government revenue in oil-exporting countries such as Saudi Arabia. However, the impacts of rising production costs against a backdrop of currently low oil prices indicate that fossil fuels are not a stable source of government revenue. With the current oil price being far below the oil price required to balance Saudi Arabia's current budget ($103 per barrel) (see Table 10), the IMF predicts the country's budget deficit will peak at 21.6% of GDP in 2015, with other oil-dependent countries showing a similar profile (IMF, 2015).

Table 10. Break-even price per barrel for oil in 2015 (price needed to balance current budgets) for selected oil producers

Country	Break-even price per barrel of oil in 2015 ($)
Libya	215.00
Algeria	111.10
Saudi Arabia	103.00
Iran	92.50
Venezuela	89.00
Russia	78.00
UAE	73.10
Iraq	70.90
Qatar	59.10
Kuwait	47.10

Sources: Bently et al. (2015); US Energy Information Administration (production, exports); WSJ Market Data Group (Brent price); International Monetary Fund (GDP, break-even prices for all countries except Nigeria, Russia and Venezuela); Deutsche Bank (break-even prices for Nigeria, Russia and Venezuela).

7.2 Coal

The information available on the capital expenditure and profits of private coal companies, and corresponding government income, is more limited than for upstream oil and gas companies. Nonetheless, we were able to identify some of this information using the Bloomberg Professional terminal (a commercial, fee-based service) and company reports.

This shows the dominance of Australian, South African and US private companies in the industry, with coal production dominated by SOEs in many of the leading G20 coal producers including China, India, Indonesia, Turkey and South Africa.

Our key findings for investment and profit of the top 20 upstream private coal companies, and for US and Australian tax take from private coal companies, were as follows:

- The total capital expenditure of 20 of the world's largest coal producers[14] (representing 16% of global production) was $10 billion on average per year in 2013 and 2014, with these same companies generating profits of just over $4 billion in the same time period (see Table 13).
- The level of private expenditure on coal is half of the total fossil fuel production subsidies identified in this report for coal production ($19 billion) (see Table 8).
- We were unable to find data on government revenue from coal production in 2013 or 2014 (from commercial and public databases), however, past research has shown that the top 20 coal companies (globally) paid $27 billion in taxes to governments in 2012 (Bast et al., 2014).

7.3 Power companies (fossil fuel-based)

The information available on the capital expenditure and profits of power companies, and corresponding government income, is more limited than for upstream oil and gas companies. Nonetheless we were able to identify some of this information using the Bloomberg Professional terminal (a commercial, fee-based service) and company reports.

This indicated that the majority (13) of the top 20 power generating companies globally (by generation capacity) are SOEs, as opposed to private companies (see Table 14). In addition to the more limited role of private companies in power generation, it was not possible to identify the share of company investment and revenue nor the share of government income that is linked to fossil fuel power production (as opposed to that from nuclear, renewables or other sources).

Nonetheless, although we were unable to disaggregate subsidies to gas- and oil-fired power generation across the G20 (as these were often bundled with wider fossil fuel-fired power), we were able to isolate support to coal-fired power which was $17 billion on average per year in 2013 and 2014 (see Table 8). All of the G20 countries provided some level of support to coal-fired power through national subsidies, SOE investment and public finance.

14 These companies are responsible for 16% of global coal production. For companies where coal production provided >90% of revenue, we include information for the whole company; for other companies we have only included the appropriate segment. However, it should be noted that Rio Tinto includes uranium production within its 'Energy' segment.

7.4 Refining

The information available on the capital expenditure and profits of refiners and corresponding government income is also more limited than for upstream oil and gas companies. However, we were able to identify the top 20 global companies (private and SOEs) in the sub-sector, including a number of private US-headquartered companies such as ExxonMobil, Valero, Chevron, Philips 66 and Marathon Oil. These companies would benefit from subsidies to refining where they are provided in the US and across the G20 (see Table 15). It was more difficult to isolate specific subsidies to refining, as this is often bundled with wider support to midstream and downstream oil and gas (see Table 8).

7.5 Shifting investment – to low-carbon alternatives

Subsidies to incumbent fossil fuel-based energy production may have far less impact on mobilising wider public and private investment than parallel subsidies to emerging lower-carbon alternatives such as renewables.

Looking at global data for 2013, the IMF estimates fossil fuel subsidies in the form of pre-tax subsidies and foregone consumption tax revenues at $908 billion (IMF, 2015), with investments in fossil fuels in the same year amounting to $1.2 trillion according to the International Energy Agency (ratio of 1:1.3) (IEA, 2014a). Comparatively, global renewable energy subsidies were estimated at $121 billion (IEA, 2014b), with investments in renewable energy amounting to $232 billion in the same year (ratio of 1:1.9) (FS-UNEP, 2015).

Given the range of underlying assumptions within the global data required to develop these estimates, a robust understanding of the comparative impact of subsidies on investment for both fossil fuels and renewables will require greater transparency across the energy sector.

Nonetheless, the potential to transfer significant volumes of investment away from fossil fuels and towards alternative energy services and other public goods, is significant, and the energy transition will only be accelerated through the removal of fossil fuel subsidies.

Table 11. Production expenditure[15] and free cash flow generated globally by 20 largest private oil and gas companies (by capital expenditure)

Company (ranked by expenditure on production)	Headquarter country	G20 countries of operation	2013–14 average production expenditure ($ million)	2013–14 average free cash flow from upstream activities ($ million)
ExxonMobil	United States	Argentina, Australia, Canada, China, Germany, Indonesia, Japan, Russia, South Africa, Turkey, United Kingdom, United States	52,058	8,252
Chevron	United States	Argentina, Australia, Brazil, Canada, China, Indonesia, United Kingdom, United States	50,514	-401
Shell	Netherlands	Argentina, Australia, Brazil, Canada, China, Germany, Indonesia, Italy, Korea, Russia, Turkey, United Kingdom, United States	46,858	10,074
Total	France	Argentina, Australia, China, France, Indonesia, Italy, Russia, South Africa, United Kingdom, United States	35,496	-1,963
BP	United Kingdom	Argentina, Australia, China, India, Indonesia, Russia, United Kingdom, United States	30,225	7,192
ConocoPhillips	United States	Australia, Canada, China, Indonesia, Italy, Russia, United Kingdom, United States	27,638	252

Table 11. Production expenditure[15] and free cash flow generated globally by 20 largest private oil and gas companies by capital expenditure (continued)

Company (ranked by expenditure on production)	Headquarter country	G20 countries of operation	2013–14 average production expenditure ($ million)	2013–14 average free cash flow from upstream activities ($ million)
Eni	Italy	Australia, China, India, Indonesia, Italy, Russia, South Africa, United Kingdom, United States	21,658	6,855
Lukoil	Russia	Russia	19,597	4,316
BG	United Kingdom	Australia, Brazil, China, India, Italy, United Kingdom, United States	13,726	-3,703
Inpex	Japan	Indonesia, Japan, Russia	12,509	-5,217
Canadian Natural Resources (CNRL)	Canada	United Kingdom	12,077	2,404
Anadarko	United States	China, South Africa, United States	11,216	137
Suncor Energy	Canada	United Kingdom	11,086	3,349
Apache	United States	Australia, Canada, United Kingdom, United States	10,973	-251
Repsol	Spain	Australia, Brazil, Canada, Indonesia, Russia, United Kingdom, United States	10,486	698
EOG Resources	United States	Canada, China, United Kingdom, United States	10,332	108
BHP Billiton	Australia	Australia, China, India, Italy, South Africa, United Kingdom, United States	10,064	1,558
Oxy	United States	United States	9,971	2,276
Devon Energy	United States	United States	9,418	-617
Chesapeake	United States	United States	7,870	-21
Total			413,772	35,298

Source: Adapted from Rystad Energy (2015)

15 Sum of exploration expenditure, capital expenditure and operating expenditure.

Table 12. Government income from oil and gas in the G20 in 2013 (across all upstream)

Country	Government income from oil and gas (2013) ($ million)[a]	Total government income (2013) ($ million)[b]	Percentage of total government income from oil and gas (2013)
Saudi Arabia	265,328	296,427	89.51
Mexico	71,531	297,220	24.07
Russia	192,216	803,227	23.93
Indonesia	28,051	137,561	20.39
India	17,632	259,062	6.81
China	74,402	2,004,493	3.71
Brazil	18,478	506,148	3.65
Canada	24,476	671,251	3.65
Argentina	5,765	171,240	3.37
United States	106,180	5,568,251	1.91
Australia	8,215	499,964	1.64
United Kingdom	2,470	1,024,492	0.24
Italy	2,314	986,563	0.23
Germany	2,251	1,595,701	0.14
Turkey	286	231,429	0.12
Japan	488	1,602,395	0.03
Korea	113	413,922	0.03
France	164	1,431,296	0.01
South Africa	-254	1,004,394	-0.03
Total or average	820,107	505,036	9.65
Total (excluding Saudi Arabia)	554,779	208,610	5.45

Notes:

(a) Sum of government profit, royalty effects, income tax and bonuses data from Rystad (2015). For Saudi Arabia, see Central Department of Statistics and Information Saudi Arabia (2014).

(b) Data for the majority of countries is from: OECD-Stats (2015a); for Argentina and Brazil see OECD-Stats (2015b) ; China, see National Bureau of Statistics of China (2014) ; for India see Government of India (2014); for Saudi Arabia see Central Department of Statistics and Information Saudi Arabia (2014); and for South Africa see Statistics South Africa (2014).

Sources: Rystad (2015); OECD-Stats (2015a, 2015b); Central Department of Statistics and Information Saudi Arabia (2014); National Bureau of Statistics of China (2014); Statistics South Africa (2014); Government of India (2014).

Table 13. 20 of the top global coal companies' production, capital expenditure and operating profits on average across 2013–2014

Company	Headquarters	Countries of operation (% 2014 revenue)	Production (million metric tonnes) (2013/2014 average)	Capex ($ million) (2013/2014 average)	Operating profit group or segment ($ million) (2013/2014 average)	Segment name
Peabody Energy Corp	United States	US (60%), Australia (40%)	202	538	-123	-
Glencore plc	Switzerland	Australia (55%), South Africa (22%), Colombia (23%)	136	2,495	1,273	Energy products
Arch Coal	United States	US (100%)	122	222	-406	-
BHP Billiton	Australia	Australia, South Africa, US, Colombia	115	2,799	491	Coal
RWE AG	Germany	Germany (100%)	96	not available	not available	-
Anglo American	United Kingdom	Australia & Canada (51%), South Africa (36%), Colombia (13%)	100	1,156	523	Coal
Alpha Natural Resources	United States	US (100% of mining; 56% of revenue from export, mainly Japan and Canada)	77	200	-994	-
SUEK plc	Russia	Russia (100%)	97	797	445	Coal
Cloud Peak Energy	United States	US (85%), Korea (12%)	80	33	100	-
Bumi Resources	Indonesia	Indonesia (100%)	75	75	119	-
Consol Energy	United States	US	28	420	372	Coal operations
Adaro Energy	Indonesia	Indonesia (100%)	54	142	988	-
Banpu Pub Co Ltd	Thailand	Indonesia (63%), Australia (31%), Thailand (7%)	40	not available	476	Coal
Exxaro	South Africa	South Africa (100%)	39	not available	284	Coal
Kuzbassrazrezugol OJSC	Russia	Russia (100%)	0	110	125	-
Sasol	South Africa	South Africa (100%)	37	342	219	Mining
Alliance Resource Partners	United States	US (100%)	36	333	494	-
Indika	Indonesia	Indonesia (100%)	35	not available	not available	Energy resources
Rio Tinto	United Kingdom	Australia, South Africa, Mozambique	34	478	33	Energy (coal, uranium)
Drummond Co	United States	US, Colombia	not available	not available	not available	-
Total			1,402	10,139	4,418	

Sources: Bloomberg Finance (2014) and company annual reports for 2013 and 2014.

