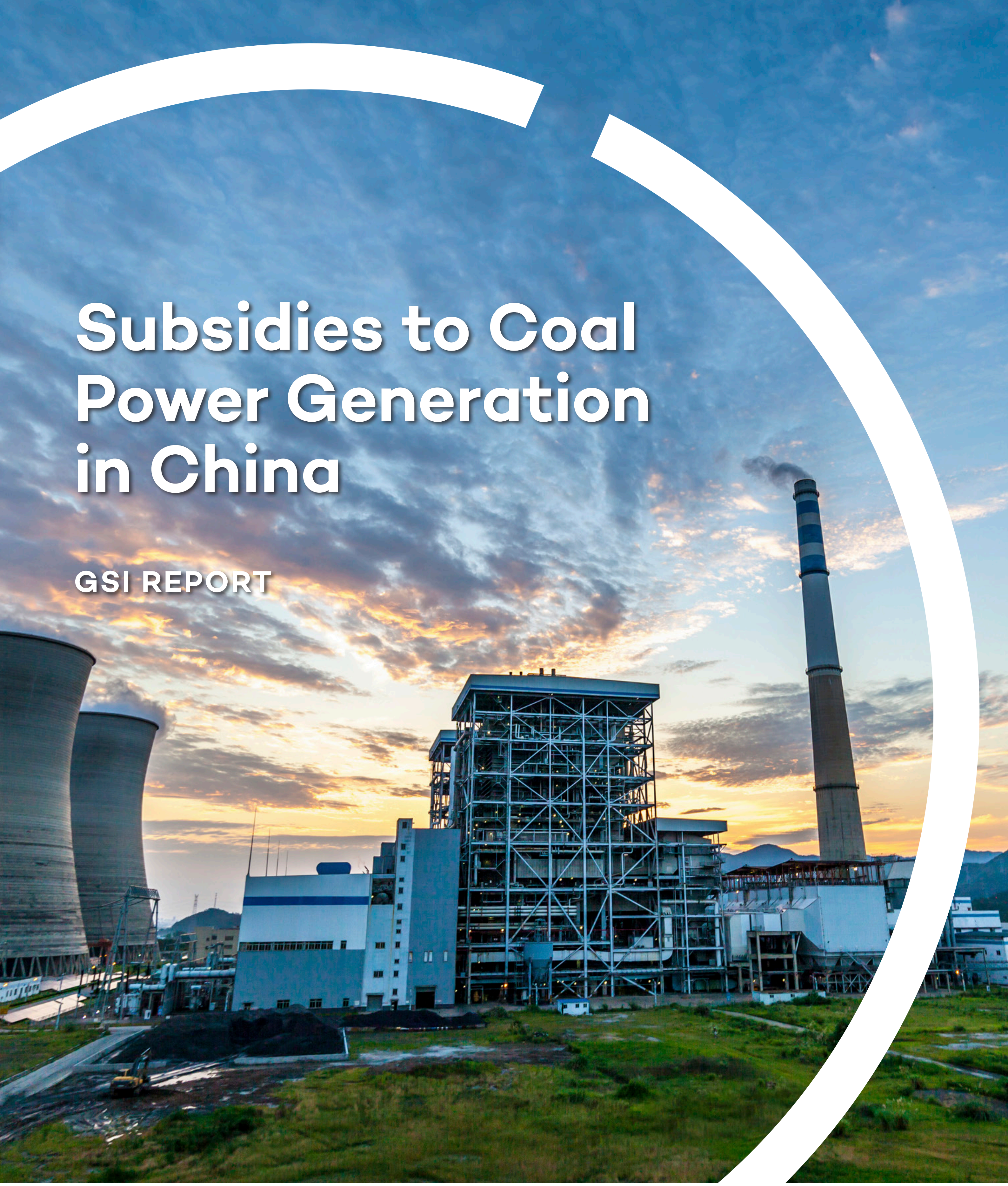
Subsidies to Coal Power Generation in China

GSI REPORT



IISD International Institute for Sustainable Development

Global Subsidies Initiative

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Executive Summary

This report seeks to assess the cost to the Chinese government, in terms of subsidies, of operating and investing in coal-fired electricity generators, the predominant source of electricity in China. We find that the value of the subsidies to coal-fired generation was at least CNY 252 billion (USD 37.7 billion) in 2014 and CNY 120 billion (USD 18 billion) in 2015. Though straightforward comparisons are complicated due to differences in methodologies, China's government support of coal-fired generation, including the so-called "zombie companies" in the sector, appears to be about approximately double the level of subsidies provided to renewables: in the order of CNY 45 billion to 103 billion (USD 6.7 billion to 15.4 billion) per year.

Even though government support to coal-fired generation in China is sizable, it was not selected as part of the voluntary peer review of fossil fuel subsidies (FSS) that China underwent and published in 2016, jointly with the United States (G20, 2016) under the G20 commitment to "phase out inefficient fossil fuel subsidies" (G20, 2009). Beyond subsidies to coal generators, the International Institute of Sustainable Development (IISD) Global Subsidies Initiative (GSI) has previously published research examining subsidies to supply-side activities, mainly in the extractive sector (Denjean, Gerasimchuk, Bossong, & Pickard, 2015; Xue, Wang, Bridle, Gerasimchuk, & Attwood, 2015).

Figure ES1 contextualizes the new estimates of subsidies from this report compared to other energy subsidy estimates in China, including in the G20 peer review. Given the sheer scale of subsidies to coal-fired generation, it is clear that they should be made the focal point of policy-makers and stakeholders interested in transition to a low-carbon economy and FFS reform.

This report applies the definition of subsidies provided by the World Trade Organization in the Agreement on Subsidies and Countervailing Measures. The scope of this subsidy definition is the same as used by the Organisation for Economic Co-operation and Development and does not include environmental costs in terms of climate impacts and pollution.

In its work on FFS in China, GSI applies the same approach as it has in more than 20 countries: identify, measure and evaluate. In this report, we follow the first two steps that lay the groundwork for evaluation. Thus the report provides estimates of subsidies to coal generation in China to support their assessment by a wider group of stakeholders. This report aims to help government officials and the general public understand the overall scale of public spending and the policies promoting coal generation, and help to identify the opportunities for reform.

The report has not quantified all subsidies to coal generation in China. More subsidy schemes may exist at both the central and provincial levels and should be subject to further research. Data limitations have precluded quantitative estimates of several important subsidy schemes that have been identified. Establishing the size of these subsidies is complicated by the involvement of state-owned enterprises (SOEs), a lack of information on financial agreements (particularly for the terms of credit offered) and decentralized industry support.

It is noteworthy that the energy subsidy landscape in China is changing very fast, and some subsidies are either being phased out or shifted to support new developments, including cleaner and more efficient combustion of coal. The overall value of the identified subsidies to coal generation has also dropped from 2014 to 2015, from CNY 252 billion to CNY 120 billion as stated above. Meanwhile, regardless of the subsidy purpose and dynamics, these are huge costs that the Chinese government have to incur to keep its coal sector operational.

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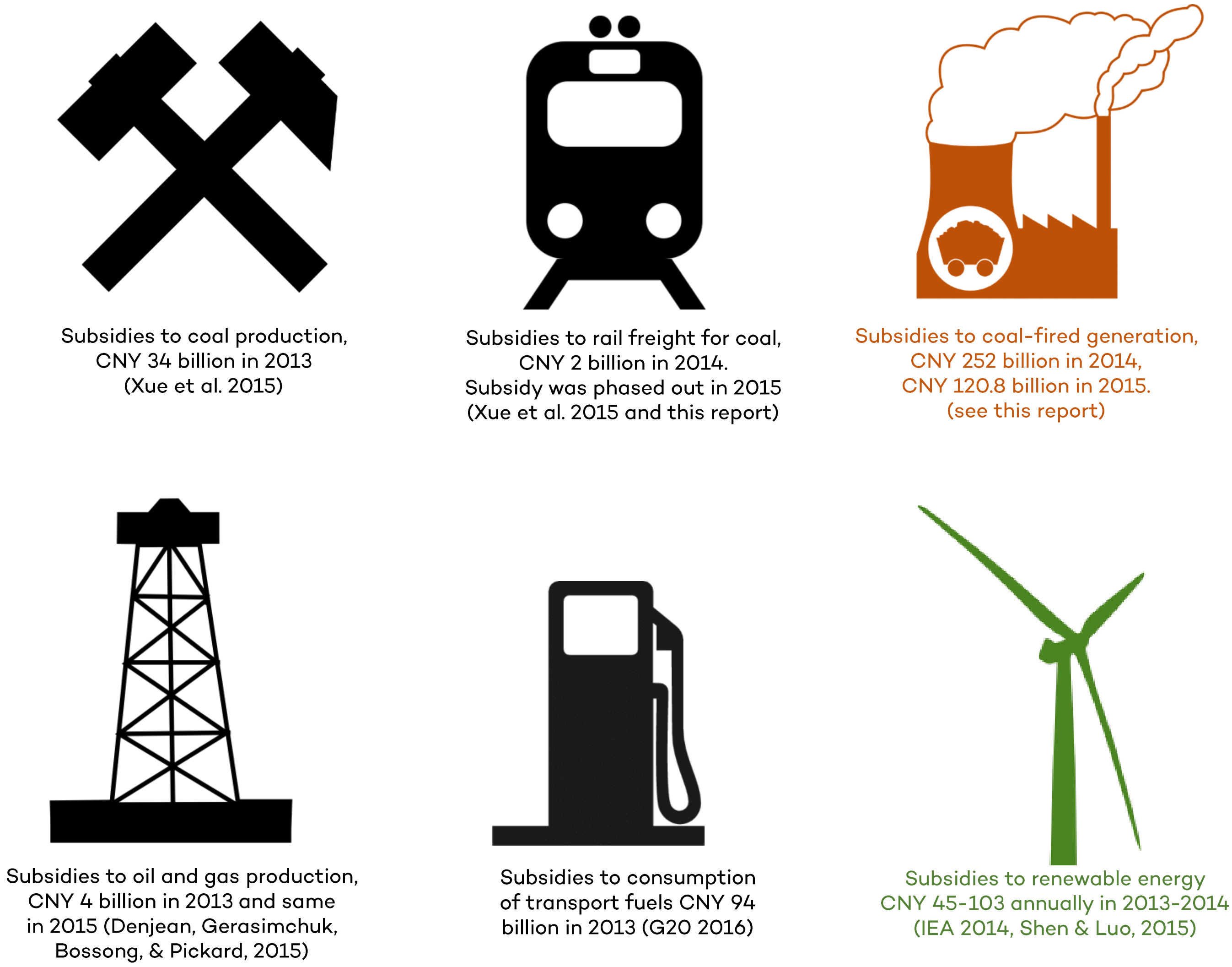

FIGURE ES1: MAPPING THE ESTIMATES OF VARIOUS FFS IN CHINA BASED ON PREVIOUS RESEARCH AND NEW FINDINGS FROM THIS REPORT (ROUNDED TO NEAREST BILLION CNY)

The inventory identified 14 subsidies that were operational in the period 2013–2015 at both the central and provincial levels. An overview is presented in Table ES1. Detailed descriptions of each of the subsidies listed in the table are provided in Section 8. Of these, it has been possible to quantify six based on official data, other sources and certain assumptions.

TABLE ES1: SUBSIDIES TO COAL GENERATORS IN CHINA

REPORT SECTION NUMBER	SUBSIDY	DESCRIPTION	VALUE (CNY BILLIONS) 2014	2015
CROSS CUTTING SUBSIDIES				
4.2.1	Mergers and acquisition support	A range of incentives that include: tax breaks, laid-off worker reallocation allowance, interest subsidy, credit support, power purchase guarantees and land-use permission	n.c.*	n.c.
4.2.2	Subsidies to "zombie" companies	Subsidies designed to prop up coal companies that make consistent losses.	n.c.	n.c.
DIRECT AND INDIRECT TRANSFER OF FUNDS AND LIABILITIES				
4.3.1	Subsidies for investment in emissions abatement equipment	Grants for retrofitting gas clean up equipment provincially (2015) and investment and maintenance expenditure nationally (2014)	130	0.2
4.3.2	Investment in coal-to-liquid and gas research and infrastructure	Investment by Yankuang group in coal-to-gas	6.5	6.8
4.3.3	Credit support	Preferential export buyers' credits, export sellers' credits, mixed credits, natural resource-backed loans or lines of credit, concessional loans	n.c.	n.c.
4.3.4	Rail freight investment	Various investment in infrastructure, e.g., the Shanxi South Central Railway and a "mega coal corridor" linking Inner Mongolia with Jiangxi	n.c.	n.c.
4.3.5	Power grid investment	Domestic investment in grid infrastructure and investment in the One Belt One Road scheme	n.c.	n.c.
4.3.6	Industrial restructuring funds	Restructuring and workers' resettlement fund	n.c.	n.c.
GOVERNMENT REVENUE FOREGONE				
4.4.1	Tax regime for coal generation	Foregone tax revenues including exemptions from land-use tax, value-added tax on heat sales, and estate tax	n.c.	n.c.
PROVISION OF GOODS OR SERVICES BELOW MARKET VALUE				
4.5.1	Providing rail freight transportation below market rate	Increase in rail freight tariffs	1.9	n.c.
INCOME OR PRICE SUPPORT				
4.6.1	Delays in passing through price reductions	Systemic delays in passing through price reductions to consumers through lower tariffs	n.c.	n.c.
4.6.2	Priority dispatch of coal over renewables	Value of curtailment in Liaoning, Jilin, Hei LongJian and East Inner Mongolia	n.c.	6.9
4.6.3	Power purchase guarantee and premium rate for low-emission plants	Premiums and power purchase guarantees for plants fitted with cleaning equipment and a premium for meeting emissions standards	94	106.9
4.6.4	Power purchase guarantee for closing of inefficient plants	Operators are awarded power purchase agreements for plants that continue to operate in exchange for closing smaller, inefficient plants.	20	n.c.
4.6.5	Raising import tariffs	The introduction of a 6% import tariffs on coal in starting in 2014	n.c.	n.c.
TOTAL			**252.4**	**120.8**

* *"n.c." indicates that the subsidy has not been calculated*

The subsidies with the largest impact on the electricity sector include:

- **Guaranteed power purchase and priority dispatch**: The allocation of a set number of operating hours for coal generators on an annual basis creates an incentive to build capacity and prevents adhering to a merit order for dispatch on the grid; this provides revenue that otherwise would not have been guaranteed. The motives for guaranteeing operating hours are various and include: support for what has been considered a strategic industry; compensation for closure of small, inefficient plants; and incentives for mitigating air pollution. Whatever the motive, the result is that coal power is often dispatched over more efficient renewables. This confers an advantage to coal over other technologies.
- **Industry reform**: Increases and more recent decreases in coal prices and poor air quality have both driven reform in the coal power sector. Before 2012 increasing coal prices put pressure on generators and led to the restructuring of the sector through vertical integration with coal producers. The extent of support for this process is not clear, but provincial examples suggest that it is wide ranging (credit support, tax breaks, power purchase guarantees). Air pollution has become a major issue in China's urban areas. To address the issue, the government has driven the closure of small, inefficient plants while at the same time promoting clean technologies (i.e., desulfurization, denitration and dedusting equipment). This process has been supported through an industrial restructuring fund, investment in clean technologies, and premiums and purchase guarantees for clean technology generation. In a move that mainly benefits employees of SOEs, the Chinese government has provided financial support from fiscal revenues to manage unemployment issues caused by coal phase-out and eliminating zombie companies.
- **Infrastructure investment**: Investment in railways and the power grid by the government and SOEs is of direct advantage to coal generators. Establishing how much of these investments comes from public money and whether the investors receive preferential credit rates, and apportioning benefit to coal over other sectors all make estimating the size of subsidies difficult.

While acknowledging the difficulties in quantifying these subsidies, it is clear that coal generation is given an advantage over other technologies through the measures described. The recent G20 subsidy peer review was a major step towards transparency, particularly for oil and gas subsidies. However, it did not include an analysis of the subsidies to coal-fired electricity generators. It is recommended that policy-makers expand the scope of the subsidy review processes to include the subsidies described here. If overall impacts of subsidies are found to be negative, reform options should be considered.

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Acronyms and Abbreviations

ASCM	Agreement on Subsidies and Countervailing Measures
CHP	combined heat and power
CRC	Chinese Railway Corporation
CTL	coal to liquids
FFS	fossil fuel subsidies
FYP	Five-Year Plan
G20	Group of 20
GSI	Global Subsidies Initiative
GtCeq	Gigatonnes of Coal Equivalent
GW	Gigawatts
IEA	International Energy Agency
IISD	International Institute for Sustainable Development
IMF	International Monetary Fund
kW	kilowatt
kWh	kilowatt-hours
n.c.	not calculated
NDRC	National Development and Reform Commission
NEA	National Energy Administration
NRDC	Natural Resources Defense Council
OECD	Organisation of Economic Co-operation and Development
PV	photovoltaic
SOE	state-owned enterprise
WTO	World Trade Organisation

1.0 Introduction

Coal-fired electricity generation has powered China's development, but its increase in electricity consumption has contributed to urban air pollution and carbon emissions. Fossil fuel subsidies (FFS) have increased the use of coal and acted to crowd out other technologies, including renewable generators. In recognition of this, China has committed to reducing the share of coal to 62 per cent of total energy consumption by 2020.

Removing subsidies to the coal industry is one option to promote a decline in coal consumption and generation while mitigating the possible negative social and economic consequences of reforms. China is making important steps in this direction. Not only has China undergone a peer review of its FFS within the G20 (along with the United States and followed by Germany, Mexico and Indonesia), but it has also committed to working closely with other G20 members to "phase out inefficient fossil fuel subsidies by a date certain" under the U.S.-China Joint Presidential Statement on Climate Change in September 2015 (The White House, Office of the Press Secretary, 2015).

Holding to the idea that "you cannot manage what you do not measure," the International Institute of Sustainable Development (IISD) Global Subsidies Initiative (GSI) has analyzed FFS in more than 20 countries under a three-step approach: identify, measure and evaluate. In this report, we follow the first two steps that lay the groundwork for evaluation. Thus the report provides estimates of subsidies to coal generation in China to support their assessment by a wider group of stakeholders. This report aims to help government officials and the general public understand the overall scale of public spending and policies promoting coal generation, and to help identify the opportunities for reform.

The report aims to help government officials and the general public understand the overall scale of public spending and policies promoting coal generation. It also aims to help identify the most important leverage points for fossil fuel reform in order to rationalize and phase out inefficient energy subsidies that encourage wasteful use of resources.

Not all of the identified subsidies serve the purpose of supporting the generation of coal-fired electricity directly. The government is trying, whatever it takes, to reduce overcapacity in the coal industry and in thermal power generation, and to transition to a low-carbon energy system. A number of subsidies aim to support closures of small and inefficient power plants and to invest in equipment to improve emissions at existing coal generators. These subsidies may have net positive environmental impacts or may provide revenues that support the overall operations of coal generators. Typical drivers for subsidies include rewarding emissions reduction, supporting cleaner fuel use and subsidizing research, development and efficiency improvement. Governments feel the imperative to reduce the impact of closures and consolidation on employees and enterprises by supporting workers whose jobs are affected, reducing taxes, and providing financial support to help companies develop new business and expand markets.

It should be noted that measures of subsidies to coal generation presented in this report are not complete. Some identified subsidies are hard to estimate because of data availability and transparency issues. In this case, only descriptive information and qualitative analysis are available. Quantified estimates may be not accurate, considering the complexity of distinguishing among those subsidies that apply to coal-fired generation from the entire power sector other sources such as gas generation, and the industry chain. Traditionally, state-owned enterprises (SOEs) are at the centre of the power sector in China and are major coal generators. Recently, these SOEs have started to diversify their electricity sources by installing renewables, which increases the difficulty in determining the overall impact of subsidies received by these diverse groups.

In this report, estimates do not include external environmental costs as subsidies. It is worth mentioning that China's subsidies to coal generation would be much larger than presented in this report if adding the environmental costs of coal consumption. For example, the cost of air pollution in China is estimated to be between CNY 222 billion and CNY 8,446 billion (Bridle & Attwood, 2015). The National Development and Reform Commission's (NRDC) estimate indicates that, in China, the externalities to people's health and environmental costs are CNY 260 per tonne of coal use, through the life cycle of production, transportation and consumption. The majority of the damage caused by coal consumption is in power generation and heating, which accounts for 64 per cent of the total costs (NDRC, 2012). These results indicate that energy subsidy reform is urgent, in particular to tackle the externalities from energy consumption. The fiscal, environmental and welfare impacts of energy subsidy reform in China are potentially enormous.

This research is the very first step in understanding subsidies for coal-fired generation in China. Future work is needed to evaluate which subsidies cannot be justified and should be reformed, and to develop plans and strategies for reform that take into account political and social concerns.

2.0 Context: Electricity Generation in China

Since 2012 supply in China's coal market has exceeded demand. This is a significant change from the period prior to 2012 when China was a net importer of coal. In 2014 China's coal use dropped to 4.12 billion tonnes, a decrease of 2.9 per cent. With another 3.6 per cent decrease in 2015, coal prices for power generation dropped to CNY 370/tonne (benchmark prices for coal trading), the lowest level since 2004, and in 2014, 90 per cent of enterprises in coal industry were reported to be operating at an economic loss (NDRC, 2014a). Reducing coal overcapacity tops the agenda of China's supply-side reform. During the 12th Five-year Plan (FYP), China eliminated about 560 million tonnes of coal production capacity and closed 7,250 coal mines. In 2016 the government released the 13th FYP and took more aggressive action to phase out 500 million tonnes of coal and reduce and reconstruct another 500 million tonnes capacity; stop approval on any new coal projects; and shut down 13 types of small, out-dated and unsafe coal mines. An increasing number of projections now suggest that coal use has already peaked—though considerably diversity of opinion remains (Qi, Stern, Wu, Lu, & Green, 2016).