Table 14. Top 20 power generators globally in terms of average generation in 2013 and 2014 (private and SOEs)

Company	SOE/Private	Headquarters	Countries of operation (% 2014 revenue)	Generation (GWh) (2013 and 2014 average)
Electricité de France SA	SOE	France	France (58%), Italy (19%), UK (15%)	638,700
Korea Electric Power Corp (KEPCO)	SOE	Korea	Korea (94%)	519,560
Engie SA	Private	France	France (37%), Belgium (11%), other EU (28%)	331,640
Huaneng Power	SOE	China	China (89%), Singapore (12%)	309,957
Enel SpA	Private	Italy	Italy (39%), Spain/Portugal (28%), Germany (4%), other Europe (14%), Brazil (4%), other Americas (10%)	284,624
Duke Energy Corp	Private	United States	US (94%), Latin America	204,907
NTPC Ltd	SOE	India	India (100%)	232,661
Tokyo Electric Power Co (TEPCO)	SOE	Japan	Japan (100%)	239,283
Eskom Holdings	SOE	South Africa	South Africa (95%)	231,924
Saudi Electricity Company	SOE	Saudi Arabia	Saudi Arabia (100%)	206,745
RWE AG	Private	Germany	Germany (57%), UK (21%), other EU (22%)	212,500
American Electric Power	Private	United States	US (100%)	210,443
E.ON SE	Private	Germany	Germany (25%), UK (8%), other EU (8%)	224,050
Centrais Elétricas Brasileiras S.A. (Eletrobras)	SOE	Brazil	Brazil (100%)	230,240
Tavanir	SOE	Iran	Iran (100%)	not available
Southern Company	Private	United States	US (100%)	185,000
Datang International Power Generation Co Ltd	SOE	China	China (100%)	190,350
Rosenergoatom Concern OJSC	SOE	Russia		176,359
Huadian Power International Corp Ltd	SOE	China	China (100%)	177,818
Egyptian Electricity Holding Company	SOE	Egypt		166,339
Total				4,973,098

Source: Bloomberg Finance (2014) and company annual reports for 2013 and 2014.

Table 15. Top 20 refiners globally in 2014 (private and SOEs)

Rank by Capacity	Company type	Company	Crude capacity, thousand barrels per calendar day
1	Private	Exxon Mobil Corporation (United States)	5,589
2	Private	Royal Dutch/Shell (Netherlands)	4,109
3	SOE	Sinopec (China)	3,971
4	Private	BP PLC (United Kingdom)	2,859
5	SOE	Saudi Arabian Oil Company (Saudi Arabia)	2,852
6	Private	Valero Energy Corporation (United States)	2,777
7	SOE	Petróleos de Venezuela S.A. (Venezuela)	2,678
8	SOE	China National Petroleum Company (China)	2,675
9	Private	Chevron Corp. (United States)	2,540
10	Private	Phillips 66 (United States)	2,514
11	Private	Total S.A. (France)	2,304
12	SOE	Petróleo Brasileiro S.A. (Brazil)	1,997
13	Private	Marathon Oil Corp. (United States)	1,714
14	SOE	Petróleos Mexicanos (Mexico)	1,703
15	SOE	National Iranian Oil Company (Iran)	1,451
16	Private	JX Nippon Oil & Energy Corp. (Japan)	1,423
17	SOE	Rosneft (Russia)	1,293
18	Private	OAO Lukoil (Russia)	1,217
19	Private	SK Innovation (Korea)	1,115
20	Private	Repsol YPF S.A. (Spain)	1,105

Source: Petrostrategies, Inc. (accessed 19 October 19 2015).

Box 9. Why fossil fuel subsidies persist

There is increasing evidence that phasing out subsidies for fossil fuels as part of wider reform of the energy sector can reduce pressure on budgets; create the necessary fiscal space to support sustainable economic development; ensure access to energy for the poor; establish price signals for investment in efficient, low-carbon energy systems and efficient urban planning and transport systems; and eliminate the perverse incentives that drive up carbon emissions (Whitley and van der Burg, 2015). However, despite the potential virtuous cycles for national priorities that could result from the removal of fossil fuel subsidies (along with other environmentally harmful subsidies), governments are often reluctant to undertake reform.

Researchers have identified several specific reasons for the persistence of fossil fuel subsidies to both production and consumption:

- Energy has significant strategic value for nations, so historically national governments have sought to control the production, price and value of these assets (CPI, 2014).
- There is limited transparent information about the wide range of subsidies provided at the regional, national and international levels.
- There are many misperceptions (and much misinformation) about the effectiveness of fossil fuel subsidies in supporting economic and wider development objectives.
- Subsidies are often vigorously defended by special interests because the benefits of subsidies are often concentrated among specific sectors or groups, while the costs are spread across the general population (i.e. consumers and taxpayers) (Whitley and van der Burg, 2015).

Taken together, these explicit and implicit barriers to reform create a dangerous inertia around subsidies, which inhibit their elimination even in the light of new technological, economic and social developments. Chapter 9 (conclusions and recommendations) highlights priority areas for G20 governments seeking to undertake reforms of fossil fuel production subsidies, and Whitley and van der Burg (2015) provide guidance for those seeking to undertake those reforms.

The barriers to subsidy reform are often reinforced through links between subsidies to producers and consumers, with governments needing a lot of 'fiscal space' to provide fossil fuel subsidies to consumers. The obvious source for such expenditure in the period of high commodity prices was the resource rent from fossil fuels. Indeed, resource-rich countries tend to have higher consumer subsidies, and people's feeling of entitlement to low fossil fuel prices can be quite common in these countries (Segal, 2012). This creates a vicious cycle by enabling extractive companies to ask for more tax breaks and other benefits in return for continuing to generate resource rent for governments. However, the causality here can be difficult to establish: is it resource endowment that leads to higher energy subsidies, or is it the energy subsidies that create the feeling of entitlement? (Cheon et al., 2013). Anecdotally, one factor that appears to be influential in Indonesia's decision to finally drop gasoline subsidies at the turn of 2015 is the increasing awareness of the depletion of the countries' resource base.

Perhaps an even more interesting development is the start of fossil fuel consumption subsidy reform in oil- and gas-producing countries in 2014 and 2015 as the world oil price dropped and as resource rents simultaneously declined in government budgets. The oil price decrease has certainly facilitated fossil fuel consumer subsidy phase-out in around 30 countries in 2014 and 2015 (Merrill et al., 2015). At the same time, fossil fuel-extracting companies in the UK, Netherlands and Canada have increased their pressure on governments by asking for more tax breaks and other support to help them 'remain competitive' (Healing, 2015; Willems, 2015; Macalister, 2015).

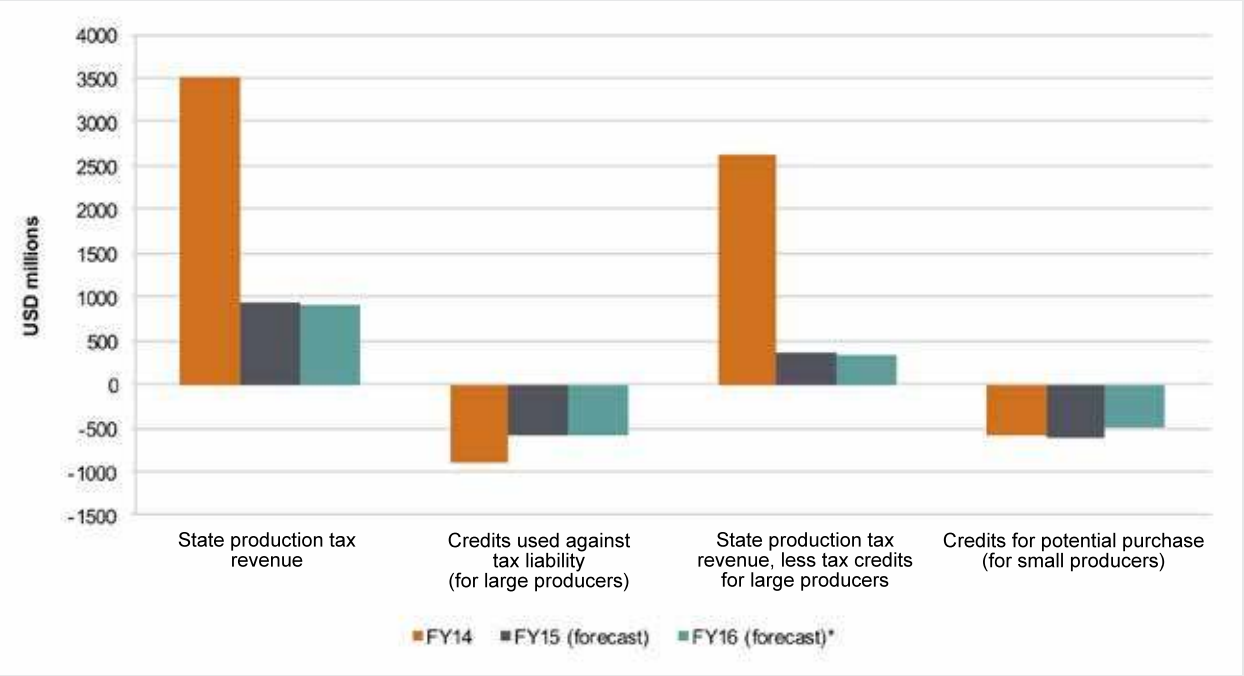
Source: Ivetta Gerasimchuk and Lucy Kitson, Global Subsidies Initiative

Box 10. Perverse outcomes from production subsidies in Alaska

Alaska's budget troubles made headlines in 2015, with a sharp drop in oil prices driving the state into a dire financial situation (Associated Press, 2015). In the midst of Alaska's budget woes, subsidies to fossil fuel producers also attracted attention, with the state expecting to pay out more to oil and gas companies in production tax incentives than it was due to take from production taxes in fiscal years 2015 and 2016 (Figure 16).

Alaska's oil and gas production tax system gives credits to large producers that reduce their overall liabilities, as well as handing out credits to small producers. In the case of small producers, these credits are allowed to exceed a producer's total tax liability, and the amount in excess of the tax liability may then be paid out by the state. In this case, it is possible for the state to spend more money on all oil and gas production taxes – across both large and small producers – than it takes in tax revenue for a given year. This is not to say that Alaska's net income across all oil and gas revenues, including royalties and corporate taxes, will be negative for the fiscal years 2015 and 2016. However, the production tax, intended as a revenue tool, has become a net loss to the Treasury as a function of the level of tax credits available and the low oil and gas price.

Figure 16. Alaska's revenue balance from oil and gas production taxes and credits (2014–2016)



**Includes adjustment for Governor's budget veto that lowered ceiling on credits for potential purchase from $700 million to $500 million for FY16.*

Source: Adapted from OCI analysis using data from Alaska Department of Revenue (2015).

Alaska's most recent official revenue forecasts from April 2015 projected that the state will pay out $442 million more in production tax credits than it will take in during 2015 and 2016 (Alaska Department of Revenue, 2015). This amount takes into account a July veto by Alaska Governor Bill Walker that effectively capped one subsidy at $500 million for 2016, rather than the original $700 million that was expected, although Governor Walker has characterised this as a deferral of subsidy payments rather than an actual reduction in subsidies. If those subsidy payments are simply deferred, as Governor Walker has indicated (Gutierrez, 2015), that would put Alaskans' total net loss on oil and gas production taxes at more than $640 million for 2015 and 2016 (Gara, 2015), at a time when state finances are already under immense pressure.

While this outcome has spurred political debate on Alaska's oil and gas tax regime, the state's oil and gas production tax illustrates how subsidies can turn what was intended to be an overall revenue-generating tax regime into a windfall for companies.