The share of coal generation in the electricity mix has begun to decline. In 2014 capacity reached its lowest historic share at 66 per cent (BP, 2015). Substitution of coal by non-fossil fuels has proceeded rapidly in the power-generation sector, driven by investments and pro-renewable policies. China's newly added wind generation capacity reached a record-setting 33 gigawatts (GW) at the end of 2015; accumulated integrated wind capacity was 129 GW, accounting for 8.6 per cent of total installed power capacity and 3.3 per cent of total power generation. As of the end of 2015, China's total solar photovoltaic (PV) installation was 43 GW, and led the world in terms of the total solar PV power capacity. In the first half of 2016, thermal power generation again decreased by 3.1 per cent to 56.79 per cent of the total power generation, while hydro, nuclear, wind and solar energy all increased.

However, there are significant signs of electricity overcapacity in China, associated with a decrease in consumption resulting from slowing economic growth and restructuring the economy towards services and low-carbon and energy-efficiency industries. In 2015 total electricity consumption increased only by 0.5 per cent, the lowest growth rate in power demand since 1998 (China Electricity Council, 2015c), while newly installed capacity reached 130 GW, an increase of 24 per cent over 2014. Meanwhile, operating hours for thermal plants declined to a total of 4,329 hours in 2015, the lowest level since 1970 due to over-investment in coal-fired installed capacity, an increase in renewable generation and a decrease in power demand. In the first half of 2016, average operating hours for power generation were 1,797 hours, a decrease of 138 hours compared with 2015. The reality is that China's power generation capacity is expected to more than double by 2030 once all power projects approved between 2012 to 2014 are built during the 13th FYP, with coal power overcapacity between 70 and 120 GW (Greenpeace, 2015).

To deliver China's energy transition to a sustainable electricity sector, controlling the consumption of fossil fuels is the key—especially coal consumption. The 13th FYP sets a coal cap for 2016–2020 to address overcapacity. *The Action Plan for Energy Development Strategy 2016–2020* (State Council of the People's Republic of China, 20154) sets the following targets by 2020: China's total coal consumption will be capped at no more than 4.8 gigatonnes of coal equivalent (GtCeq); the share of coal consumption will account for less than 62 per cent of total energy consumption; and non-fossil fuels will rise from 11 per cent to a minimum of 15 per cent. In March 2016 NDRC and the National Energy Administration (NEA) introduced a warning system to guide investment in coal power generation and to control overcapacity. As a result, 28 provinces were ordered to stop approval or construction of new coal power plants, and approved plants are requested to delay the construction until 2018 (Boren, 2016).

Combined heat and power generation (CHP) is being promoted to improve the thermal efficiency of coal generators. During the 13th FYP period, the proportion of coal capacity with CHP capability is expected to increase to 40 per cent, up from 30 per cent in 2014 (NEA, 2016; Polaris, 2015). Retrofitting CHP capacity can be capital-intensive due the complexities of installing heat networks and associated equipment at existing facilities and the need to transport heat long distances to viable demand centres. Currently, greening China's power system is challenged by the curtailment of renewables, delays in grid development and improvement, and the geographical mismatch of energy use and renewable production. As of the end of 2015, solar power generation in northwestern China was seriously curtailed—generation operating hours averaged just 1,133 hours. Solar curtailment rates reached 31 per cent in Gansu and 26 per cent in Xinjiang, the two main solar-generating provinces. In the first half of 2016, wind curtailment got even worse, with the highest curtailment rates occurring in Gansu (47 per cent), Xinjiang (45 per cent), Jilin (39 per cent) and Inner Mongolia (30 per cent) (Wang, Kitson, Bridle, Gass, & Attwood, 2016). In July 2016 the government issued a policy to regulate and monitor wind investment and ordered the regions with the highest wind discard rate in the red zones to stop approval of wind projects over the next three years.

Closely linked to fossil fuel consumption, air pollution is an urgent social and public health challenge in China. The International Energy Agency (IEA, 2016) estimates that 1 million premature deaths can be attributed to air pollution in China, and average life expectancy in China is reduced by almost 25 months because of poor air quality. A study from the World Bank and Institute for Health Metrics and Evaluation (2016) estimates that 1.6 million deaths were caused by air pollution in 2013. As a result of policies to control air pollutants and greenhouse gas emissions, today it takes 320 grams of coal to provide one kilowatt hour of electricity, compared with 370 grams 10 years ago and 412 grams 20 years ago. By 2020 all coal-fired generation units are required to reach 310 grams of coal consumption per unit of power generation and to implement the lowest emission standards of sulphur dioxide, nitrogen oxide and particulates.

The 13th FYP for energy development was not yet complete at the time of the writing this report, but one of the central themes is building a clean, low-carbon, high-efficiency and safe energy system. Given the current circumstances of overcapacity in energy supply and power sector reform, China's energy development in the next five years will be focussed on restricting new coal supply and generation and on pursuing quality of renewable development, mainly driven by markets and consumer demand rather than government investments and subsidy policies. Energy supply-side reform will be a priority of wider economic reforms, alongside power market reform. This includes reform of inefficient supporting policies that encourage wasteful use of resources, including FFSs.

3.0 Scope and Method of the Report

3.1 SCOPE

The scope of this paper is limited to identifying and quantifying, where possible, the most significant subsidies to coal generators in China. The inventory excludes subsidies to coal production (i.e., extraction), including in the electricity sector, which was covered by GSI earlier in Subsidies to Coal Production in China (Xue, Wang, Bridle, Gerasimchuk, & Attwood, 2015). There is, however, some crossover with this report in coal transportation and imports tariffs, which affect both coal-extracting companies and coal-fired electricity generation. The two reports are designed as "sister" publications. The report also includes a discussion of the credit support given for outward investment in coal generation projects outside China.

The inventory focuses on the years 2013–2015. Given the rate of reform in the electricity generation sector and the market dynamics in the broader coal industry, as well as non-availability of data points for all years, the aim of the inventory is to produce a representative estimate of as many of the main subsidies as possible. The years 2014 and 2015 were selected as these were the most recent years for which it was possible to gather data on the widest range of subsidies.

3.2 SUBSIDY DEFINITION AND TYPOLOGY

In broad terms, energy subsidies are often defined as "any government action that lowers the cost of energy production, raises the revenues of energy producers, or lowers the price paid by energy consumers" (IEA, 2006). At the same time, labelling specific policies as subsidies can be controversial. Therefore, it is important to establish an objective definition as to what does or does not constitute a subsidy.

Subsidy definitions vary. Some elements are common to all definitions, such as direct payments to private companies, while some elements may be categorized as subsidies under some definitions, but not in others. For example, market price support.

This report applies a definition developed by GSI based on the Agreement on Subsidies and Countervailing Measures (ASCM) of the World Trade Organization (WTO), which was signed by 164 WTO member states, including China. As this definition has been accepted in an international agreement by a large number of countries, it is considered by some to be the most widely accepted definition available. It is outlined in Box 1.

Thus, GSI's approach to defining subsidies is very similar to that of the Organisation of Economic Co-operation and Development (OECD). Definitions of subsidies based on the WTO definition, including the definition applied in this report, generally exclude under-pricing of social and environmental externalities, such as health-related costs associated with fossil fuel use. However, since these represent a cost to society that the liable parties are not required to pay, there is an argument for considering them in the subsidy definition or for at least taking account of them otherwise. The notable exception to this is the definition applied by the International Monetary Fund (IMF), which includes a range of externalities including the health impacts of air pollution and the social cost of greenhouse gas emissions (IMF, 2015).

BOX 1: WHAT ARE SUBSIDIES?

The WTO ASCM defines four categories of subsidies that exist, where governments:

1. Provide a direct transfer of funds or liabilities, such as the provision of grants
2. Forgo or otherwise fail to collect revenue, including tax exemptions and reductions
3. Provide goods or services below market rates, such as the provision of land, services or inputs
4. Provide income or price support, for example through price regulation

In order to be considered a subsidy, a measure also has to be specific to its recipient: a company or an industry.

This definition makes no distinction as to whether a subsidy is efficient (justified). Subsidies may indeed be justified where they have been put in place to correct a market failure, such as the unsustainable depletion of a natural resource.

In the context of fossil fuels, subsidies are often split into two non-exclusive categories: those that reduce the cost of consuming fossil fuel-based energy, called consumer subsidies, and those that support the domestic production of fossil fuels, called producer subsidies.

For further discussion on subsidy definitions see Beaton, Gerasimchuk, Laan, Lang, Vis-Dunbar, & Wooders (2013)

The subsidies described in Section 4 are grouped according to the categories listed in the definition described in Box 1. Where a policy contains elements that fall under more than one category, the policy is mentioned in each applicable section, but only described in the section detailing the predominant subsidy category.

3.3 SUBSIDY ESTIMATION METHODOLOGIES

There are two common types of methodologies for subsidy estimation. These are known as "price-gap" (top-down) and "inventory" (bottom-up) approaches.

The **inventory approach** involves constructing a listing of government support policies affecting the production and consumption of fossil fuels and considering the cost or impact of each in turn. This method is used by OECD and GSI. The advantage of this method is that it not only identifies the aggregate level of subsidies but also the policies responsible. Disadvantages include the labour intensity of the analysis and the frequent lack of available data.

The **price-gap approach** estimates the gap between domestic energy prices and reference prices (the "price gap"). If the domestic price is lower, a consumption subsidy is deemed to exist. Both the IEA and IMF use this method. The reference price for electricity is based on the cost of production, transmission and distribution of electricity in individual countries. Using the price-gap approach alone is useful for enabling comparisons among countries where the main form of support is through administrative pricing or export restrictions, but it does have some drawbacks. For example, a price-gap analysis will not reveal producer subsidies that arise when energy producers are inefficient and mark losses at benchmark prices.

This report applies an inventory approach to identify subsidies through analysis of policies. The price-gap approach is not used at the aggregate national level; it is used to estimate the cost of individual policies by considering the impact of the policy on prices. Below, in the description of each subsidy, we provide a summary of the applied approach to its quantification. For a review of different quantification methodologies refer to Jones & Steenblik (2010). For a summary of the range of subsidy estimates produced by the OECD, IEA, IMF and GSI, see GSI (2014).

3.4 EXISTING ENERGY SUBSIDY ESTIMATES FOR CHINA

Even though government support to coal-fired generation in China is sizable, it has been largely outside the focus of the voluntary peer review of fossil fuel subsidies (FFS) that China published in 2016 jointly with United States under the G20 commitment to "phase out inefficient fossil fuel subsidies" (G20, 2009, 2016). On the supply-side, GSI's previous research of FFS in China (Denjean et al., 2015; Xue, Wang, Bridle, Gerasimchuk, & Attwood, 2015) also has focused on other types of subsidies, mainly in the extractive sector. Some subsidies benefit either or both producers and generators of coal, notably, subsidies to rail freight of coal and changes to import tariffs. Discussion of these subsidies appear in both this report and the aforementioned report on producers (Xue, Wang, Bridle, Gerasimchuk, & Attwood, 2015).

On the demand side, fossil fuel consumption subsidies in China have been quantified by IEA (2015). Figure 1 contextualizes the new estimates of subsidies from this report compared to other energy subsidy estimates in China.

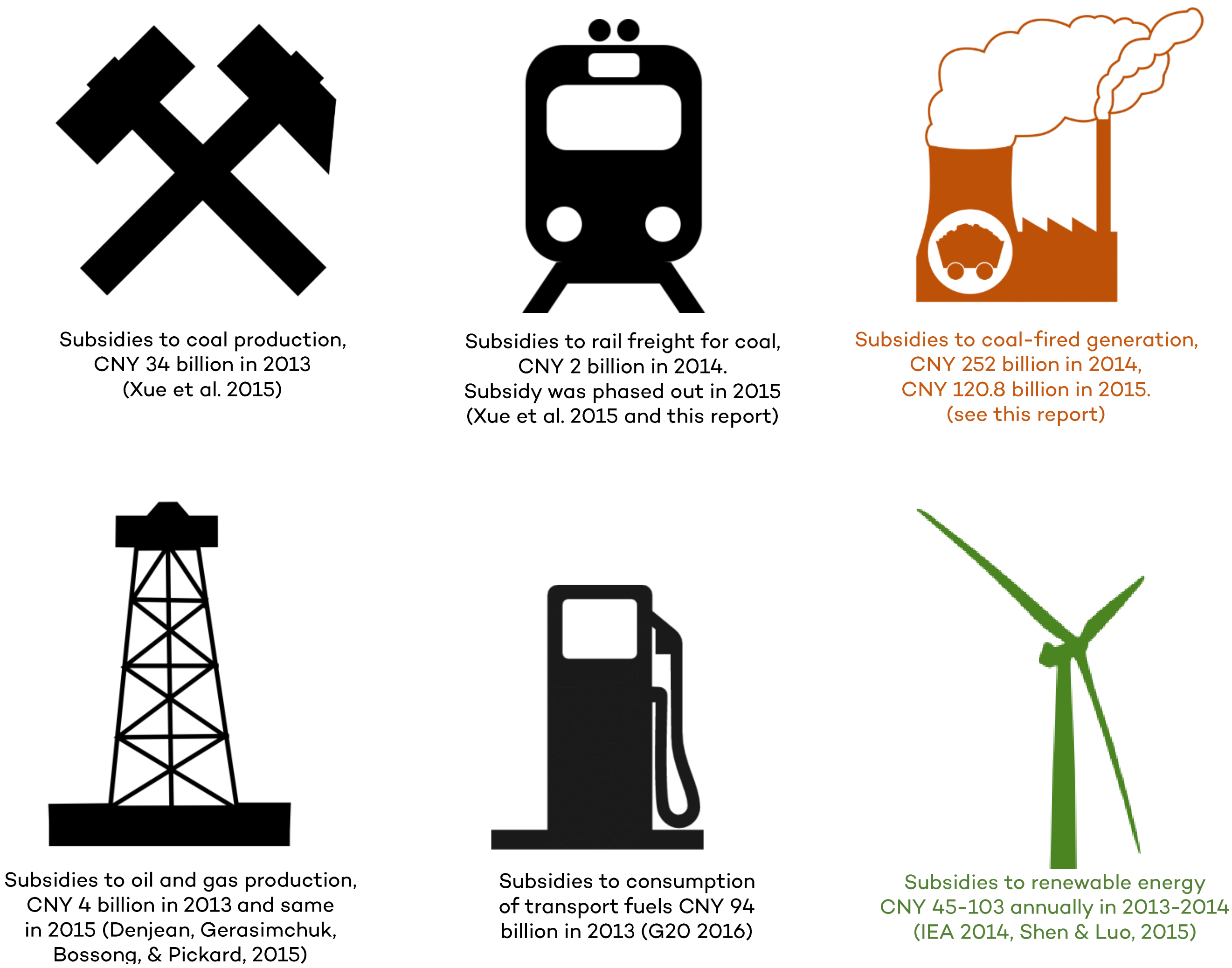

FIGURE 1: MAPPING THE ESTIMATES OF VARIOUS FFS IN CHINA BASED ON PREVIOUS RESEARCH AND NEW FINDINGS FROM THIS REPORT (ROUNDED TO NEAREST BILLION CNY).

In 2015 GSI published first-of-a-kind estimates for ***producer*** subsidies to coal based on an inventory approach (Xue et al., 2015). This study identified CNY 35.7 billion in subsidies to coal producers in China not including credit support in 2013. Credit support is an important element of support and not insignificant (NRDC, 2015). Depending on the assumptions made, credit support is valued at between CNY 3.5 and 35.7 billion in 2013 (Xue et al., 2015). The large range here indicates the difficulties in assessing credit support and the need for further research in this area. Due to data limitations and the fast pace of reforms in China, the GSI estimates need further updates.

In addition to the subsidies to generators and coal producers that have been estimated by GSI, a number of other organizations have published subsidy estimates. These estimates tend to be estimates of consumer subsidies and are calculated based on the price-gap method. They also provide less information regarding the recipients of the subsidies and do not specifically differentiate between different end uses of coal.

The IEA (2012) used the price-gap approach to estimate that China had USD 1.24 billion coal consumer subsidies in 2011. Since 2012 the IEA has published estimates for oil gas and electricity, but it has not published a figure for coal consumer subsidies in more recent years. Total FFS were estimated by the IEA to be CNY 110 billion in 2014, down from CNY 140 billion in 2013.

In addition to aforementioned studies, the IMF produces both “pre-tax” and “post-tax” subsidy estimates for coal. The latter category includes externalities. The overall post-tax estimate was USD 1,630 billion in 2013 and USD 2,133 billion in 2015. Coal externalities make up the bulk of this estimate. Excluding externalities, the IMF estimates that, for all fossil fuels, not just coal, pre-tax subsidies were USD 7.21 billion in 2013 and foregone tax revenue is a further USD 71.23 billion. Pre-tax subsidies are based on IEA consumer subsidies data for coal in 39 countries and OECD producer subsidies data for coal in 16 countries between 2007 and 2011 (Clemense, 2013). Externalities of coal consumption such as health impacts of air pollution (WHO, 2014) are estimated at USD 2.53 trillion in 2013 and USD 3.417 trillion in 2015.

A number of national estimates are available for consumption subsidies, calculated via the price-gap approach by China-based researchers. Lin and Jang (2011) show that coal consumer subsidies were CNY 53.2 billion (USD 6.99 billion) in 2007, and around CNY 158 billion (USD 23 billion) in both 2008 and 2010 (Lin & Ouyang, 2014).

4.0 Coal Generation Subsidies

This section presents GSI's estimates of subsidies to coal power generation, including an outline of the scope of the estimates and a description of any calculations and methodologies used to determine their impact.

4.1 SUMMARY OF COAL GENERATION SUBSIDY ESTIMATES

The inventory approach has identified 14 subsidies that were operational in the period 2013–2015. An overview is presented in Table 1. Detailed descriptions of each subsidy listed in the table are provided in Section 8. Of these, six have been quantified based on official data, other sources and certain assumptions. The total value of quantifiable subsidies is CNY 252.4 billion (USD 37.7 billion) in 2014 and CNY 120.8 billion (USD 18 billion) in 2015.

TABLE 1: SUBSIDIES TO COAL GENERATORS IN CHINA

REPORT SECTION NUMBER	SUBSIDY	DESCRIPTION	VALUE (CNY BILLIONS)	
			2014	2015
CROSS CUTTING SUBSIDIES				
4.2.1	Mergers and acquisition support	A range of incentives that include: tax breaks, laid-off worker reallocation allowance, interest subsidy, credit support, power purchase guarantees and land-use permission	n.c.*	n.c.
4.2.2	Subsidies to “zombie” companies	Subsidies designed to prop up coal companies that make consistent losses	n.c.	n.c.
DIRECT AND INDIRECT TRANSFER OF FUNDS AND LIABILITIES				
4.3.1	Subsidies for investment in emissions abatement equipment	Grants for retrofitting gas clean up equipment provincially (2015) and investment and maintenance expenditure nationally (2014)	130	0.2
4.3.2	Investment in coal-to-liquid and gas research and infrastructure	Investment by Yankuang group in coal-to-gas	6.5	6.8
4.3.3	Credit support	Preferential export buyers' credits, export sellers' credits, mixed credits, natural resource-backed loans or lines of credit, concessional loans	n.c.	n.c.
4.3.4	Rail freight investment	Various investment in infrastructure, e.g., the Shanxi South Central Railway and a “mega coal corridor” linking Inner Mongolia with Jiangxi	n.c.	n.c.
4.3.5	Power grid investment	Domestic investment in grid infrastructure and investment in the One Belt One Road scheme	n.c.	n.c.
4.3.6	Industrial restructuring funds	Restructuring and workers' resettlement fund	n.c.	n.c.
GOVERNMENT REVENUE FOREGONE				
4.4.1	Tax regime for coal generation	Foregone tax revenues including exemptions from land-use tax, value-added tax on heat sales, and estate tax	n.c.	n.c.

PROVISION OF GOODS OR SERVICES BELOW MARKET VALUE				
4.5.1	Providing rail freight transportation below market rate	Increase in rail freight tariffs	1.9	n.c.
INCOME OR PRICE SUPPORT				
4.6.1	Delays in passing through price reductions	Systemic delays in passing through price reductions to consumers through lower tariffs	n.c.	n.c.
4.6.2	Priority dispatch of coal over renewables	Value of curtailment in Liaoning, Jilin, Hei LongJian and East Inner Mongolia	n.c.	6.9
4.6.3	Power purchase guarantee and premium rate for low-emission plants	Premiums and power purchase guarantees for plants fitted with cleaning equipment and a premium for meeting emissions standards	94	106.9
4.6.4	Power purchase guarantee for closing of inefficient plants	Operators are awarded power purchase agreements for plants that continue to operate in exchange for closing smaller, inefficient plants.	20	n.c.
4.6.5	Raising import tariffs	The introduction of a 6% import tariffs on coal in starting in 2014	n.c.	n.c.
TOTAL			**252.4**	**120.8**

** "n.c." indicates that the subsidy has not been calculated*

4.2 CROSS-CUTTING SUBSIDIES

4.2.1 Mergers and Acquisition Support

In order to make both producers and consumers of coal more resilient to price changes, the industry has undergone a process of integration. This process has been supported by government; for example, with credit support or power purchase guarantees, these measures are considered a subsidy.

Power companies looked to actively acquire shares of upstream coal mines or for a long-term coal purchase agreement to protect themselves from price increases, and coal producers sought collaboration with generators to protect themselves from price falls. As overcapacity and debt issues in the coal industry increased, coal-power integration has been discussed as one possible solution, though whether this model should be widely promoted is still being debated. In April 2016, NDRC released a policy on coal and power integration in order to speed up energy structure adjustment (NDRC, 2016). The policy encourages large power generators near coal mines to take the business model of coal-power integration in order to lower investment, decrease operational costs and improve competitiveness. Cross shareholding is one of the most popular ways to collaborate. By the end of 2014, the five major power generation groups held the share of annual coal production capacity at 320 million tonnes, equivalent to 20 per cent of their coal consumption for power generation at that year (Chinacoal, 2015). On the other hand, coal production enterprises nationwide held the share of coal-fired generation for 0.14 billion kilowatt-hours (kWh), accounting for 17 per cent of the total coal-fired installations (Sina Finance, 2016).

This report identified one example of this process of integration being driven by provincial government, though it may exist elsewhere. In Shanxi province a range of incentives have been introduced since 2012 that include: tax breaks (income tax and land contract tax), laid-off worker reallocation allowances, interest subsidy, credit support, power purchase guarantees and land-use permission (Shanxi Provincial Commission of Economy and Information Technology, 2014). As a result, by 2015, 80 per cent of coal power plants (above 200,000 kilowatt [kW] capacity) were in collaboration with coal production enterprises (B. Wang, 2016).