8.
Country summaries

Image: Bernice 1 and 2 wells, Evanson Place, Arnegard, North Dakota, United States. Tim Evanson, 2013.

Country summaries

The findings on national subsidies, state-owned enterprise investment and public finance for fossil fuel production are based on desk-based studies that were completed for each of the G20 member countries. Links to the full Country Studies and accompanying Data Sheets can be found in Appendix 1. The following section summarises these more detailed country studies.

Argentina

Argentina is one of the largest producers of natural gas and crude oil in Latin America. However, declining production coupled with growth in consumption led in 2011 to the country becoming, for the first time since 1984, a net importer of energy (Borderes and Parravicini, 2014; Fin24, 2013). The country holds modest proven conventional reserves of oil and gas (0.1% and 0.2% of the global total, respectively). The current focus is on (unconventional) shale gas and oil deposits, which are the second and fourth largest in the world, respectively (Stafford, 2014; Fossett, 2013). Exploring and developing these reserves is costly: it is estimated that the development of the country's largest formation (Vaca Muerta) will require anything from $70 billion to $200 billion in investment over the coming decades (The Economist, 2013; Gonzalez and Cancel, 2014).

The formerly privately owned oil company Yacimientos Petrolíferos Fiscales (YPF) was partially renationalised in 2012, meaning that the government can now lead exploration and production activity in the country. The government is aiming to support this activity through a recent $2 billion line of credit that has been set up solely to benefit state-owned fossil fuel producers (Ministerio de Economía y Finanzas Públicas, 2013). However, as it is unable to finance all of the development domestically, the government has also introduced considerable incentives for international fossil fuel producers to invest in exploration and development.

National subsidies include significant tax breaks for exploration and production activities, price supports for suppliers and a number of budgetary transfers. These transfers include large one-off payments, like compensation for the renationalisation of YPF as well as bonus payments for producers of oil, gas and refined products, and capital investments in fossil fuel infrastructure. The total annual national subsidies identified averaged $2.2 billion per year in 2013 and 2014.

Several national SOEs have a mandate to explore for and produce fossil fuels in Argentina. However, YPF is by far the dominant player. As well as attracting international investment via joint ventures, YPF invested heavily in exploration and production of oil and gas as well as operating approximately half of Argentina's refining capacity. Although it was not possible to fully disaggregate investment in fossil fuel production, SOEs were found to have made investments in coal mining, fossil-powered electricity, and the distribution of gas and power. An annual average of $8.2 billion in investment by SOEs in fossil fuel production was identified in 2013 and 2014 (including the one-off $5 billion payment transferred to Repsol for the expropriation of YPF).

An annual average of $2.1 billion in public finance for fossil fuel production was identified in 2013 and 2014, largely for domestic finance. Soon after renationalising YPF, a $2 billion Argentinian Hydrocarbons Fund was established in 2013 by the Ministry of Economy and Public Finance to provide support to fossil fuel companies in which the government has some level of ownership. The government also provided finance averaging $1.1 billion per year for the construction of gas trunk transmission lines and two fossil-fuelled power plants.

Internationally, the country's 100% state-owned Banco de Inversión y Comercio Exterior (BICE) makes medium- and long-term investments and provides export finance to domestic companies, though less than $10 million annually could be identified as potentially supporting fossil fuel production (as it went to went to 'Gas/Oil/ Plást' (plastics)) (BICE, 2014a, 2014b, 2014c, BNAmericas, 2014). Argentina also provided $33 million on average annually in public finance for fossil fuel production in 2013 and 2014 through its shares of multilateral development banks.

Australia

Until recently, Australia was leading the largest effort, among the OECD countries, to expand coal and natural gas production. Australia has the fourth largest coal reserves in the world, and is the world's fourth largest coal producer and second largest coal exporter (EIA, 2014). Though not historically a major oil and gas producer, drilling operations have expanded into new offshore areas – especially off the northwest coast – in recent years, significantly boosting reserves and production of gas in particular. Expansions through Gladstone in Queensland have also seen three major LNG terminals built, exporting LNG derived from coal seam gas.

In 2013 and 2014 the Australian federal government approved an extensive build-out of fossil fuel infrastructure, including massive coal mines in Queensland and the Abbot Point coal export terminal which would send ships out through the Great Barrier Reef. At the same time, the government led the repeal of the country's carbon tax, in place since 2012. Australian companies have also received billions of dollars in finance from foreign governments to develop LNG fields, largely from coal seam gas. Japanese public finance institutions are by far the largest financer of these projects.

Investment in fossil fuel exploration, extraction and electricity production in Australia are supported by an average of $5 billion in national subsidies annually. The mining industry receives most of these benefits through tax breaks for fuel and capital investment costs. Previously, major

national subsidies to electricity producers were also provided through direct transfers from the Energy Security Fund and through loopholes in the carbon price scheme. These subsidies are no longer in place due to the carbon tax repeal.

In addition to national subsidies, Australia's public finance for fossil fuel production averaged $262 million per year between 2013 and 2014. This includes domestic and international financing via Australia's export credit agency, the Export Finance and Insurance Corporation (EFIC), and public finance for fossil fuel production through shares in multilateral development banks.

Most of Australia's fossil fuel companies are majority privately owned (with the exception of the electricity sector, where many state-owned enterprises are active at the sub-national level). Despite billions in annual public support, private fossil fuel producers are losing money through their investments in Australia. Several individual oil and gas companies lost several billion dollars from their operations in Australia in 2013 and 2014, with multinational corporations posting some of the largest losses. Chevron – also the largest oil and gas reserve holder in Australia – lost the most ($19.3 billion) (Rystad, 2015).

Private investors have also shown their unwillingness to invest in Australia's coal industry – major investors have withdrawn from the Indian company Adani's planned Carmichael coal mine, due to be the largest mine developed in Australia, and several commercial banks have ruled out funding the Abbot Point coal terminal expansion over environmental concerns. According to the head of the Queensland Resources Council, almost half of Queensland's coal is produced at a loss, and many mines are 'still open only because of "take-or-pay" agreements with rail and port operators which lock them into paying haulage charges for coal, regardless of whether or not they ship it' (Saunders, 2015).

Brazil

Brazil is endeavouring to establish itself as a major oil-producing country. Brazil's proven oil and gas reserves increased substantially in recent years due to advances in deep-water drilling and the discovery of the pre-salt oil fields (very large deposits trapped below 2 km of salt under the seabed, several hundred kilometres off Brazil's southeast coast).

Brazil's oil and gas industry is dominated by the SOE Petrobras, which is leading development of the pre-salt fields, and which invests heavily in oil and gas production in the country and overseas.

Over 2013 and 2014, Petrobras invested an average of just over $41 billion annually, more than half of which was dedicated to fossil fuel exploration, extraction and production (Petrobras, 2014: 44; Petrobras, 2015: 13). However, concerns about the firm's level of indebtedness and fall-out from a recent corruption scandal have led Petrobras to scale back its investment plans and divest from low-priority areas (Petrobras, 2015) (see also Box 6).

In addition to its wider role as an SOE, the government supports Petrobras with public finance (concessional loans) through the national development bank BNDES, and through national subsidies that benefit the industry.

Also, although fossil fuels provide only 6.5% of the country's electricity, the largest budgetary transfer (national subsidy) that supports fossil fuel production is attributed to the Fuel Consumption Fund (CCC). Across 2013 and 2014, this transfer, which specifically provides support to electricity generators for fuel purchases (OECD, 2014), was estimated at an annual average of $1.7 billion (Eletrobras, 2013).

Brazil's tax code also includes many exemptions and reductions that support various stages of fossil fuel production, including support to R&D.

The total amount of national subsidies to fossil fuel production via tax expenditures and direct government spending (that can be quantified) averaged just under $5 billion annually between 2013 and 2014. However, this figure is likely to be an underestimate, as there are many subsidies to fossil fuel production in Brazil that cannot be quantified due to the lack of publicly available information. As it is, this figure does not account for expenditures associated with more than half of the tax incentive programmes nor several direct spending programmes that clearly benefit fossil fuel production.

Brazil's national development bank, BNDES, is by far the country's largest public finance institution and, in addition to its support for Petrobras, provides significant support to domestic and international fossil fuel production, including several programmes that directly target oil and gas. The state-owned Banco do Brasil also finances oil and gas production domestically. In 2013 and 2014, Brazil financed gas pipelines in Argentina through BNDES along with supporting fossil fuel production through its shares in multilateral development banks. Altogether, public financing for fossil fuel production averaged $3.2 billion annually (not including public finance for Petrobras).

Until recently Petrobras had been required to limit consumer prices, in addition to its support for fossil fuel production, resulting in significant costs to the company. In 2015, subsidies that reduced consumer prices for electricity were brought to an end, and many other preferential tax rates are under review (Glickhouse, 2015).

Canada

Canada is one of the world's largest energy producers, with significant resources of conventional and unconventional oil, natural gas and hydroelectricity. In 2013, oil production was 4 million barrels of oil equivalent per day, more than four times the production a decade ago. Half of the oil production is from tar sands, notably those in the province of Alberta. Natural gas production, by

contrast, has declined in recent years as a result of resource depletion, and stood at 6.3 trillion cubic feet in 2013. Nonetheless, Canada remains one of the top five producers of dry natural gas, and there is potential to increase exploitation of unconventional reserves. Coal production has increased slightly over the past 10 years, but whereas 10 years ago Canada consumed its entire coal production, today more than half of the coal is exported – a result of declining domestic demand.

Total national subsidies to fossil fuel production averaged $2.7 billion per annum over 2013 and 2014, with federal subsidies accounting for $1.6 billion of this. Most of the identified measures benefit oil and natural gas production upstream, providing tax breaks to exploration activities, field development and extraction. At the provincial level, tax breaks amount to a minimum of $979 million annually, mostly delivered for oil and natural gas exploration activities as relief on royalties by the provinces of Alberta and British Columbia.

With regard to direct spending, the Canadian government provided Saskatchewan's electricity provider, SaskPower, with $226 million in grants for the refurbishment, retrofitting and development of CCS between 2011 and 2014 (SaskPower, 2015, 2014, 2013, 2012). An SOE at the provincial level, SaskPower also invested heavily in this CCS project. Another province, Alberta, spent an annual average of $103 million on two CCS projects as well (Energy Alberta, 2014). The Canadian government will invest a total of $156 million in these two projects over their implementation phase (Natural Resources Canada, 2013).

In recent years, Canada has phased out a number of measures, directly linking this to the 2009 commitment at the G20 Leaders' Summit to phase-out inefficient fossil fuel subsidies. Notably, the Atlantic Investment Tax Credit (AITC) will be completely phased out as of 2016 (Department of Finance Canada, 2014; Sawyer and Stiebert, 2010),[16] while the Accelerated Capital Cost Allowance (ACCA) for tar sands projects has also been completely removed as of 2015. However, major subsidies to fossil fuel production persist and new subsidies are also being added, including an ACCA measure for LNG projects and tax deductions for mandated environmental studies and community consultations.

Beyond national subsidies, Canada also provides a significant level of public finance for fossil fuel production both domestically and internationally. Finance for fossil fuel production through Export Development Canada (EDC), Canada's export credit agency, averaged at least $2.5 billion per year in 2013 and 2014, and may be significantly higher.

China

China was the world's largest consumer of energy in 2013 and 2014, averaging 23% of the global total, with coal providing two thirds of the total energy the country consumed (BP, 2015). Coal absolutely dominates both energy production and consumption in China. Conventional oil and gas is produced on- and offshore while unconventional coal-bed production from shale gas and coal-bed methane is increasingly produced onshore.