4.2.2 Subsidies to "Zombie" Companies

According to a statement by the State Council, companies that have made losses in three consecutive years or more may be considered "zombies" (State Council of the People's Republic of China, 2015). "Zombie" companies no longer make profits, have high debts and rely on bank finance to continue their operations. It is reported that the coal industry has more zombie companies than many other industries (Nie, Jiang, Zhang, & Fang, 2016). Zombie companies are barriers to industrial restructuring and coal phase-out efforts.

Several reasons have been suggested that explain the persistence of zombie companies, including their local importance as employers, their political influence and the reluctance of banks to see the failure of companies that already have large debts. In the coal industry, a belief that coal demand may bounce back and prices might one day rise again is still prevalent. Further discussion on zombie companies is presented by Nie et al. (2016).

Subsidies to prop up so-called zombie companies have not been possible to quantify in this report. However, understanding the role of state-owned banks and their support to the coal industry is important.

4.3 DIRECT AND INDIRECT TRANSFER OF FUNDS AND LIABILITIES

4.3.1 Subsidies for Investment in Emissions Abatement Equipment

The coal power sector in China is actively promoting investment in emissions abatement equipment to reduce air pollution. Where investment is supported by the government through direct investment, credit support or preferential rates offered for generation from cleaner plants, this is considered a form of subsidy.

The policy to promote this emissions abatement equipment is outlined in China's Action Plan for Air Pollution Prevention and Control (2013). The action plan sets out plans for the introduction of tax reductions for coal generators to reduce emissions of sulphur dioxide, nitrogen oxide and particulates (State Council of the People's Republic of China, 2013). Since this action plan was put in place, there has been significant progress in improving coal generators by retrofitting emission abatement equipment to existing units, building new units and retiring poor performing units under 300,000 kW capacity. By the end of 2014, 80 per cent of units were installed with equipment to reduce nitrogen oxide, 92 per cent with desulfurization equipment, and almost all units had installed particulate filters (Think Tank Changce (长策智库) Thinkgtank, n.d.).

Other polices that have influenced the installation of emissions abatement equipment include the Action Plan for Energy Development Strategy (2014–2020) (State Council of the People's Republic of China, 2014), the Action Plan for Upgrading and Retrofitting Coal Power Plant for Energy Efficiency and Emission Reduction (2014–2020) (State Council of the People's Republic of China, 2014) and the Law of Air Pollution Prevention and Treatment (Standing Committee of the National People's Congress, 2015).

Subsidies are provided in the form of a premium price for electricity sold by generators that have retrofitted gas clean-up equipment and those achieving low emission standards. Generators that have installed gas clean-up equipment are also understood to receive power purchase guarantees for retrofitted plants. These subsidies are classified as income or price support and covered in more detail in Section 8.3.4.

Direct investment support in the form of grants for retrofitting gas clean-up equipment is also evident at the provincial level. It is estimated that in some provinces around 10–30 per cent of investment costs could be covered by government funding (China Electricity Council, 2014). Our research was unable to identify the policy instruments that provide these grants, but did find evidence that they are in fact provided. Shaanxi, province for example, provided a subsidy of CNY 10,000 per MW for coal generation capacity in 2015 to install gas clean-up equipment. Total expenditure on this subsidy was reported to be CNY 150 million in 2015 (Xiao, Ma, & Li, 2016). In Shanxi province emissions abatement, de-dust, desulfurization and denitration equipment for sulphur dioxide and nitrogen oxide particulates was retrofitted to 17,400 MW, 12,400 MW and 12,000 MW of capacity respectively in 2014 (Department of Environmental Protection of Shanxi Province, 2015). Based on average costs for retrofitting[1] and local government support of 10 per cent of the investment, the cost of these subsidies is estimated to be between CNY 1.41 billion and 2.16 billion. At a national level, investment in low-emission equipment was estimated to be CNY 50 billion in 2014 with a further CNY 80 billion for maintenance during operation (China Electricity Council, 2015b).

On December 2, 2015, at the routine meeting of the State Council hosted by Premier Li Keqiang, the State Council emphasized that actions need to be taken to complete the installment of emission-abatement equipment on all coal-fired power units by 2020 (State Council of the People's Republic of China, 2015). In order to achieve this, policy support such as credit and bond issuance, central government's air pollution prevention and treatment fund should be put in place. It is estimated that a total investment of CNY 40.5 billion will be required for this goal (Lu, 2015).

4.3.2 Investment in Coal-to-Liquid and Gas Research and Infrastructure

Technologies that convert coal to liquid and gas are linked with power generation, since coal liquids and gas are used as feedstock for generation. With the drive to lower particulate emissions (Municipal Government of Beijing, 2012), electricity generators using coal liquid and gas as a fuel are seen as a cleaner technology. For this reason, subsidies to coal-to-liquid (CTL) and gas were evaluated as part of this study.

Between 2000 and 2015 nine major CTL and coal to synthetic natural gas projects were commissioned and a total of 15 approved across China, including pilot/test and more advanced projects (Xu, Yang, & Li, 2015). Prior to 2010, national support for liquefaction projects amounted to USD 10 billion (hydrocarbons-technology, 2016). CTL projects have primarily been developed by SOEs (particularly Shenhua and Yankuang groups). As these are demonstration projects, the investment has been considered a subsidy. As such the CNY 20 billion (USD 3.2 billion) investment over the past three years by Yankuang group is included as a subsidy (C. Liu, 2015). Investment in CTL is expected to grow along with forecasted increases in production capacity (i.e., from 10 Mt of per annum in 2017 to 30 Mt in 2020) (NDRC, 2014b). With a further 50 plants planned across the country, the subsidy figure is likely to grow significantly (Ottery, 2014).

In parallel with CTL production development, a CNY 14.2 billion program of investment in four CTL-dedicated pipelines started in 2007, although not all of this investment was to benefit generators (Minchener, 2011).

[1] The average cost of retrofitting denitration and desulfurization equipment is 100-150 yuan/kw, and for dedust is 50-100 yuan/kw (NEA, 2011)

4.3.3 Credit Support to Investment in Coal Generation

Credit support is the provision of finance below market rates. If government-backed financial institutions were instructed to provide low finance at low rates of interest to a particular type of project, then this would qualify as a subsidy.

A previous report explored the value of credit support to coal producers. The report concluded that credit support is likely to artificially reduce the cost of borrowing for coal producers, and that this reduction in interest rates, estimated to be between 0.5 and 5 per cent, could be providing a subsidy of between CNY 3.5 billion and CNY 35.68 billion in 2013 (Xue et al., 2015). To apply these same assumptions to coal generators, the total investment in coal generators is reported to be CNY 94.9 billion in 2014 and CNY 106.1 billion in 2015 (China Electricity Council, 2016). A reduction in the cost of finance due to credit support across the annual investment made in 2014 would provide a subsidy to these newly installed coal generators of between CYN 475 million and CNY 4.75 billion in 2014 and between CYN 530 million and CNY 5.3 billion in 2015. These subsidies would persist as long as lower interest rates were available, so the subsidy provided would be cumulative as new capacity is added each year. These illustrative calculations demonstrate the potential importance of credit support as a subsidy to coal generators, but there is insufficient data available to accurately estimate the reduction in interest that may be available to coal generators. Due to this uncertainty, credit support to coal generators is not included in the overall subsidy estimate presented in Table 1.[2]

China invests a significant amount in coal projects outside of China, almost all of which is through SOEs. In 2015 this outward investment in coal totalled CNY 10.3 billion and included investment in both coal extraction and power (American Enterprise Institute, 2016). According to Bast, Godinot, Kretzmann and Schmidt (2015), 92 per cent of total Chinese coal investments between 2007 and 2014 were devoted to coal power plants, with the remaining 8 per cent going to coal mining. Year to year there is significant variability in the value of outward investment, but the longer-term trend appears to be an increase (Figure 2). The value of outward investment in 2015 was considerably lower than in 2014 (CNY 16.7 billion), but no judgement has yet been made as to whether this reduced investment will continue.

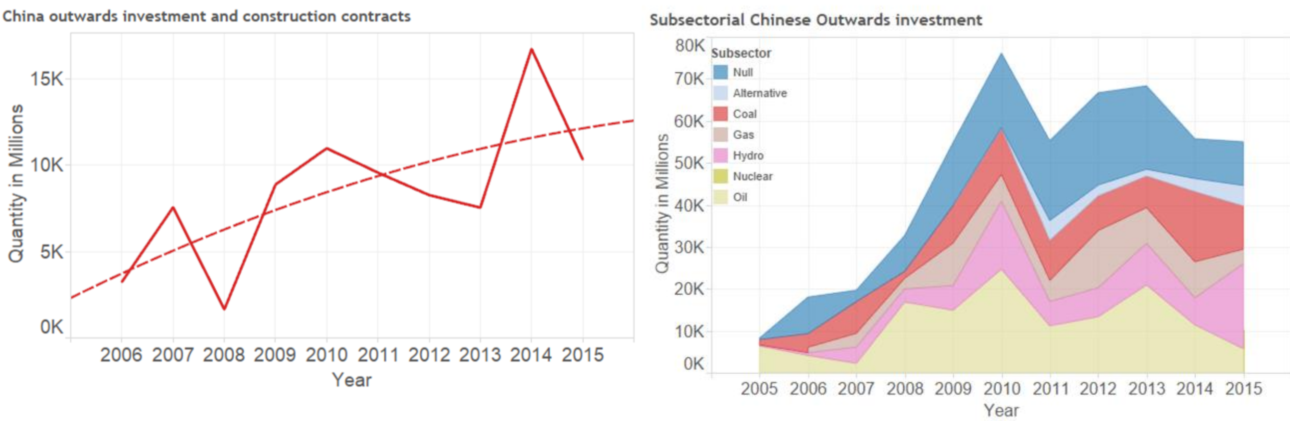

FIGURE 2: TRENDS IN CHINESE OVERSEAS FOREIGN DIRECT INVESTMENT LEFT: OUTWARD INVESTMENT AND CONSTRUCTION CONTRACTS IN COAL WITHIN THE ENERGY CATEGORY BETWEEN 2006 AND 2015. RIGHT: SUBSECTORIAL INVESTMENT IN ENERGY DURING THE SAME PERIOD

Source: China Global Investment Tracker

[2] For further discussion of credit support see Xue et al. (2015)

China, like many other countries, supports outward investment by providing export credit through quasi-governmental institutions such as the China Development Bank and the China Export and Credit Insurance Corporation. This support comes in various forms, including preferential export buyers' credits, export sellers' credits, mixed credits, natural resource-backed loans or lines of credit, concessional loans and export special economic zones (DG EXPO, 2011). As an example, USD 800 million and USD 700 million have been granted respectively in loans and sovereign guarantees for the construction of a coal-fired power plant in the China Pakistan Economic Corridor in 2015 (Dawn, 2015). A similar example of governmental financial support can be found in Sri Lanka for the Lakvijaya Power station, where USD 450 Million—the full cost of the first phase of investment—was provided in two loans with interest rates of 2 per cent and 6 per cent, respectively (Sri Lanka Ministry of Power and Rewnewable Energy 2016). Because enterprises in receipt of this finance receive preferential rates for credit and insurance—lower than could be achieved by market rates—this is considered to be a subsidy. Unfortunately, information about the terms of such agreements is not consistently available, so assessing the size of the subsidy is difficult. Between 2007 and 2014 China was reported to be the second-largest provider of international public finance for coal-fired power, so the scale of the subsidy is likely to be significant (Bast et al., 2015).