The production of fossil fuels in China is dominated by SOEs, which are closely tied to the government. The country is undertaking fundamental reforms to its energy sector, including opening up the oil and gas sector to private investment, while the state seeks to consolidate the primarily publicly owned coal industry.

In spite of these reforms, government support for fossil fuel production remains among the highest levels across the G20. Unfortunately, because of limited public disclosure, where we have been able to identify Chinese subsidies to fossil fuel production we often could not quantify them.

Despite these limitations, our analysis suggests that the most significant national subsidies are provided by the central government. Examples include direct budgetary transfers to support coal production and oil and gas exploration, which are detailed in government accounts alongside transfers to fossil fuel-producing companies. Further national subsidies to fossil fuel production include those applied to the wellhead prices[17] for unconventional fuels like shale gas and coal-bed methane, discounted costs for transporting coal and government funding for research into carbon capture and storage. In addition to direct spending, the tax regime also provides a large number of support mechanisms with tax breaks and fee waivers in place for a number of fossil fuel production activities. Taken together, identified national subsidies amounted to an annual average of just over $3 billion in 2013 and 2014. The estimates of national subsidies exclude direct support provided to SOEs in order to avoid double counting.

Particularly in the oil and gas industry, SOEs have monopolised fossil fuel production in China where vertical integration across the production chain allows for SOEs to cover the financial losses resulting from centrally regulated prices. Although the bulk of coal and coal-fired power in China is also produced by SOEs, a much larger number of sub-national SOEs (provincial and local) are involved in this sector (Leung et al., 2014; Wang, 2014). The large SOEs in China (in oil and gas, coal and fossil fuel-based power generation) are responsible for significant investments in fossil fuel production, both domestically and overseas, often in collaboration with state-owned banks and public finance institutions. In a number of cases,

16 Finance Canada provides data on the cost of AITC. Although these are not disaggregated between sectors benefiting from the measure – such as agriculture and logging – it is estimated that half of the tax breaks were allocated to the oil and gas sector under AITC (Sawyer and Stiebert, 2010).

a lack of publicly available information prevents fully separating SOE investment in fossil fuel power production from wider power generation investments. Nonetheless, our conservative estimate is that the expenditure by the national level Chinese SOEs on fossil fuel production averaged at least $76.5 billion annually in 2013 and 2014.

Although information on China's domestic public finance for fossil fuel production was limited, our review of project-level financing at seven Chinese state-owned banks uncovered only one domestic project not financing a major SOE, with loans from China Export Import Bank and China Development Bank totalling an annual average of $91 million in 2013 and 2014. In addition, the banks we reviewed were found to have provided $16 billion per year on average in international public finance for fossil fuel production in 2013 and 2014. Investments in oil and gas projects involving exploration and production, transportation, storage, processing and refining were responsible for more than three quarters of the total with the remainder invested in coal projects including mining, transportation and combustion. The estimates of public finance exclude direct support provided to SOEs in order to avoid double counting.

China also provided an additional annual $152 million to fossil fuel production in 2013 and 2014 through its shares in multilateral development banks.

France

Since 2012, France has been pushing forward with an Energy Transition which focuses on reducing fossil fuel use, lowering energy demand and increasing the share of renewables in the energy mix while simultaneously reducing the share of nuclear generation (République Française, 2015).

In line with this focus on a sustainable energy system, France has made a series of commitments supporting the phase-out of fossil fuel subsidies. In April 2015, France became the first country outside the Friends of Fossil Fuel Subsidy Reform group to endorse a communiqué committing to phase-out subsidies (RFI, 2015). This commitment has been echoed in practice by the phasing-out of a number of subsidies and support mechanisms in recent years, most recently the support given to public finance institutions for coal-fired power stations overseas. In October 2015 the government also announced that the minority state-owned utility ENGIE (formerly GDF Suez) would cease its investments in coal as a result of the French government's policy to end subsidies to coal (Le Figaro, 2015).

However, the French state still provides support to fossil fuel production. At the domestic level, excise exemptions continue to exist for fossil fuels used in refining and co-generation. Phasing these out would give further credibility to the government's public commitment on fossil fuel subsidy reform. National subsidies to fossil fuel production were estimated to be $125 million per year on average in 2013 and 2014.

In addition, France continues to support fossil fuel production internationally, first through its majority shareholding in Electricité de France (EDF), which undertakes electricity generation from coal in Europe and Asia, as well as upstream oil and gas activities and gas infrastructure projects. While minority state-owned ENGIE will withdraw from its coal-based projects, it will continue to engage in other fossil fuel-based projects. Second, while French public finance institutions will no longer support coal-fired power projects that are not CCS-equipped, these institutions continue to support projects involving fossil fuel production, including exploration activities and fossil fuel-based electricity distribution. France's international public finance for fossil fuel production is estimated at an annual average of $518 million in 2013 and 2014 via its export credit agency COFACE. Public finance for fossil fuel production through multilateral development banks averaged $812 million annually in 2013 and 2014, for a total of $1.4 billion of public finance for fossil fuel production.

Germany

Germany is Europe's second largest primary energy producer and its largest energy consumer (Eurostat, 2015; EIA, 2015). Although historically dependent on coal, Germany's *Energiewende* (energy transition) has resulted in a significant shift in the energy mix, with 28% of primary energy production sourced from renewables in 2013 (Eurostat 2015). However, coal still provides more than 40% of Germany's electricity with the scale-up of renewables mostly replacing phased-out nuclear capacity. Domestic oil and gas production in Germany from conventional sources is relatively limited though the nation has significant refining capacity. Shale gas activities in Germany have been limited to date. However, an emerging legal framework seems to be designed to enable shale gas exploration (reserves are estimated at 0.7 to 2.3 billion cubic metres), with extraction potentially beginning by 2019 (Nelsen, 2015). As the legislative process is still under way, it is uncertain whether this will happen.

Domestically, the German government has committed to phasing out national subsidies to its hard coal mining industry, with subsidies to hard coal and lignite cumulatively estimated at $538 billion between 1970 and 2014 (Bmf, 2014). National subsidies that have been deployed to support the phase-out of the wider support for coal amounted to an estimated $1.6 billion in 2014 (ibid.). Ongoing subsidies to fossil fuel production, in the form of tax breaks for mining companies and energy producers, and budgetary spending on mine rehabilitation and related R&D, came to a little under $1.1 billion (Küchler and Wronski, 2015; Bmf 2014). In sum, Germany's national subsidies to fossil fuel production averaged $2.8 billion annually between 2013 and 2014.

Internationally, Germany continued to finance fossil fuel production through its export finance bank KfW IPEX, the development finance agency KfW Entwicklungsbank, the KfW subsidiary DEG, and the trade credit insurance company, Euler Hermes. Unfortunately, such financing in Germany is deeply opaque. Bearing in mind that this is likely an underestimate, our analysis finds that Germany's international public financing for fossil fuel production averaged nearly $2 billion annually in 2013 and 2014, in addition to public finance for fossil fuel production through multilateral development banks, which averaged $850 million annually in 2013 and 2014.

In December 2014, the German government amended its policy on international public finance for coal-fired power plants. While development finance through KfW Entwicklungsbank will no longer be available for the construction of new coal-fired power plants or the upgrading of decommissioned coal plants, private export finance through KfW IPEX (the bulk of current support in this sector) and credit guarantees through Euler Hermes may continue to provide support to such projects (Neuwirth, 2015; KfW, 2015). In terms of phasing out government support for fossil fuel production, although efforts to move away from national subsidies to the domestic coal industry are progressing, international public finance for a sub-set of coal projects and wider fossil fuel production is likely to continue.

The majority of Germany's fossil fuel sector is privately held, although there are a number of electricity suppliers owned by municipalities. The majority of support identified was targeted at the private sector, specifically the hard coal and lignite mining industries, where the dominant players are owned by RAG Aktiengesellschaft (Germany) for hard coal and RWE (Germany) and Vattenfall (Sweden) for lignite. Support for energy inputs is likely to benefit oil refiners, an industry dominated by Shell (Netherlands), ExxonMobil (US), Petróleos de Venezuela S.A. (Venezuela), and BP (UK).

Oil and gas production is concentrated among five companies with three quarters of total production controlled by ExxonMobil (United States), Shell (Netherlands), and LetterOne Group (Luxembourg). The primary electricity suppliers in Germany are EnBW (which is 98% owned by municipalities), RWE (which is 15% owned by municipalities), E.ON (private), and Vattenfall (which is owned by the Swedish government).

India

India is the world's third largest coal producer after China and the US, producing 650 million tonnes of coal in 2014. It also produces some oil (982,000 barrels per day in 2014) and gas (1.2 trillion feet per annum). Coal is the main source of energy, comprising 56% of primary energy consumption, followed by oil (28%), natural gas (7%), hydroelectricity (4.7%) and renewables (2.1%) (BP, 2015).

As India continues to develop, its demand for fossil fuels is likely to grow. To mitigate this increase, some recent steps have been taken to reform subsidies to both fossil fuel producers and consumers. Notable examples include the introduction of competitive bidding for coal production following the 'coalgate' scandal (where mining licences were given away free) and the deregulation of petrol and diesel prices. However, alongside investment by SOEs, the government continues to provide support via subsidies and public finance to upstream, midstream and downstream producers of oil, gas and coal, as well as to the electricity sector.

A variety of national subsidies support fossil fuel production. Capital outlay targeting the extraction and production of crude oil, natural gas, coal and the development of fossil-fuelled power projects constituted the largest share of India's national subsidies to fossil fuel production, which were identified as averaging $64 million per year across 2013 and 2014. Other support, in the form of tax breaks for coal excise duties and fossil fuel transport infrastructure, also contributed to this total, averaging $40 million each in 2013 and 2014. However, a lack of publicly available information prevented quantification of the benefits received by fossil fuel producers through tax breaks which allow for expensing of exploration costs and accelerated depreciation of capital R&D costs. India's total national subsidies on average per year were $103 million in 2013 and 2014.

Investment by SOEs in fossil fuel production represented a large portion of overall government support with a number of state-owned industries being involved in the production of coal, oil and gas as well as transporting and refining oil and natural gas in India. SOE support for upstream oil and gas was dominated by investment by the Oil and Natural Gas Corporation, midstream by Gas Authority of India Limited (GAIL) and downstream by Indian Oil (IOCL), while 90% of coal produced in India is produced by Coal India Limited (CIL). Annual expenditure on fossil fuel production by these and other SOEs amounted to nearly $15 billion on average in 2013 and 2014.

Indian state-owned banks provided an annual average of $1.5 billion in domestic public finance for fossil fuel production over 2013 and 2014, with the large majority

17 Wellhead price: the price, less transportation costs, charged by the producer for petroleum or natural gas (Merriam Webster, 2015).

of this going to coal-fired power plants. Internationally, 10 individual loans from Indian public finance institutions and state-owned banks averaged $388 million annually in finance for fossil fuel production over 2013 and 2014. In addition to support to fossil fuel production through multilateral development banks ($149 million average per year in 2013 and 2014), the government also provided guarantees for loans provided by those banks to CIL, as well as to coal-fired power projects. Further support occurs through schemes like the National Electricity Fund to encourage investment in electricity distribution projects and the Power System Development Fund to increase use of gas-based power generation capacity.

Indonesia

Indonesia is a major producer of oil and gas, although production has declined in recent years as a result of maturing fields. In turn, this has given rise to increased pressure to incentivise new production. Domestic production of coal is high, with Indonesia ranking as the world's top exporter, but production has also fallen recently. Extractives represent a significant share of Indonesia's wealth, contributing 25% of all government revenues in 2014.