4.3.4 Rail Freight Investment

The transport of coal from coal mines to generators is a key logistical issue for the industry. The geographical mismatch in supply and demand of coal means there is a large requirement for coal transportation that is mostly met with rail freight.

Investment in rail has been put in place to meet the demand. This investment could constitute a subsidy if the investment is partly funded through government grants, subsidized loans or other measures that reduce the cost of investment. An investment is not a subsidy if the infrastructure that is funded by that investment is operated commercially, paying commercial rates of interest on debt, or covering operating expenses and returning profits to shareholders by generating revenues from the sale of transport services. Without detailed project-level financial information, it is difficult to assess the extent to which the rail infrastructure investments are being run as businesses or providing a subsidy to generators in the form of low-cost freight. To establish whether a subsidized investment may be benefiting a particularly industry, it needs to be determined whether the infrastructure was constructed for the exclusive use of that industry or a significant share of it. For example, a subsidy to a rail line that exclusively transports coal is a subsidy to the coal industry, whereas as it is less clearly a subsidy to coal if the rail line is also used for general freight and passengers. SOEs and nationalized industries may be more likely to make non-commercial investments, as they are subject to greater political influence.

Despite the uncertainty over whether investment in rail infrastructure can be said to be a subsidy, there have certainly been some significant investments made. The Shanxi South Central Railway, a dedicated line for the transport of coal costing CNY 10.4 billion has been constructed and is 34 per cent owned by China Rail Corp and 20 per cent owned by the provincially owned Shanxi Energy & Transport Investment. The majority of the funding was made available by Bank of China Group (CNY 7.5 billion) (Railway Gazette, 2015). The terms of this financing is not clear, but it is possible that the rates are below market rates. In addition to Dagin Railway, running from Datong, Shanxi to Qinhuangdao, Hebei, which transports 0.4 billion tonnes of coal each year, Mongolia China Railway, starting from Inner Mongolia and ending at Ji'an, Jiangxi province, is another important coal transportation route. This special coal line is under construction and expected to operate by 2020 with a capacity of 0.2 billion tonnes of coal each year. Other major coal-transporting railways include the Dagin railway, running from Datong, Shanxi to Qinhuangdao, Hebei; and the Yanshi, Menhua and Shenhua railways.

The Chinese Ministry of Transport funds 20 per cent of the CNY 60 billion construction of a dedicated "mega coal corridor" that links Inner Mongolia with Jiangxi, and the balance (80 per cent) is funded by local governments, local businesses and energy enterprises (Cornot-Gandolphe, 2014). Historically, publicly owned companies have primarily invested in China's rail infrastructure, though this is beginning to change. In 2012 the Ministry of Railways opened up investment opportunities to the private sector, but some analysts currently do not consider long-term investment by private sector actors attractive (KPMG, 2013).

To estimate the total investment in coal-related rail infrastructure for the transport of coal, the investment of CNY 155 billion in high-speed rail used for passenger services was subtracted from the total investment in rail infrastructure (CNY 810 billion). Assuming that in 2015 around half of the national value of rail freight is used for coal, and the level of public investment is 86 per cent as reported by Wan & Liu (2009) for the period up to 2005, the total public investment in rail infrastructure for coal is CNY 281 billion (Powell, 2009; Z. Wang, 2016). It is not possible to estimate what proportion of this figure can be described as a subsidy, but given the size of the investment it may be significant. Transportation is estimated to account for 18 per cent of the final cost of coal (Yang, Zeng, Xue, Wang, & Li, 2015), so the provision of low-cost transport infrastructure could make a large change to the cost of operating coal-fired electricity generators. To evaluate what proportion of coal-related rail infrastructure is a subsidy, a project-level analysis would need to consider the profitability of investments and the cost of finance compared to the rates available from commercial lenders.

4.3.5 Power Grid Investment

Generators benefit from investment in the electricity grid by the state. Untangling exactly how much different generators benefit from investment is, however, quite complicated and varies widely according to the region and project. For example, Zhao, Zhang, Zou & Yao (2013) present information on the proportion of investment specific to wind generation in the Northern Grid Region, finding a range from 8 per cent of investment to nearly 100 per cent. This very wide range highlights the difficulties of assigning grid investment to a particular type of generator.

Investment in the power grid does not in itself constitute a subsidy. If infrastructure is constructed in response to demand and the users of the infrastructure pay fees that allow the infrastructure to be operated and recover the capital costs, then there is no subsidy. However, if infrastructure is operated on a non-commercial basis, it is effectively providing a subsidy to the generators.

To get an idea of the scale of any potential subsidy, the investment in grid infrastructure that supports each technology is considered. To arrive at an estimate for how much grid investment can be said to have been made for each technology, NDRC figures for grid investment were divided by the generators in the electricity mix. It was assumed that plans to reduce the thermal contribution of electricity generation from 71 per cent in 2015 to 62 per cent by 2020 come to fruition (authors calculation based on Statistical Year Book [2014] and Out-Law [2015]). Based on this calculation, annual investment in coal-related power grid infrastructure will be equal to CNY 222 billion over the next five years. If it can be shown that this investment is not operated on commercial terms, then some fraction of this should be considered a subsidy.

Some of this investment includes preliminary work for creating grid connections beyond China's borders—the One Belt One Road scheme aims to link China with central Asia and beyond, and has been mooted as being able to facilitate the sale of electricity to Germany (Financial Times, 2016). Similarly, the "energy internet" concept is being championed by China as a way of creating international power grids using ultrahigh voltage lines that can cope with future energy demands, in particular from increased deployment of renewables. Additional research will be required to determine the extent to which grid investment can be considered a subsidy to coal generators.

4.3.6 Industrial Restructuring Funds

Because of their age and volume, small thermal generators in China have had a detrimental effect on energy consumption and environmental pollution. In response to this, the NDRC and the Energy Bureau started to instigate the closure of small thermal plants (State Council of the People's Republic of China, 2007). This process started in 1999 with the size of power plants targeted going from 50,000 MW in 1999 to 300,000 MW in 2015. The speed at which capacity was been shut down increased dramatically up until 2010, and then slowed as room for further closures became limited. Only half of the capacity closed down between 2005 and 2010 was expected to be closed between 2010 and 2015 (Yuan, 2011). As a result of this slowdown, focus has shifted to the retrofitting and installation of equipment to reduce emissions and energy consumption (see sections 4.6.2 and 4.6.3). Even so, as the threshold of retiring small units has been increased further, during the 13th FYP (2015–2020), 20 GW of capacity of thermal power units under 300,000 MKW capacity are to be retired.

The main policy tool to drive the closure of plants has been administrative, including: constraint on connection to grid, limiting access to finance and lowering on-grid electricity price. Nevertheless, the direct economic cost from the public budget is still large. The cost of these activities during 2006–2010, is estimated to be CNY 32.8 billion. This includes direct subsidy to closing (CNY 2 billion from central government and the rest from local government), investment to build new grid and reallocation, and the cost to laid-off workers (Think Tank Changce (长策智库) Thinkgtank, n.d.).

There is no evidence of direct subsidies from national government for small unit shutdown after 2011; however, local level subsidization still exists. These subsidies come in two forms: direct subsidies to enterprises and power purchase agreements. No information on the size of these is available.

4.3.7 Investment by SOEs

In China, investment in energy production and power generation is dominated by government. Just over half of investment in coal power comes from government, including entities that are entirely or majority-owned by government (Denjean, Gerasimchuk, Bossong, & Pickard, 2015). Much of this investment comes from SOEs, defined by the OECD as "enterprises where the state has significant control through full, majority, or significant minority ownership" (OECD, 2004). The SOE sector encompasses a wide range of business models, with some operating in a similar manner to their private competitors and others being less commercial and directed much more by government strategy.

SOEs in China are owned (completely or partly) through the State-Owned Assets and Supervision and Administration Commission. In addition to those directly owned by the state, there are SOEs that are majority owners of enterprises that are not officially considered SOEs but are effectively controlled by their SOE owners. Finally, there is a group of entities that is owned and controlled indirectly through SOE subsidiaries based inside and outside of China. Together this group of organizations accounts for more than 40 per cent of China's non-agricultural GDP (Szamosszegi & Kyle, 2011). Some SOEs depend on budgetary transfers from government to remain in operation. This in addition to government having majority ownership in SOEs gives the state a large level of control in decision-making and financing with regard to SOEs (Denjean, Gerasimchuk, Bossong, & Pickard, 2015). SOEs are significant actors in both coal production and generation in China and have been involved in the process of the vertical integration of these two sectors, a process that has received significant public support.

A lack of information on government-SOE transfers and the distribution of investment make it very difficult to identify the amount of investment from SOEs that confers to a subsidy. The types of subsidies identified below are those where SOE involvement makes estimating subsidies more complicated:

- Investment in CTL and gas
- Outward investment in coal generation
- Providing rail freight transportation below market rate
- Gas clean-up equipment to reduce nitrogen oxide, sulphur dioxide and particulates

Further work is needed to evaluate the role of subsidies and access to finance in SOE decision-making processes both in China and abroad.

4.4 GOVERNMENT REVENUE FOREGONE

4.4.1 Tax Regime for Coal Generation

When tax rates are reduced or exemptions are provided to a particular industry, the government foregoes revenues that would otherwise be collected. This creates an effective subsidy to that industry. The cost of the subsidy is equal to the cost of the taxes that would otherwise have been collected. To assess the level of subsidy, the applicable rates can be compared with standard or benchmark tax rates from similar industries.

Decentralized fiscal policy in China makes it difficult to assess the full effects of tax on coal generation across China (Shen, Jin, & Zou, 2012). Looking at provincial-level case studies can give some insight as to the likely effects. Zhao et al. (2013) looked at the relative burden of tax (value-added, feed-in tariff, corporation, urban maintenance and construction, stamp) for wind and coal generation in Jilin province and found that it was higher for thermal power than for wind generation, both per year and over their lifetime. While this is a useful comparison, as it suggests coal does not benefit from the tax regime more than other forms of generation, it does not give any indication of whether coal generation is made more viable or profitable through the tax system. Benchmarking against a wider set of industries might be useful in this respect.

The recently published G20 (2016) subsidy peer review identified nine policies that are considered to provide subsidies to fossil fuels. Of these, three may provide subsidies to coal generators. First, a policy of exempting thermal power stations from land-use tax in cities and towns reduces the operational expenses of generators and causes the government to forego revenue that would otherwise be collected. Thermal generators may also sell heat, distributed via district heating systems. Two policies designed to reduce taxes on heat sales may provide a benefit to coal generators. First, value-added tax exemptions are given for heat sold to individual residences. Second, heat supply enterprises, which may be owned by coal-fired electricity generators and distributing coal-fired heat, are exempt from real estate tax and urban land-use tax. Cost estimates of these policies are not published in the peer review (G20, 2016). It should be noted that the sale of heat from thermal power plants increases their operating efficiency, but it is not clear whether these subsidies have net negative impacts.