The Indonesian government's share of oil and gas profits is among the highest in the world, but in the face of declining reserves the government has established a number of policies that promote oil and gas exploration and extraction. Due to limitations in publicly available data, it has not been possible to estimate many of Indonesia's national subsidies. The majority are tax breaks, estimated in previous years to be worth several hundred million dollars per year. One potentially significant policy is the form of the government's 'cost recovery' payments, in which Indonesia reimburses companies for all operational costs of oil production. These payments, worth $16.3 billion in 2014, are intended to reimburse private companies for the fact that the government assumes ownership of their capital upon commencing a project. Insufficient data are available to determine whether the transfers provide a net benefit or loss to private producers.

Capital expenditure from the state-owned oil and gas enterprises, PT Pertamina and PT PGN, averaged $6.9 billion per year between 2013 and 2014.

Other oil and gas sector subsidies were identified but, rather than promoting exploration and production, their purpose was to promote the interests of domestic institutions. The most significant of these policies, the Domestic Market Obligation (DMO), requires all oil producers to send a share of production to the state-owned oil company PT Pertamina at a price substantially below the market level. In addition, local content requirements exist. The government is currently discussing revisions to Indonesia's Oil and Gas Act and a number of proposals suggest further measures to favour domestic operators. Such policies may actually increase the costs of fossil fuel production, assuming that domestic suppliers of goods and services require preferential treatment in order to compete with international counterparts.

Domestically, Indonesian coal mainly serves power generation, which consumed 55 million tonnes in 2013 (Ministry of Energy and Mineral Resources of the Republic of Indonesia, 2014). Support for coal appears to exist on both the supply and demand side. President Joko Widodo recently announced an initiative to build 35 GW of new power generation capacity by 2019, of which more than 60 per cent would be coal-fired. This effectively guarantees a future market for domestic producers. In addition, public finance appears to have facilitated investments in coal power plants, as well as ports and railways, to allow for increased coal production, although the exact scale and nature of this support is hard to determine. On the demand side, a DMO exists on coal, requiring coal producers to provide a share of their coal production to domestic consumers. This policy does not appear to provide coal at below-cost, but does aim to help promote a domestic coal market for energy security reasons.

It is clear that significant volumes of Indonesian public finance are invested in fossil fuel production but it is difficult to determine specific levels of support. Domestically, only one transaction, $87 million of financing from Bank Mandiri for the Medco Senoro gas facility, was identified. Internationally, Indonesia's contributions to the MDBs translate to $78 million in finance for fossil fuel production annually.

As in many countries, estimating the value of Indonesia's subsidies for fossil fuel production is fraught with difficulty due to low transparency and areas where data are missing or unclear. It is not possible to quantify all identified subsidies and further work could usefully be conducted to better isolate and understand the full range of subsidies for fossil fuel exploration and production.

Italy

While not a major fossil fuel producer, Italy's energy system is highly fossil fuel-dependent, deriving 88% of its energy from fossil fuel sources (OECD, 2014).

In order to keep energy prices low for targeted sectors and users, and to stimulate fossil fuel exploration and development, Italy has several incentive regimes that support fossil fuel production. These quantifiable national subsidies took the form of excise tax reductions for fossil fuel-based electricity production on small islands. In addition to these quantifiable subsidies, Italy provides several other support measures for which data were not available. These include a low royalty regime that provides royalty relief and reductions for various levels and types of fossil fuel production, VAT deductions for specific types of fossil fuel use (for electricity production) and support to an offshore regasification plant.

In addition to direct spending and tax breaks, the state-owned Gestore dei Servizi Energetici (GSE) in Italy is responsible for the implementation of law CIP6/92, under which billions have been paid out to electricity generation using fossil fuels. Although it has since been repealed, the 'assimilated sources provision' of the law provides support to energy generation through energy and waste recovery. These 'assimilated sources' include cogeneration plants, which combine the production of electrical and thermal energy; heat recovery; and waste fumes and other types of recoverable energy from processes and equipment. Approximately one third of assimilated sources energy is fossil fuel-based. GSE is required to purchase electricity from these plants at above-market prices. GSE then resells the energy at lower prices in the national markets. Including payments by GSE, in 2013 and 2014 Italy's national subsidies to fossil fuel production were $1.2 billion per year on average.

The Italian government provided an average of $1.5 billion annually in international public finance for fossil fuel production in 2013 and 2014, through equity investments and acquisitions in oil and gas companies by state-owned bank Cassa Depositi e Prestiti and export credit guarantees offered by Servizi Assicurativi del Commercio Estero. Italy also contributed an annual average of $757 million to fossil fuel production globally in 2013 and 2014 through its shares in multilateral development banks.

While neither a large coal producer nor consumer, Italy has also been investing in investigating carbon capture and storage related to coal production and energy generation.

Japan

Despite its own limited domestic fossil fuel resources, the Japanese government is among the largest supporters of fossil fuel production (especially coal) in the G20. Following the Fukushima disaster in 2011, most of Japan's nuclear power plants remain closed, having previously accounted for about 30% of electricity generation. Fossil fuels now account for about 90% of power production in Japan. While electricity sector deregulation is expected to take full effect in 2016, Japan's power sector is currently dominated by regional utility monopolies, which produce mostly fossil fuel electricity. Many of these utility companies have recently refused to enter into new solar power purchasing contracts, while at the same time dozens of new coal power plants are currently planned for the country.

Domestically, Japanese private companies Japex and Inpex are the only oil and gas producers with significant capital expenditures in Japanese operations, respectively averaging $132 million and $92 million annually. Due to the shortage of fossil fuel resources within Japan, many national fossil fuel production subsidies support oil refining and marketing. Some subsidies also support exploration for resources in waters off Japan's coast and abroad. In total, Japan's national subsidies for fossil fuel production averaged $736 million per year in 2013 and 2014.

However, Japan's role in spurring fossil fuel production internationally through public finance makes the country's domestic national subsidies seem small by comparison. Japan is the largest G20 country in terms of public support for fossil fuel production through public finance, averaging just over $19 billion per year in 2013 and 2014. Only $351 million of that finance was for domestic fossil fuel production, while $18.2 billion went to projects internationally via Japan Bank for International Co-operation, Nippon Export and Investment Insurance, Japan Oil Gas and Metals National Corporation, Development Bank of Japan, and Japan International Cooperation Agency. A further $440 million annually went to finance fossil fuel production via Japan's shares in the multilateral development banks.

The Japanese government, joined by Australia and Korea, are among the few OECD countries that continue to explicitly defend broad public financing of coal-fired power plants (Dixon, 2015). While coal finance bans have taken effect across many multilateral development banks, export credit agencies, and bilateral institutions, Japan continues to provide finance not only for coal mining (largely to secure coal for power plants in Japan), but also the construction of new coal power plants abroad. In 2013 and 2014, Japan financed an average of $2.8 billion annually in coal projects. Further, Japan has recently even claimed about $1 billion in coal power finance as part of its climate finance contributions (Associated Press, 2014).

Korea

The Republic of Korea has limited and declining oil, gas and coal reserves, yet is a major energy consumer, ranked as the ninth largest primary energy consumer in the world. As a result, Korea relies on imports for about 96% of the energy it consumes (KEEI, 2014).

Averaging $217 million per year in 2013 and 2014, Korea's national subsidies to domestic fossil fuel production are relatively low compared to other G20 countries. One of the largest remaining subsidies, $149 million annually in support for coal briquette production, is due to be phased out by 2020.

In terms of domestic fossil fuel industries, Korea's coal, oil, gas and electricity production industries are mostly controlled by a handful of SOEs. The Korea National Oil Corporation (KNOC) reported approximately $2.1 billion in capital expenditures in 2013, the most recent year for which data were found, and Korea's mid- and downstream gas-focused state-owned enterprise, Korea Gas Corporation (KOGAS), reported $2.9 billion in capital expenditure in 2014 (KNOC, 2014; KOGAS, 2014).

For electricity production, state-owned KEPCO's supply mix is about 70% fossil fuel-based. In addition to Korea's significant domestic energy production, KEPCO

owns Australian coal mining assets and has also built and operated coal-fired power plants in a number of countries around the world, with its most recent winning bid a 1,200 MW capacity coal plant in Viet Nam (KEPCO, 2014).

Total SOE investment in fossil fuel production in Korea averaged $11.6 billion per year between 2013 and 2014, with the majority – $6.1 billion – coming from KEPCO's investments in fossil fuel-fired electricity generation facilities.

Korea's main channel for supporting fossil fuel production comes through its international public finance, as well as its SOEs. Korea's public finance institutions provided an average of at least $10 billion per year in 2013 and 2014 to fossil fuel production, primarily through the export credit agencies Export-Import Bank of Korea (KEXIM) and Korea Trade Insurance Corporation (K-sure). Support to coal-fired power plants averaged $1.2 billion per year over the two-year period 2013 to 2014, and Korea's public finance institutions approved transactions in 2013 and 2014 that will support the development of more than 3.8 GW of new coal-fired electricity generating capacity overseas.

Korea has not indicated that it plans to place any restrictions on the provision of public finance for fossil fuels internationally, despite the establishment of restrictions on international finance for coal projects by a number of other countries. In ongoing discussions among OECD countries to establish limits on international coal finance, observers cited Korea as one of the major blockers in reaching any agreement (Mathiesen, 2015). This contrasts with Korea's role as host of the Green Climate Fund and the Global Green Growth Institute, among other major sustainability-focused institutions. In October of 2015, Korea's government committed to work together with the United States to 'achieve an ambitious outcome' in the OECD to limit export credit finance for coal-fired power plants, but the results of this commitment remain to be seen (The White House, 2015).

Mexico

Although Mexico is one of the largest oil producers in the world, production has slowed since 2005 as a result of a natural decline of major fields. Production stood at 2.8 million barrels per day in 2014 (EIA, 2015). While Mexico's natural gas reserves are also significant, production stood at 1.6 trillion cubic feet in 2013, and Mexico is currently a net importer (EIA, 2015).

In December 2013, the Mexican government enacted energy reform with the aim of increasing oil production by attracting international private industry players. The new regulations allow other companies beyond the state-owned oil and gas company Petróleos Mexicanos (Pemex) to enter into exploration and production activities, alongside restructuring Pemex's business activities to make it more competitive. With these changes, the government expects to increase oil output to approximately 3 million barrels per day in the long term, and to increase the country's refining capacity and reduce the budgetary burden of the country's fossil fuel consumption subsidies.

In spite of some reforms, Mexico has continued to provide subsidies to oil, gas and coal production. Based on available data, national subsidies to cover labour liabilities in Pemex and the state-owned electricity company Comisión Federal de Electricidad (CFE) amounted to an average value of $1.4 billion per annum in 2013 and 2014. A number of other subsidies relating to tax deductions for spending on exploration and development, and on storage and transport infrastructure, have recently been introduced to encourage new companies to enter the market, but it is too early to quantify the value of these subsidies. One of the new subsidies will allow new oil and gas entrants to deduct 100% of exploration expenditures from their tax liabilities.

Investment by Mexican SOEs in fossil fuel production is significant, with investment by Pemex averaging $27 billion per annum over 2013 and 2014. Figures are not available for investment by CFE related to fossil fuel electricity production.

Mexico also provides domestic public finance for fossil fuels through state-owned banks Banobras and Nafinsa, and internationally through its export credit agency Bancomext. Although data on public finance are not particularly transparent, an average of $421 million in annual domestic public finance for fossil fuel production per annum was identified for 2013 and 2014. No bilateral international public finance for fossil fuel production was identified over this period. However, Mexico provided an annual average of $28 million to fossil fuel production internationally through its shares in multilateral development banks.

Russia

Russia holds significant fossil fuel reserves and was the third largest producer of oil and second largest gas producer globally in 2014 (BP, 2015). In 2014, the revenue from the oil and gas industry ($196 billion) represented more than half of the government's budget revenue and accounted for more than 10% of GDP (MF, 2015). Five companies control more than 75% of Russia's oil production with the state-owned Rosneft alone producing almost 40%. Overall, more than half of oil production is directly controlled by the state (Henderson, 2015).