This review found some further evidence of tax policies that subsidize coal generation, but it has not been possible to assess their size. For example, sources made reference to tax breaks for generators meeting air quality standards (State Council of the People's Republic of China, 2013). In Shanxi province, reductions in income tax and land contract tax were identified. These were introduced with the objective of speeding up the merger and acquisition process for vertical integration of coal-electricity (Shanxi Provincial Commission of Economy and Information Technology, 2014). Further work is needed to determine the extent to which the tax system provides subsidies to coal-fired generators.

4.5 PROVISION OF GOODS OR SERVICES BELOW MARKET RATE

4.5.1 Providing Rail Freight Transportation Below Market Rate

In China, the Chinese Railway Corporation (CRC) has a monopoly on the railways, and freight service prices are regulated by the NDRC. The Ministry of Transport and the State Railway Administration, which oversees the CRC, transferred the operation and infrastructure development to an SOE in 2013 with the aim of solving some of the debt problems it faced. However, in 2016 the Chinese Railway was still running a deficit (CNY 8.73 billion between January and March), up by 35 per cent on 2015 (Zhong & Lyu, 2016). This suggests that, at present, the cost recovery model of Chinese railways is still not sufficient to recover the massive cost of long-term investment. This indicates that there is an effective subsidy through the provision of rail freight service below the market cost of delivering this service.

Generators receive a benefit because they pay a lower rate for the transport of coal than if the CRC priced freight at cost-recovery levels. Since the CRC is state owned, the deficits will ultimately be the responsibility of the government. In practise, any measures that use government funds to forgive debts that have been accrued or that transfer the debt to another agency would constitute a subsidy to the CRC. This, in turn, provides a subsidy to the coal generators and other transporters of freight. When publicly owned organizations rack up deficits, either customers must eventually pay through higher prices or the government must step in with subsidies. It remains to be seen how the deficit of the CRC will eventually be resolved.

To give an indication of the possible size of the subsidy to generators from the provision of low-cost rail freight, a recent price rise is considered. In 2014 the NDRC increased transport tariffs in order to ease the burden on CRC. The average tariff rose by CNY 0.03 per tkm from CNY 0.13 per tkm (NDRC, 2015). It is assumed that, before, the price rise tariffs were set at a level below cost recovery and the recent price rise effectively brings the tariffs up to cost-recovery levels. Since the deficit is large, it is unlikely that this rise will actually achieve cost recovery, so this calculation may be considered very conservative.

Under this assumption, the subsidy that was in place before the price rise has been eliminated. The size of the original subsidy is equal to the magnitude of the price increase. Based on average distance travelled and volume transported in 2012, this price support would equate to a subsidy of **CNY 1.92 billion** (Wang & Ducruet, 2014). Similarly, additional price increases of CNY 0.01 per tkm have been announced for four railways, as well as an end to special rates for a further 13. Unfortunately, data was not available to estimate the value of these. Previous estimates for rail tariff subsidies to coal producers in Inner Mongolia gave a subsidy of **CNY 7.2 billion** (Xue et al., 2015). This all suggests that that our original value of CNY 1.92 billion is an underestimate.

These estimates are rather uncertain based on the assumptions involved. However, it is clear that the deficit of the CRC indicates that generators are benefiting from lower cost transport costs than would be the case if all costs were considered.

4.6 INCOME OR PRICE SUPPORT

4.6.1 Delays in Passing Through Price Reductions to Consumers

Consumer electricity tariffs are regulated in China. A lag between an increase in market prices and a revision of consumer tariffs can result in a temporary reduction or increase in profitability. If operating price increases are passed through more rapidly than price reductions, then there can be a consistent bias leading to a subsidy. This phenomenon is sometimes described as "up like a rocket down like a feather." If price changes are consistently in one direction, then price lags could also be said to confer a subsidy.

In China the sustained increases in market coal prices between 2002 and 2012 (Figure 3) and the delay to pass through coal price rises to consumers in the form of higher electricity prices have led to losses for generators. Power companies are estimated to have lost the equivalent of USD 2.3 billion in the first half of 2011 when coal prices rose, but they were not able to pass on the costs (Ma, 2011). Analysis by Liu, Margaritis and Zhang (2013) shows this lag to be asymmetrical in that cost increases are passed on more rapidly than cost decreases. Perhaps more significantly, only a small proportion of cost increases is passed through to consumers: 4 per cent for domestic and 23 per cent for industrial. This historical lack of complete pass through has acted as a subsidy to the end consumer, particularly domestic consumers, rather than generators.

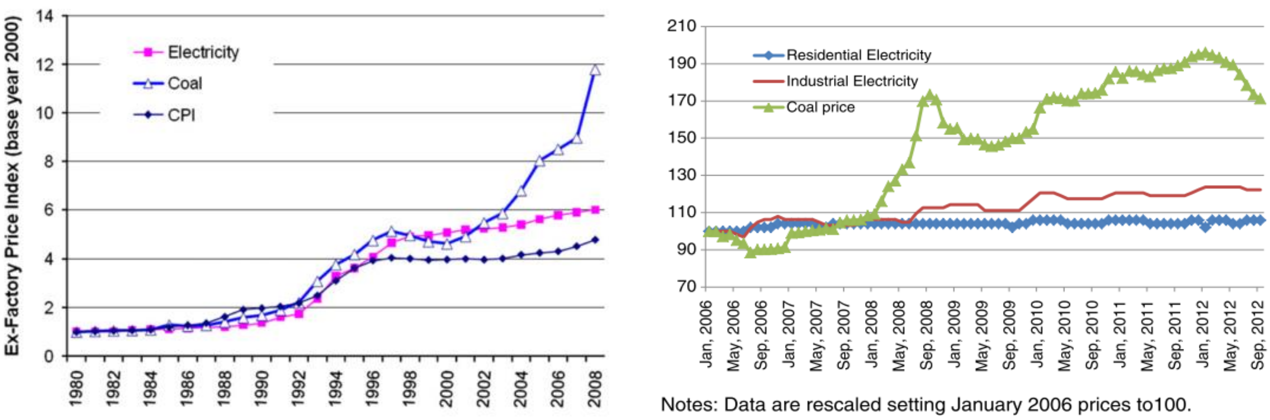

FIGURE 3: RELATIVE EVOLUTION OF COAL AND ELECTRICITY PRICES BETWEEN 1980 AND 2008 AND BETWEEN 2006 AND 2012

Sources: left: Ma (2001); right: Liu, Margaritis & Zhang (2013)

The tendency to pass through price increases faster than decreases would confer a subsidy if it has been repeated and is effectively part of government policy. The magnitude of the subsidy would be equal to the value of the price increase that would otherwise have been passed through. However, the literature suggests that not all price rises are passed through to consumers. Overall, there is not enough information to conclude whether the lag in passing through price changes provides a subsidy to generators.

4.6.2 Priority Dispatch of Coal Over Renewables

The dispatch of power from generators to the grid is critical in balancing supply with demand on the grid, making sure that the grid is in balance and that demand from consumers is met. Priority dispatch refers to the order of priority given to generators for dispatch on the grid in the event that generation capacity exceeds demand. The prioritized generator is assured that it can sell the produced electricity, and thus cover its costs. The chosen policy or mechanism has a large influence on the market for generation, affecting the grid price and its environmental impact.

In China, the NEA determines the responsibilities of dispatch organizations, which are currently Power Dispatch and Communications Centers (电力调度通信中心), that sit within the State Grid Corporation of China and are organized into five hierarchical levels. These five levels all develop dispatching rules and procedures—a situation that does not allow for centralized planning. In parallel to this decentralized dispatching system, China has traditionally—and to a certain extent still does—used demand planning as another mechanism to meet demand with existing capacity. China's dispatch system has not followed the widely used international system of merit order based on operational cost (see Figure 4 below). Under this principle, as operation costs are mainly driven by fuel costs, renewable energy often has priority, followed by the most fuel-efficient fossil fuel systems.

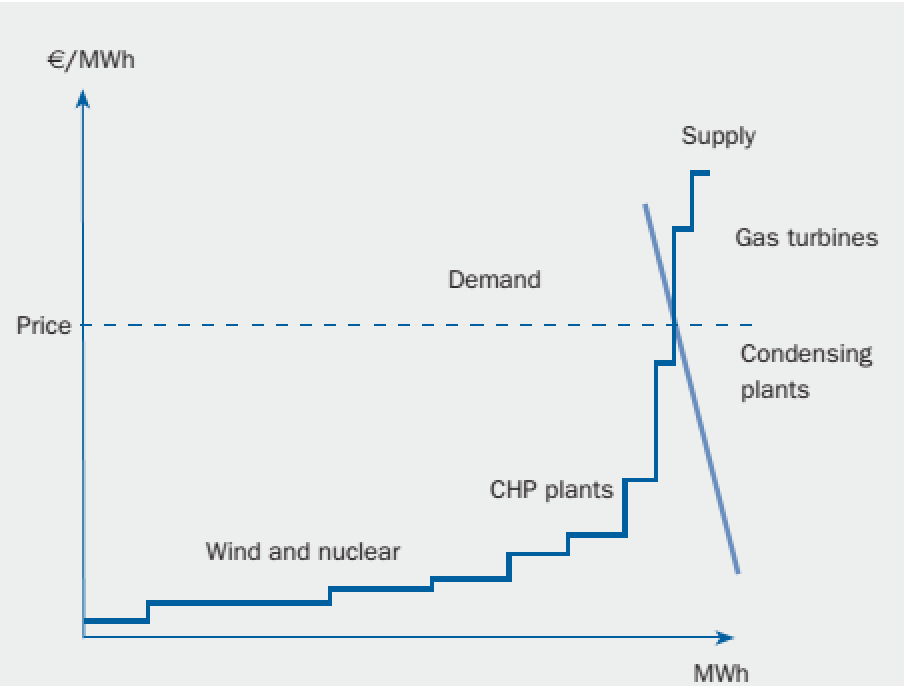

FIGURE 4: THEORETICAL MERIT-ORDER CURVE.

Source: Krohn, Morthorst, & Awerbuch (2009)

Prior to 2007, all coal power plants were allocated roughly the same number of operating hours, regardless of their energy efficiency. Now operating hours are attributed on a yearly basis by provincial planning agencies with annual and monthly output totals being included in annual contracts for generators. This system gives more access to the power market for high-emitting and less energy-efficient operators than a merit order would.

A number of policies are in conflict with the guarantees for coal generators and the apparent priority given to coal. In 2007 the State Electricity Regulatory Commission introduced regulatory measures that required full purchase of renewable energy subject to grid security constraints. In provinces that apply "energy-efficient dispatch," non-fossil resources are prioritized in the dispatch order (Kahrl & Wang, 2014). Article 42 of the 2015 Revised Air Law (Fanyunbo, 2015) and the Renewable Energy Power New Generation Guaranteed Purchase mechanism (NDRC, 2016) have both reconfirmed the principle of priority dispatch for renewable technologies in regulation. Despite this, curtailment of wind seems to continue: in March 2016, the Chinese Wind Energy Association reported curtailment in several provinces in the absence of any technical failure (Shepherd & Hornby, 2016). For the first six months of 2015 alone, the cost of curtailment is estimated at approximately CNY 3.5 billion if considered an average variable coal-based production cost of 200 CNY per MWh.

Since 2007, pilot programs have been launched in Jiangsu, Henan, Sichuan, Guangdong and Guizhou to assess merit order system feasibility. For example, the Energy Saving Power Dispatch Principle has a mandatory rule that gives dispatch to higher-efficiency units in the order of: renewable energy sources, nuclear power plants, CHP and then thermal power. Implemented nationally, this would fulfill China's commitment to green power dispatch as announced in the US-China joint presidential Statement on Climate Change in 2015 (The White House, Office of the Press Secretary, 2015). Implementation, however, remains at the provincial level and progress is slow (Ciwei & Yang, 2010). For example, in late 2010 the China Southern Power Grid began implementation in the five provinces under its jurisdiction.

The issue of dispatch clearly affects the ability of renewables to sell to the grid. Limits on grid infrastructure, particularly interregional infrastructure, are also considered a major constraint (Liu, 2016). A lack of grid connectivity prevents the distribution of power over greater geographical areas and therefore limits the scope for operators to match supply with demand. Curtailment has both technical and political elements. The technical constraints of the grid are beyond the scope of this paper.

The effective subsidy to coal is provided by the priority given to coal in the electricity system. For example, the value of electricity that is curtailed from the renewable sector, but delivered from coal generation instead, is considered to be supporting coal, and therefore could be considered a subsidy. To provide an estimate of this value, we considered the level of curtailment in four major coal-producing provinces: Liaoning, Jilin, Hei LongJian and East Inner Mongolia. The level of curtailment that could be considered a subsidy was calculated by comparing a theoretical minimum level of curtailment assuming wind was second in the merit order after CHP with the actual curtailment for each province (Zhao et al., 2013; Xinhua, 2016). This calculation gives a figure of CNY 1.5 billion in 2015. Taking a more bold approach, and assuming that all curtailment could be considered a subsidy to coal, the estimate becomes CNY 6.88 billion for 2015. This estimate should be considered as an upper bound and a likely overestimate of the subsidy, since technical issues play a role in curtailment and the value to the coal industry of the additional power purchased is likely to be considerably less than the total value of the electricity sold.

4.6.3 Power Purchase Guarantee and Premium Rate for Low-Emission Plants

Under the policy issued in March 2014 by NDRC and the Ministry of Energy, coal-fired generation units that are equipped with qualifying emissions abatement equipment are awarded the environmental protection premium, adding CNY 0.015, 0.01, 0.002 per kWh for operating equipment to reduce sulphur dioxide, nitrogen oxide and particulates respectively, based on equipped capacity and generation (State Council of the People's Republic of China, 2014). The proportion of capacity with emissions reduction equipment fitted was reported to be 92.1 per cent, 83 per cent and 23 per cent for sulphur dioxide, nitrogen oxide and dedust respectively (China Electricity Council, 2015a); and 92.8 per cent, 95 per cent and 23 per cent respectively in 2015 (China Electricity Council, 2016b). By multiplying these figures by the total generation, this report estimates that the total value of the subsidy provided by this policy is CNY 94 billion in 2014 and CNY 100 billion in 2015.

A series of measures were introduced to support the implementation of the Action Plan of Upgrading and Retrofitting Coal Power Plant for Energy Efficiency and Emission Reduction (2014–2020) issued by NDRC in September 2014 (see Section 4.3.1). For example, a premium payment is assured for generators that meet an "ultra-low" emission standard (CNY 0.01 per kWh for those connected to grid systems before January 1, 2016 and CNY 0.005 per kWh connected after). This emission standard is for the equivalent performance to gas power generation, considered a benchmark for low-emission generation. The subsidy is paid on an hourly basis when then the emissions standard is achieved. By end of 2015, there were 84 GW of "ultra-low" emission units, one tenth of the total capacity, and another 81 GW of capacity in the process of being retrofitted (China Electricity Council, 2015c). Based on average operating hours in 2015 of 4,329 hours, the cost of the ultra-low emissions subsidy is estimated to be CNY 3.6 billion for already installed capacity and another 1.8 billion for newly installed capacity in 2016.

In addition, power generation units that meet the ultra-low emissions standards are rewarded with an extra 200 hours in the annual electricity generation plan.

As well as offering premiums for retrofitting and meeting low emissions standards, the plan also guarantees purchase by the grid of an additional 200 hours from the generator in the annual electricity generation plan. We consider this a subsidy as it guarantees that level of dispatch over cleaner technologies for which dispatch is not guaranteed (see Section 4.6.2). In practise, plants that benefit from this may still get some of these hours with an improved dispatch mechanism. However, it is not possible to predict whether this is the case, so we consider the whole 200 hours to be a subsidy. By the end of 2015 there were 84 GW of coal power units installed with ultra-low emission technology. Based on average operating hours in 2015, the total eligible installed capacity and an average selling price of CNY 0.2 per KWh, the value of the purchase guarantee is estimated at CNY 3.3 billion.

4.6.4 Power Purchase Guarantee for Closure of Inefficient Plants

As part of the Chinese government's drive to close smaller, inefficient thermal plants (see Section 4.3.6) compensation has been offered to operators in the form of power purchase agreements. The scheme was introduced on January 26, 2007 and intended to guarantee lost revenues from closed power plants by assuring the purchase of equivalent amounts of electricity generated by more efficient power plants from the same generator (State Council of the People's Republic of China, 2007).

The scheme offers a power purchase agreement to plant operators equal to generation for three years of the closure of units that are distributed to other units that continue to operate. For instance, Beijing Energy Group shut down four 220 MW coal power units in Shijingshan in 2015 to due to policies to limit air pollution. The group was compensated 2.7 TWh of guaranteed power generation equal to CNY 900 million in 2015 (Beijing Energy Group, 2016). Henan's Zhoukou Longda Power Station is another example: the shut-down of two 135 MW coal-fired units in 2015 is to be compensated with 810 GWh of generation (Henan NDRC, 2015). If the same principle is applied to all retired capacity in the 12th FYP period, then the total monetized compensation in 2013 and 2014 is CNY 13.6 billion and CNY 5.6 billion respectively (Wu Xinxiong, 2014). Although this is not a direct subsidy, it still effectively subsidizes the sector as it guarantees income that would otherwise not necessarily be available if a market-based approach was taken to power allocation.

4.6.5 Raising Import Tariffs

Until recently, a rising share of Chinese provinces (17 in 1986 to 26 in 2000) suffered from a shortage of coal. This bottleneck drove China's shift from being a net coal exporter to coal importer in 2009, but it also changed the opportunity costs for coastal provinces. Fujian, Hainan, Guangxi or Guangdong were relying on either coastal transfer or imported coal to reduce coal costs in the face of increasing inland transportation costs.

After decades of removing coal import barriers, the recent fall in prices after 2012 and the dramatic reduction in coal mine profitability triggered a sudden change in policy. A new 6 per cent import tariff on thermal coal was announced end of 2014. Major Chinese coal producers responded by raising prices to reflect the higher costs of imports. For example, Shenhua Group raised its prices for all kinds of coal by CNY 15 per tonne in response to tariff increases (Zhao, 2014). This is clearly a disadvantage to coal generators and likely not a subsidy.

The longevity of these import tariffs is, however, in question, as, according to the new China-Australia Free Trade Agreement, coking coal imported from Australia should have zero tariffs as of July 2015 and steam coal will decrease to zero by 2017 (Xue et al., 2015). As Australia contributes 50 per cent of import of steam and coking coal in China, the agreement will significantly reduce the effect of tariffs and put downward pressure on prices. The effective removal of these subsidies will reduce the competitiveness of Chinese coal producers. A complete removal of coal import tariffs is estimated to increase revenues to Australian coal producers by USD 222 million (Coal Industry Communication Information Center, 2015). If we assume imports continue at 2014 levels into 2015, this import tariff would have represented USD 1.4 trillion in 2015, excluding any effects of the China-Australia Free Trade Agreement.

5.0 Conclusions

Through our analysis, we have identified a total of 14 subsidies to coal-fired electricity generators. Establishing the size of these subsidies is complicated by the involvement of SOEs, a lack of information on financial agreements (particularly for the terms of credit offered) and decentralized industry support. The value for those that have been quantified totals CNY 252 billion (USD 37.7 billion) in 2014 and CNY 120 billion (USD 18 billion) in 2015.

Given the sheer scale of subsidies for coal-fired generation, it is clear that they should be the focus of policy-makers and stakeholders interested in transitioning to a low-carbon economy and fossil fuel subsidy reform. The recent G20 subsidy peer review has identified and analyzed a significant number of subsidies. Those with the largest impact on the electricity sector include:

- **Guaranteed power purchase and priority dispatch**: The allocation of a set number of operating hours for coal generators on an annual basis creates an incentive to build capacity and prevents a merit order for dispatch on the grid being adhered to. It therefore provides revenue that otherwise would not have been guaranteed. The motives for guaranteeing operating hours are various and include: support for what has been considered a strategic industry; compensation for closure of small, inefficient plants; and incentives for mitigating air pollution. Whatever the motive, the result is that coal power is often dispatched over more efficient renewables. This confers an advantage to coal over other technologies.
- **Industry reform**: Increases in coal price and poor air quality have both driven reform in the coal power sector. Increasing coal prices prior to 2012 and price falls thereafter have put pressure on generators and led to the restructuring of the sector through vertical integration with coal producers. The extent of support for this process is not clear, but provincial examples suggest that it is wide ranging (credit support, tax breaks, power purchase guarantees). Air pollution has become a major issue in China's urban areas. To address the issue, the government has driven the closure of small, inefficient plants while promoting clean technologies (i.e., desulfurization, denitration and dedusting equipment). This process has been supported through an industrial restructuring fund, investment in clean technologies, and premiums and purchase guarantees for clean technology generation. In a move that mainly benefits employees of SOEs, the Chinese government has provided financial support from fiscal revenues to manage unemployment issues caused by coal phase-out and eliminating zombie companies.
- **Infrastructure investment:** Investment in railways and the power grid by the government and SOEs is of direct advantage to coal generators. Challenges to estimating the size of the subsidy include establishing how much of these investments comes from public money, establishing whether the investors receive preferential credit rates and apportioning benefit to coal over other sectors.

Governments typically subsidize energy for a range of reasons: to support the more vulnerable sections of society and ensure their access to energy, to stimulate economic development in certain regions or the economy as a whole, or to promote energy security. However, regardless of intentions, subsidies frequently evolve into costly mechanisms that fail to meet their original objectives and that have other adverse consequences. Among these consequences, FFSs impede the deployment of renewable energy sources and the development of a sustainable energy system by altering relative investment and generation costs (Bridle & Kitson, 2014).

It is clear that coal generation is given an advantage in China over other technologies through the measures described in this report. Policy-makers should review the performance of these subsidies. If overall impacts are found to be negative, reform options should be considered. This report recommends that the process of reviewing existing FFS, including the G20 subsidy peer review, be expanded to include subsidies to the electricity sector and, in particular, the subsides identified in this report.

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