The vast majority of coal mining in Russia is conducted by private companies, with 16 holding companies now responsible for almost 80% of coal production in Russia (Kuznetsov, 2013; Slivyak and Podosenova, 2013).

Direct spending by the government includes funding for geological and seismic studies to explore and prospect for hydrocarbon resources, and sharing the findings with interested companies for free. Various forms of preferential taxation were also applied to support fossil fuel production in 2013 and 2014. These include the exemption from

or reductions to the Mineral Extraction Tax (MET) for producers of all types of fossil fuels, and reductions in export and customs duties for specific oil fields (MF, 2013, 2015; FCS 2015, 2014). On average in 2013 and 2014, almost $23 billion per year worth of subsidies were provided to the fossil fuel sector in the form of direct budget transfers or tax benefits. In 2015 the government amended the Tax Code affecting the production of fossil fuels. This included the phase-out of exemptions from extractive tax for new conventional fields (which could reduce national subsidies) and changing royalty payments and a range of exemptions and reductions to tax rates in order to stimulate extraction from hard-to-produce reserves, depleted fields and shale formations (which could increase national subsidies).

As mentioned above, SOEs dominate Russia's oil and gas industries. The two largest are Gazprom, which owns the world's largest natural gas reserves, and Rosneft, which is the world's largest government-owned oil and gas company by proven reserves. Both of these companies are vertically integrated and have operations across the oil and gas value chain. They also have large operations in Russia and abroad, while the much smaller Bashneft appears to largely operate domestically. Total investment by these SOEs supporting the production of oil and gas averaged almost $50 billion per year between 2013 and 2014.

Russian state-owned banks and finance institutions also provide significant domestic and international finance for fossil fuel production. Domestic public finance averaged $5.7 billion annually while an average of $846 million was provided for international projects. By far the two largest financiers during 2013 and 2014 were Sberbank and the Russian Development Bank (Vnesheconombank), though finance from Vneshtorgbank (VTB Bank) and the Export Insurance Agency of Russia (EXIAR) was also identified. Russia also contributed an annual average of $118 million to fossil fuel production in 2013 and 2014 through its shares in the European Bank for Reconstruction and Development and the World Bank Group.

Saudi Arabia

Saudi Arabia is the world's largest exporter of petroleum liquids, it has the largest crude oil production capacity and holds 16% of the known global oil reserves (EIA, 2015; Saudi Aramco, 2015). The country also holds the world's fifth largest natural gas reserves but currently produced gas is only used domestically (EIA, 2015). It is also the largest consumer of oil products in the Middle East. The Saudi economy is dependent on oil exports to generate fiscal revenues and, as a result, has slid into a budgetary deficit following the fall in oil prices in 2014 and 2015 (El-Katiri and Fattouh, 2015; IMF, 2015; SAMA 2015a). In an attempt to move away from dependence on selling just crude oil, the most recent five-year plan focuses on linking economic development even more closely with the downstream oil and gas sectors (notably refining and petrochemicals). Although income from crude oil exports fell by 15% in 2014, exports from refined products increased by 22% (SAMA, 2015b).

Oil and gas production are controlled by the entirely state-owned Saudi Aramco. It is the world's largest energy company, and controls pipeline networks and the bulk of refining operations in the country as well as other holding shares in refining operations in Japan, China, Korea, the US and Indonesia (Saudi Aramco, 2015; Forbes, 2015). Although the recent drop in oil prices has slowed expansion, 2014 saw the use of a record number of drilling and production rigs (Atansova, 2015; Reuters, 2015). Substantial capital investments are targeted at maintaining its 12 million barrels per day of oil production capacity, adding 5 billion standard cubic feet per day to its gas production and substantially increasing its oil refining capabilities in the coming years (Saudi Aramco, 2015). Its goal for 2020 is to be 'the world's leading energy and chemicals company' (ibid.).

SOEs dominate many other industries in Saudi Arabia and benefit from subsidies to fossil fuel production. The state-owned Saudi Electric Company (SEC) oversees the almost entirely fossil-fuelled electricity sector as well owning many of the generating units within the network. Saudi Arabia Basic Industrial Chemicals (SABIC) is one of the world's largest diversified chemicals company. These and other SOEs benefit from a range of subsidies to energy and non-energy inputs, which include water, feedstocks and land, among others (US Department of State, 2012; SAGIA, n.d.). The cost of all subsidies (including those to consumers) recognised by the Ministry of Finance was reported as $13 billion in 2013 (Saudi Arabian Ministry of Finance, 2014).

Data detailing national subsidies specific to fossil fuel production were not available. Data availability for SOE investment was also limited, though Saudi Aramco's expenditure on material and contract procurement averaged $45 billion per year across 2013 and 2014 (Saudi Aramco, 2015). Given the company's plans noted above, this amount is presumed to relate almost exclusively to fossil fuel production and run across the full production chain. SEC is also building a number of fossil fuel power stations although no data could be found detailing expenditure in 2013 or 2014.

A number of public finance institutions exist in the country, although information on their domestic and international lending activity to support fossil fuel production was limited. Domestic finance averaging $7 billion annually in 2013 and 2014 was identified from the National Commercial Bank (NCB) and Public Investment Fund, as well as a $13 billion loan in 2014 from the Ministry of Finance to the SEC to help fund its generation projects, which will likely solely benefit fossil-fuel based electricity generation. International public finance from NCB and the Saudi Fund for Development

averaged $132 million annually during 2013 and 2014. An average of $69 million in support for fossil fuel production was also identified through Saudi Arabia's membership of international development banks.

No private companies are directly responsible for producing fossil fuels in the country.

South Africa

South Africa has significant coal reserves, with the country holding 3.4% of global coal reserves and more than 95% of proven reserves in Africa (EIA, 2015). Proven domestic oil and gas reserves are much smaller, and therefore coal dominates South Africa's energy mix, providing 71% of total primary energy consumption. Coal powers 85% of the country's almost entirely state-owned electricity sector (ibid.), and is also transformed into synthetic gas and petroleum fuels that are widely consumed for a multitude of end-uses.

Private companies produce the majority of South Africa's coal, while the state-owned PetroSA is heavily involved in the exploration and production of oil and gas. Exploration is particularly concentrated offshore and in the country's onshore shale regions (reportedly the eighth largest in the world (EIA, 2015), although PetroSA also holds foreign exploration and production rights. The onshore shale gas blocks primarily belong to foreign companies such as Falcon, Bundu and Shell.

As well as directly funding some exploration and production activities, the South African government provides significant incentives to investment in exploration and production of oil and gas with 'super' tax breaks for exploration, production and R&D associated with the oil and gas sector. As publicly available information was not available for the majority of national subsidies identified in South Africa, the quantifiable total of approximately $20 million on average per year in 2013 and 2014 is likely to be an underestimate. In order to avoid double counting, Eskom's activities in fossil fuel production are captured under SOE investment below, and not in national subsidies.

SOEs dominate fossil fuel transport and electricity generation in South Africa, in addition to being active in the upstream oil and gas sector. Here, Transnet are building the new Durban–Johannesburg pipeline while Eskom are adding 9.6 GW of coal-fired power generation. However, for both companies, a lack of detailed data prevented quantifying SOE investment directly linked to fossil fuel production. Eskom's capital expenditure, net of non-fossil fuel generation and distribution infrastructure, averaged $4.6 billion between 2013 and 2014. Altogether, an annual average of $5.4 billion of SOE investment in fossil fuel production infrastructure was identified between 2013 and 2014.

South Africa's domestic and international public finance for fossil fuel production averaged $425 million per year in 2013 and 2014. More than three quarters of the total was for downstream oil and gas activities, primarily for natural gas-fired power plants. Of the projects identified, about $70 million per year went to domestic finance for fossil fuel production, while $322 million went overseas, with South Africa providing an additional $33 million in public finance for fossil fuel production via its shares in multilateral development banks.

Turkey

Turkey is currently heavily dependent on imports of coal, and even more dependent on imports of gas. This import dependency, coupled with recent large gas discoveries by nearby countries offshore in the east Mediterranean deep marine basin, has seen Turkey embark on an intensified oil and gas exploration programme, accompanied by subsidies for producers.

Turkey's current energy strategy involves a continued rapid expansion of coal-fired generation and coal production. As a result, Turkey is promoting the construction of more coal plants than any other OECD country – with more than 65 GW of capacity proposed, planned or under construction (Shearer et al., 2015). Recently, however several plants have been cancelled or put on hold due to difficulties in obtaining financing.

The expansion of coal in Turkey is particularly problematic from a climate change perspective, since most domestic coal is lignite, which has the highest level of emissions. If all the currently planned coal plants were to be built, Turkey's greenhouse gas emissions would grow by an estimated 94% by 2030 (BNEF, 2014). Support for coal also continues despite recent analysis indicating that it would cost roughly the same to build up and operate Turkey's electricity system through either renewable energy or fossil fuels (WWF Turkey and BNEF, 2014).

Turkey's national subsidies for fossil fuel production averaged at least $627 million annually between 2013 and 2014. However, data were not available for several known subsidies, suggesting that the value of national subsidies may be much higher. Many of these subsidies are directed at coal.

Among the largest national subsidies is a set of tax breaks in Turkey's 2012 New Investment Incentives Regime, although a lack of publicly available information means it is not yet possible to quantify these subsidies reliably. One calculation indicated that these exemptions could amount to as much as $11.6 billion between 2012 and 2030 for coal-fired power plants alone. Capital injections from the Treasury to Turkey's hard coal enterprise (TKK) represent another national subsidy; these are to cover the losses it currently makes in coal production. Turkey also continues to provide national subsidies for oil and gas exploration, through capital injections of $500 million in 2013 to the state-owned Turkish Petroleum Corporation (TPAO) for exploration.

Turkey has embarked on a project of privatisation for its state-supported and -owned coal mining and power generation companies. Additionally, SOEs in hard coal (TTK), lignite (TKI), power generation (EUAS), upstream oil and gas (TPAO) and midstream oil and gas (BOTAS)

continue to play important roles in fossil fuel production. A lack of publicly available information prevented quantification of those SOE investments directly linked to fossil fuel production, although several capital injections to SOEs for fossil fuel production are captured in the figure for national subsidies.

Turkey also provides public finance – both domestically and internationally – for fossil fuel production. Domestically, investments averaging $1 billion per year in 2013 and 2014 from three state-owned banks financed the transfer of publicly owned coal-fired power plants to private control. Internationally, Turkey's state-owned Vakifbank loaned $500 million to the state-owned oil company, TPAO, to support the purchase of gas rights in Azerbaijan in 2014 for an annual average of $250 million for 2013 and 2014. Turkey further provided an additional $40 million annually in financing to fossil fuel production via its shares in multilateral development banks. Due to the lack of publicly available information on Turkey's state-owned banks and public finance institutions, it is likely that the above estimates are very conservative.

United Kingdom

The UK stands out as a member of the G20 that, despite its pledge to phase-out fossil fuel subsidies, has dramatically increased its support to the production of fossil fuels in recent years, and has responded to the low oil price by lowering taxes on oil and gas rather than raising them. Although the UK remains the largest producer of oil and the second largest producer of gas in the EU (BP, 2015), these fuels are mainly produced offshore where production is declining as accessible reserves run out in fields across the North Sea. The decrease in domestic production resulted in the UK's net energy imports rising to their highest level since 1976 in 2013 (Oil and Gas UK, 2015).

National subsidies for fossil fuel production in the UK are predominantly provided through tax concessions for oil and gas production in the North Sea. In particular, recent changes to the tax regime (which are protected from future policy changes) now mean that 'UK taxpayers [are] effectively footing the bill for as much as half the costs of decommissioning rigs' (Dunbar, 2015). Support is likely to increase through a legal obligation for the Secretary of State for Energy and Climate Change to 'maximize economic recovery' of oil and gas (see Box 5). These new subsidies come despite diminishing budgetary revenues from the sector and the UK government's recent declaration of its intention to join the Friends of Fossil Fuel Subsidy Reform.

The government also provides national subsidies to support the closure, decommissioning, and rehabilitation of the last of the country's deep coal mines, the last of which is due to close this year. Conversely, open-cast, surface mines continue to produce coal, and a number of new projects may come on line in the coming years as new permits are applied for and granted (NAE, 2015).

The UK government is also keen to develop onshore shale gas reserves, though none of these resources have yet been produced, in part due to local resistance to development. Nonetheless, central government is directly supporting a public relations campaign around hydraulic fracturing, and exploration activities (HM Government, 2015).

It is estimated that the UK provided an average of $9 billion per year in support in 2013 and 2014 across all national subsidies, dominated by tax relief for the decommissioning activities of oil and gas companies. The tax breaks introduced in 2015 make it likely that the value of national subsidies will grow substantially in the coming years. In addition to supporting oil, gas and coal production, the UK power sector is heavily reliant on fossil fuels, and the government also provides support to fossil fuel production through significant funding for CCS (including the $1.6 billion committed to the Commercialisation Competition that has yet to be disbursed) and for fossil fuel power generation under the newly implemented capacity market.

Public finance for fossil fuel production appears relatively limited domestically with an annual average of $72 million identified across 2013 and 2014. However, the recently passed Infrastructure Bill suggests that both gas-fired power stations and CCS are priorities that the UK government is keen to help finance in the coming years (HM Treasury, 2014). Also, the UK provides public finance for fossil fuel production overseas which averaged $4.6 billion per year during 2013 and 2014 through the 73% government-owned Royal Bank of Scotland (RBS); the UK's export credit agency, UK Export Finance; the Department for International Development; and the CDC Group development finance institution. The UK also contributed an annual average of $817 million to fossil fuel production from 2013 to 2014 through its shares in the multilateral development banks.

Fossil fuel production in the UK is dominated by private companies. Approximately three quarters of oil and gas production (implicitly including most of the subsidies in that sector) was attributed to companies headquartered outside the UK.

United States

Due to recent supply growth, the US has become the world's largest producer of oil and gas. This supply growth has been driven in part by advances in horizontal drilling and hydraulic fracturing technology, allowing oil and gas producers to access previously unreachable reserves. It is also supported by generous national subsidies at federal and state levels. Offshore exploration activity in the US's Alaskan Arctic waters, particularly by Shell, underscores the drive to find new and harder-to-reach fossil fuel reserves across the US.

In contrast to the rise in oil and gas reserves, US coal production fell below 900 million metric tons in 2013 for the first time in two decades, and production continues to

slow. Reflecting the decline of coal in the US, the market capitalisation of the top four US coal producers has declined precipitously in recent years, standing at $1.2 billion in mid-2015, compared to $22 billion as recently as 2010 (The Economist, 2015). Coal-fired power is being crowded out by natural gas and, to a lesser degree, new renewables. Dozens of coal-fired power plants are also being shut due to local and national advocacy efforts as well as forthcoming regulation relating to air pollution and climate impacts (Grunwald, 2015).

National subsidies to oil, gas and coal producers in the US amount to $20.5 billion annually, with almost all of those subsidies being received in the form of tax or royalty breaks that benefit producers. Federal subsidies amount to $17.2 billion annually, while subsidies in a number of oil-, gas- and coal-producing states average $3.3 billion annually. US President Barack Obama has pledged to act on fossil fuel subsidies, but he has met resistance. In every budget the Obama administration has sent to Congress, efforts to remove major subsidies have been blocked. In spite of these calls to phase-out subsidies, the administration's domestic energy strategy remains focused on an 'all-of-the-above' approach, supporting the expansion of domestic fossil fuel production (The White House, n.d.).

Many of the largest US national subsidies take the form of tax exemptions for specific production activities and investments. For example, Master Limited Partnerships (MLPs) are a tax-advantaged investment structure with an estimated cost of $3.9 billion per year. Similarly, deductions available for 'intangible drilling costs' – soft costs incurred in preparation for drilling activities that have no salvageable value, such as survey work or ground clearing – cost US taxpayers an average of $2.6 billion annually.

The US is set apart from other G20 countries by the sheer variety of tax exemptions for fossil fuel producers. The deduction for oil spill remediation costs allows companies to deduct the cost of cleaning up and addressing the effects of oil spills as a standard business expense. A recent and notable example occurred in 2010 when BP claimed a $9.9 billion tax deduction due to $32.2 billion in reported clean-up costs for the Deepwater Horizon exploration drilling rig blowout and oil spill in the Gulf of Mexico. The value of this subsidy is estimated to have been $679 million in 2014, however, the exact value is challenging to calculate as it is considered confidential, and because the level of subsidy is highly dependent on the number and extent of spills that incur remediation costs, which can vary greatly from year to year. In 2015, BP reached a final settlement with the US government and five state governments totalling $20.8 billion. However, only $5.5 billion of this is in the form of a non-tax-deductible penalty, and the remainder can be written off by BP (Wood, 2015).

In some cases, the design of subsidies may actually be sufficient to turn a tax on producers into a net loss to treasuries. In Alaska, it is expected that a particular tax on oil and gas producers will lose more money than it takes in over the course of fiscal years 2015 and 2016 (see Box 10).

While the bulk of US subsidies to fossil fuel producers benefit the oil and gas sector, coal producers also benefit from significant subsidies: the Powder River Basin is not designated as a coal-producing region, despite supplying approximately 40% of US coal and being the largest coal reserve in the US. This lack of official designation allows coal companies to lease federal lands at costs lower than would otherwise be the case, amounting to a subsidy of more than $1 billion per year when last calculated in 2012 (Sanzillo, 2012). Recent research has found that production subsidies in the Powder River Basin equal nearly $8 per tonne, a total of $2.9 billion per year, and that removal of these subsidies would result in an 8 to 29% reduction in demand for coal from the basin, with associated cumulative reductions of 0.7 to 2.5 $GtCO^2$ to 2035, demonstrating the significant potential climate impact of removing these production subsidies (CTI, ETA, Earth Track, and IEEFA, 2015).

No domestic public finance for fossil fuel production was identified. Internationally, US public financing for fossil fuel production via the Overseas Private Investment Corporation (OPIC) and US Export-Import Bank (ExIm) averaged $3 billion annually in 2013 and 2014, with an additional $743 million annually through US shares of multilateral development banks. US public finance institutions put in place limits on finance for emissions-intensive fossil fuel infrastructure internationally in 2013, and there has been a reduction in lending for coal-fired power plants by these financing institutions in recent years.

Box 11. Leaders and laggards: reforming subsidies to fossil fuel production

In recent years, reform of consumer subsidies has gained momentum inside and outside the G20 countries. Of those countries reviewed, particular progress has been made in Argentina, Brazil, India, Indonesia and Mexico. In contrast, reform of subsidies to the production of fossil fuels is limited, with some countries even increasing the level of subsidies in response to falling fossil fuel prices. In addition, countries often have a contradictory approach to the reform of fossil fuel production subsidies, whereby they continue to subsidise domestic activity while cutting international public finance (or vice versa), or will phase-out one subsidy while simultaneously introducing another. The following stories highlight some of the encouraging and frustrating developments with regards to fossil fuel production subsidies in the G20 countries in 2013 and 2014. They show that progress can be made, but that there is still much to be done.

Leaders

1. France and the US – international public finance. A number of G20 countries, notably France and the US, have committed to restricting international public finance for coal-fired power generation. The French government announced in 2013 that its overseas development agency (AFD) would no longer support coal-fired power stations without CCS, and in 2015 it extended this restriction to France's export credit agency (COFACE). In the US, in 2013, the US Export-Import Bank became one of the first export credit agencies to significantly curtail support for coal-fired power plants. The Overseas Private Investment Corporation (OPIC) has shifted its financing away from fossil fuels and towards renewable energy, while guidelines from the US Department of the Treasury also restricts US support for multilateral development bank funding of coal-fired power projects. (See France and US Country Studies for more information.)

2. Germany – national subsidies (hard coal). In 2007 Germany formally committed to phasing out support to its domestic hard coal industry by 2018. The government provides significant support for early retirement schemes for those working in coal production, and shares the costs of closures and inherited liabilities with the industry to manage the impacts of reform. (See Germany Country Study for more information.)

3. Canada – national subsidies. A number of subsidies to oil, gas and mining are in the process of being phased out in Canada. As of January 2015, tar sands were no longer eligible for accelerated depreciation, and are now subject to the same tax regime as other oil, mining and gas development (which still benefit from a lower level of accelerated depreciation than that of other sectors). In addition, the Atlantic Investment Tax Credit, which applies to oil, gas and mining, is also currently being phased out. In spite of these positive developments, Canada has introduced new subsidies to fossil fuel producers, particularly new tax breaks for LNG production in the form of increased capital cost allowance rates that allow companies to deduct capital spending more quickly than was previously possible. (See Canada Country Study for more information.)

4. Indonesia – national subsidies. Indonesia's tax and royalty regime means that the government's share of oil and gas profits is among the highest in the world. However, the most encouraging development regarding fossil fuel subsidies in Indonesia relates not to production subsidies (the focus of this report), but rather to consumption subsidies. The complete removal of most petrol subsidies and a reduction in diesel subsidies, together amounting to public savings of just over $15 billion in 2015, has been announced (Lontoh et al., 2015). While there have been some missteps in implementation, the policy change still represents a dramatic step forward. The reform has no explicit links to subsidies for fossil fuel production – but it does show that Indonesia's new government, inaugurated in 2014, is serious about implementing its G20 pledge to rationalise and phase-out inefficient fossil fuel subsidies that promote wasteful consumption. (See Indonesia Country Study for more information.)

Laggards

1. Japan, China and Korea – international public finance. A number of governments continue to provide significant international public finance to fossil fuel production. Most notably, Japan and Korea remain aggressive supporters of fossil fuel production outside their borders, blocking calls for reform in forums such as the OECD. Japan provided an average of $19 billion per year in international public finance for coal, oil and gas production in 2013 and 2014, while Korea provided just over $10 billion per year. China is also a major provider of international public finance for fossil fuel production, averaging $17 billion per year in 2013 and 2014. However, in contrast to Korea, China recently announced plans to 'strictly control' public investment in high-emitting projects both domestically and abroad, and Japan has reached agreement with the US to curb public financing of overseas coal projects. (See Japan, Korea and China Country Studies for more information.)

2. United Kingdom – national subsidies. Following a consultation process focused on opportunities to maximise the economic recovery of oil and gas, the UK government is aiming to extract an additional 3 to 4 billion barrels of oil and gas in the next 20 years. To that end, the government introduced a new set of tax breaks in 2015 that 2015 that will cost it $2.7 billion between 2015 and 2020. At the same time support for renewables and energy efficiency measures has been cut. (See UK Country Study for more information.)

3. Russia and the US – national subsidies. There is a continued high level of national subsidies for fossil fuel production in many countries. This is particularly frustrating as it includes a group of countries in which reforms to a sub-set of national subsidies and public finance have been undertaken. In Russia, national subsidies to fossil fuel producers averaged almost $23 billion annually in 2013 and 2014, while in the US they were just over $20 billion in the same time period. (See Russia and US Country Studies for more information.)

4. Turkey and Indonesia – national subsidies and public finance (coal-fired power). Government support for the expansion of coal-fired power generation continues in both Turkey and Indonesia. In Turkey, the pipeline of coal-fired power projects adds up to 65 GW of capacity, and national subsidies (including tax breaks) for new coal-fired power plant construction are enshrined in the 2012 New Investment Incentives Regime. In May 2015, President Joko Widodo of Indonesia launched a programme to build 35 GW of new power capacity that will predominantly consist of new coal-fired power stations, and which will be supported through public finance, including guarantees. (See Turkey and Indonesia Country Studies for more information.)

9.
Conclusions and recommendations

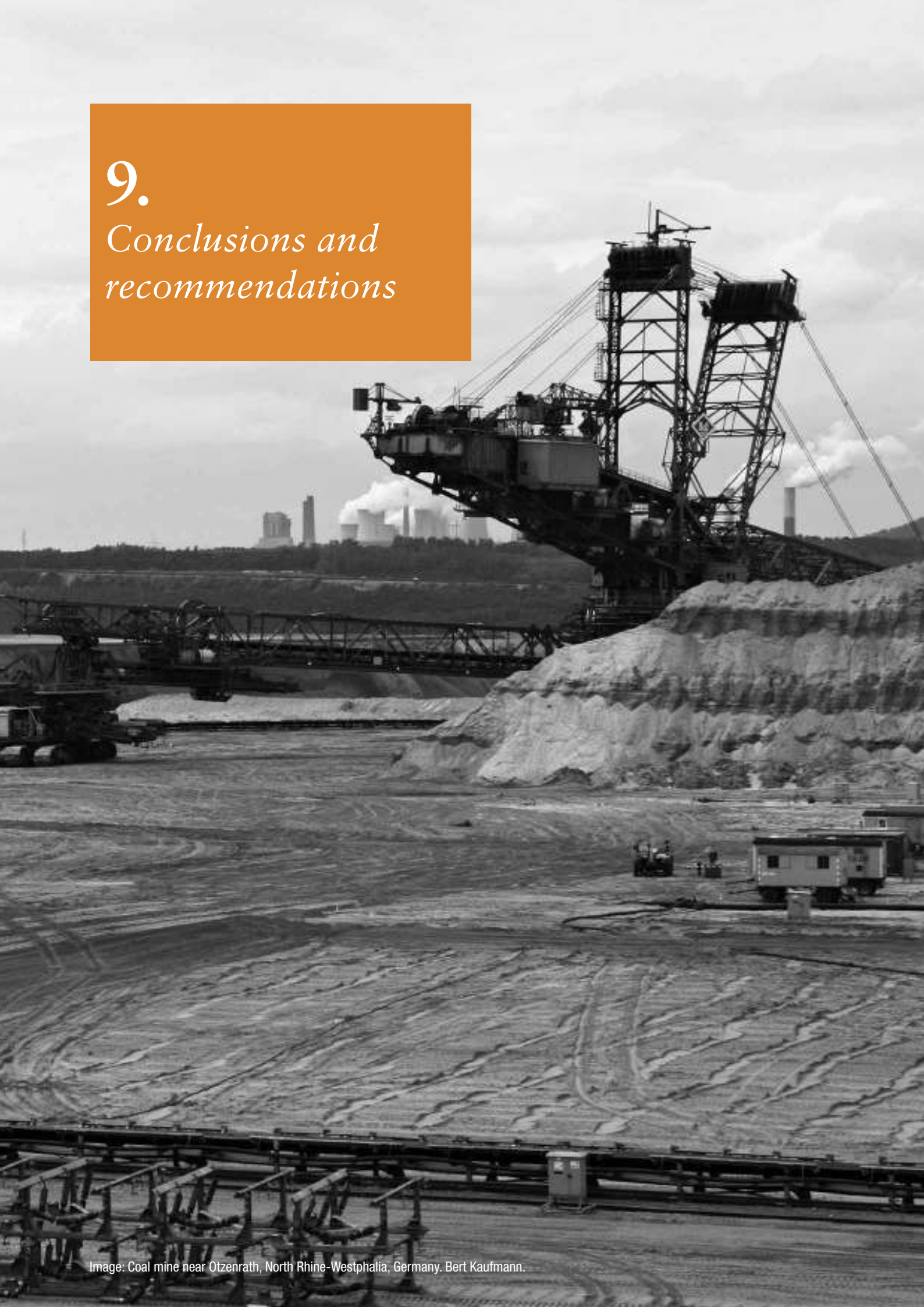


Image: Coal mine near Otzenrath, North Rhine-Westphalia, Germany. Bert Kaufmann.

9.1 Conclusions

The world will not be able to avoid climate change if countries continue to rely on fossil fuels for their energy needs. In particular, it is clear that we must shift investment towards clean alternatives if we are to avoid carbon lock-in that commits us to the most dangerous levels of climate change. Shifting government support away from fossil fuel production and towards alternatives is an important means to achieve this objective.

It is also increasingly clear that we can only use a small percentage of proven fossil fuel reserves if global warming is to be limited to 2°C or less. There are also strong indications that, even when commodity prices were high, the production of oil, gas and coal was getting more expensive and challenging, with declining returns. This trend is an argument for hastening the shift of government support away from fossil fuel production.

G20 countries are supporting fossil fuel production by $452 billion per year on average in 2013 and 2014 – through national subsidies $78 billion, investment by state-owned enterprises $286 billion and public finance $88 billion. The scale of this support is not consistent with agreed goals on the removal of fossil fuel subsidies or with agreed climate goals, and it is increasingly uneconomic.

While the urgent need to reform fossil fuel subsidies to consumers has received growing global attention and support, subsidies to fossil fuel production are rarely discussed and are often hidden by both governments and companies (IEA et al., 2010; Whitley and van der Burg, 2015; Merrill et al., 2015). This is particularly problematic in the context of the recent declines in oil, coal and gas prices that facilitate consumption subsidy reform, but lead fossil fuel producers to demand even greater levels of government support.

Recognising this lack of transparent information, this report is a first attempt at providing a picture of the full range of G20 subsidies to fossil fuel production. Building on this research, work is also under way to model the economic effects, and potential emission reduction benefits, of reforming subsidies to the production of fossil fuels (Carbon Tracker, 2015).

Regulation to address the rising impacts of air pollution, improvements in energy efficiency and competition from renewables and electric vehicles are all making fossil fuel production projects increasingly risky investments. An increasing share of fossil fuel investments is likely to lose money in rapidly transforming energy markets, creating the risk that government support is diverting finite resources to the development of assets that will end up 'stranded'.

9.2 Recommendations

Recognising that subsidies for fossil fuel production:

- drive the world towards exceeding safe climate limits
- enable increasingly risky and uneconomic activities by fossil fuel companies
- place countries and companies at financial risk of stranded assets in a carbon-constrained world
- strain treasuries
- divert public resources away from supporting low-carbon energy systems and universal energy access.

This report recommends that governments:

1. Adopt strict timelines for the phase-out of fossil fuel production subsidies (and remaining subsidies to consumption) with country-specified measurable outcomes. The first step would be to eliminate all subsidies to exploration and coal by 2020.

   This directly builds on the September 2015 US–China commitment to 'working closely with other G-20 members [...] to phasing out inefficient fossil fuel subsidies by a date certain' under China's forthcoming 2016 presidency of the G20 (White House, 2015).

   A transparent phase-out of fossil fuel production subsidies should prioritise:
   - National subsidies: amending government budgets and tax codes to ensure that budget and tax expenditures do not support fossil fuel production, starting with phasing out subsidies to exploration and coal production.
   - SOE investment: identifying and phasing out government support to state-owned enterprises for fossil fuel production, starting with ending support to exploration and coal production.
   - Public finance: immediately ending all bilateral and multilateral finance to fossil fuel production, except for very rare circumstances to support energy access for the poor using best available technologies where no other option is available.

2. Increase transparency through a publicly disclosed, consistent reporting scheme for all national subsidies for fossil fuels, strengthening the OECD inventory and expanding it to include all countries (using their model for tracking agricultural subsidies).
3. Increase transparency of reporting on investment in and finance for fossil fuels by state-owned enterprises and majority publicly owned financial institutions.

4. Work closely within international institutions and processes, such as the G20 and APEC, the OECD, the UNFCCC and the Sustainable Development Goals to ensure that any existing incentives for fossil fuel production are eliminated, and to monitor reforms so that no new incentives are established.
5. Transfer subsidies from fossil fuel production to support wider public goods, including the transition to low-carbon energy systems and universal energy access.

As this report shows, governments around the world continue to subsidise and finance a continued reliance on oil, gas and coal – fuelling dangerous climate change with taxpayer dollars. Production subsidies bolster the fossil fuel industry, supporting the activities of oil, gas, coal and fossil fuel power companies that are increasingly uneconomic and environmentally harmful.

Despite broad agreement that fossil fuel subsidies are a problem, and early examples of a select group of countries undertaking reform (see Box 11), these subsidies have proven politically difficult to eliminate. Governments must be held accountable for the production subsidies highlighted in this report, and must seize the clear opportunities for reform. The G20 must lead by taking swift and decisive action to end public support to fossil fuel production.

Phasing out fossil fuel subsidies is a critical and necessary step to limit the impacts of climate change, reduce air pollution and facilitate the transition to low-carbon energy systems. Removing public support for fossil fuels would rebalance our energy markets and force the industry to operate on a more level playing field with emerging options to provide the same energy services. Ending these subsidies will also free up scarce government resources for development needs and social goods.

Appendices

Appendix 1. Country Studies and Data Sheets

Argentina
Australia
Brazil
Canada
China
France
Germany
India
Indonesia
Italy
Japan
Korea
Mexico
Russia
Saudi Arabia
South Africa
Turkey
United Kingdom
United States

* All Country studies and Data Sheets are available online at: odi.org/empty-promises

Appendix 2. Multilateral development bank financing for fossil fuel production

G20 countries are among the largest shareholders of most major multilateral development banks, including the various branches of the World Bank Group, the European Investment Bank, the European Bank for Reconstruction and Development, the Asian Development Bank, the African Development Bank and the Inter-American Development Bank.

Together these institutions provided an average of $8.8 billion in annual financing for fossil fuel production in 2013 and 2014 – cancelling out the $8.8 billion that these institutions financed in 'clean' energy over the same time period. These same institutions financed an additional $15.2 billion annually in 'other' energy sources in the same time period.[18]

G20 countries collectively own the majority of shares in each of the multilateral development banks listed above (ranging from 54% to 75%), except for the African Development Bank, where G20 shares add up to 36%. Each G20 country owns a percentage of shares that ranges from zero to 30%.

By assigning a proportion of financing for fossil fuel production in accordance with the percentage of shares that each country owns in each institution, we were able to calculate how much fossil fuel finance each country is responsible for from each multilateral development bank.

We found that the G20 portion of financing for fossil fuel production from the multilateral development banks averaged $5.5 billion annually, or 63% of the total fossil fuel financing from these institutions. Of this amount, $3.7 billion (68%) went to oil and gas pipelines, power plants and refineries; $1.3 billion (23%) went to upstream oil and gas; $500 million (9%) went to coal-fired power; and $4 million (less than 1%) to coal mining.

See multilateral development bank financing spreadsheet. Available online at **odi.org/empty-promises**

18 'Clean' energy for the purposes of this comparison is defined as projects with energy sources that are both low carbon and have low impacts on the local environment and on human populations. Some energy efficiency and some renewable energy – i.e., energy from naturally replenished resources such as the sun, wind, rain, tides, and geothermal energy – are included as 'clean' energy. This category also includes any policy reforms that provide incentives for clean energy development and investment. 'Other' energy includes energy sources that can have significant impacts on the local environment and on human populations that make it difficult to consider them totally 'clean', such as large hydropower, biofuels and biomass. These energy sources, along with nuclear power, incineration and other forms of power that are not fossil fuel–based but are also not 'clean', are included in the 'other' category. Additionally, transmission/distribution and energy sector policy reforms that are unable to be specifically linked to the source of energy are also classified as 'other'.

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9. Conclusions and recommendations

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