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BELOW-MARKET ENERGY INPUTS

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Measuring Distortions in International Markets: Below-Market Energy Inputs

Government support for industrial firms can come in many different forms and through a range of channels, varying in complexity. A particularly challenging form of support is energy inputs offered to industrial producers at below-market prices. To improve understanding about the scope and scale of such support, this report examines an illustrative sample of 33 companies and their subsidiaries operating in energy-intensive industries, namely aluminium smelting, steelmaking, chemicals (including fertilisers), and cement. Most of the energy subsidies identified appear to concern the provision of natural gas and electricity at below-market rates, resulting in an average subsidy of USD 0.4-1.3 per million British thermal units and USD 0.02-0.03 per kWh, respectively, over the period 2010-20. In some cases, estimates indicate that subsidies are a multiple of firms' energy costs, suggesting a sizable impact on firms' profits and operating margins. The results have important policy implications for efforts to better discipline industrial subsidies in the WTO and elsewhere, notably in relation to how to ensure policy transparency in a context where large energy providers tend to be majority-owned by governments.

Key words: Natural gas; electricity; fossil fuels; subsidies; trade; state enterprises

JEL codes: F13, F23, H25, L52, L60, L94, O25, Q41

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Table of Contents

Figures

Tables

Boxes

Executive Summary

Government support continues to be a pressing concern for global trade. This is particularly the case of industrial subsidies, for which data remain scarce and incomplete. Governments' lack of transparency on the support they provide to firms explains partly these data gaps. Yet the complexity and diversity of support instruments also contributes to obscuring the true scope and scale of industrial subsidies, particularly where subsidies take the form of below-market transactions that are hard to identify and measure.

Below-market energy does not cover all forms of government support that help reduce firms' energy costs, but instead only concerns the provision of energy inputs to industrial users at below-market prices. It is especially problematic for trade in the context of industries for which energy constitutes an essential input, such as aluminium smelting, steel, cement, fertilisers, and chemicals.

The identification and measurement of below-market energy can be very complex since they require that the prices paid by industrial firms for the energy they use be compared with a reference price benchmark, chosen to reflect market conditions. Not only does this require detailed information about how particular plants or companies obtain their energy inputs and at what cost, but it also necessitates that careful assumptions be made in selecting an adequate market benchmark.

Using publicly available information and commercial databases at the plant- or firm-level, the OECD has estimated below-market energy for an illustrative sample of energy-intensive companies. While the resulting data are not comprehensive nor representative of entire energy-intensive industries, they do provide relevant insights into the size and distribution of below-market energy.

The OECD has found the firms covered to have received below-market energy amounting to between USD 63 billion (low estimate) and USD 155 billion (high estimate) over the entire period 2010-20. Almost all the support identified was for natural gas and electricity. In some cases, estimates indicate that subsidies are a multiple of firms' energy costs, thus suggesting a sizable impact on firms' profits and operating margins. Support was generally found to be larger for firms based in countries of the Gulf Cooperation Council and for state enterprises.

The results have several policy implications for efforts to better discipline industrial subsidies in the WTO and elsewhere. One is that widespread government intervention in energy markets can make it hard to judge whether particular transactions are 'market-consistent'. This matters not only for policy transparency, but also for the ability of trade partners to challenge the support provided through the intermediary of state energy companies. Another implication is that it is necessary to consider government support in all its forms in order to correctly diagnose market distortions in international markets. Different countries use different support instruments, with some relying on below-market energy relatively more while others use below-market finance. Only through careful efforts to collect more and better data can we obtain an accurate picture of global trade distortions.

1. Why below-market energy matters

1.1. The broader issue of government support remains a pressing concern for trade

There is a growing awareness that government support can affect global trade in ways that undermine competition, multilateral trade rules, and support for openness. Although government support is far from being a novel issue, it has recently taken on increased relevance amid countries' renewed interest in industrial policy; ongoing debates about supply-chain resilience, including in terms of national security; greater government involvement in the economy in the context of COVID-19 emergency support; and the broader push by governments to decarbonise and digitalise their economies. More recently, the Russian Federation's (hereafter "Russia") large-scale aggression against Ukraine has prompted governments to offer assistance to households and firms affected by related shortages and price spikes of food and energy items.

Recent joint statements by governments underscore the extent to which government support has come to the fore of the trade-policy agenda. G7 Trade Ministers, in their communiqué of 22 October 2021, undertook "to step up [their] efforts in countering [market-distorting] practices, through appropriate tools and levers, and to develop stronger international rules on practices such as market-distorting industrial subsidies and trade-distorting actions by state enterprises."[1] The Trade Ministers of the United States, Japan, and the European Union noted in their joint trilateral statement of 30 November 2021 that they would seek "to address the global challenges posed by non-market policies and practices of third countries that undermine and negatively affect [their] workers and businesses."[2] The EU-US Trade and Technology Council Inaugural Joint Statement of 29 September 2021 likewise mentions the shared aim of participants to avoid "a subsidy race" in semiconductor production, and to "share information on non-market distortive policies and practices", including "market-distorting industrial subsidies, including support given to and through SOEs, and all other types of support offered by governments."[3]

In spite of the many concerns expressed about government support, there is a persistent lack of data on its scope and scale. This lack of data is not uniform, however, with considerably more information being available for certain sectors, countries, and time periods. The OECD has long documented the support that countries provide to their farming sector (OECD, 2021[1]), and subsequent efforts extended measurement to fisheries (OECD, 2020[2]) and fossil fuels (OECD, 2021[3]).[4] More recently, the OECD has initiated work aiming to measure support for industrial sectors, with initial studies covering the aluminium value chain (OECD, 2019[4]), semiconductors (OECD, 2019[5]), and the provision of government support through the financial system across 13 large industrial sectors (OECD, 2021[6]).[5] While much progress has been made to date – including in quantifying government grants, income-tax concessions, and below-market financing – considerable data gaps remain, both in terms of sectors and support instruments.

The persistent lack of comprehensive data on government support in industrial sectors continues to hinder efforts to better discipline such subsidies at the WTO and elsewhere. Absent a clear understanding of how large support is and how it reaches producers, attempts to improve subsidy disciplines may be at risk of missing their target and failing to assuage concerns that the global playing field for trade is not level or 'fair'. This is especially the case for more complex forms of government support, for which WTO Members may struggle to agree a definition or a measurement method. Below-market energy falls into that category.

[1] See www.gov.uk/government/news/g7-trade-ministers-communique-october-2021 (accessed 7 December 2021).

[2] See https://ustr.gov/about-us/policy-offices/press-office/press-releases/2021/november/joint-statement-trade-ministers-united-states-japan-and-european-union-after-trilateral-meeting (accessed on 7 December 2021).

[3] See https://ec.europa.eu/commission/presscorner/detail/en/STATEMENT_21_4951 (accessed 7 December 2021).

[4] See the OECD's government support and subsidies portal, which is available at www.oecd.org/subsidies/.

[5] OECD has also measured government support benefitting the rolling-stock industry (OECD Trade Policy Paper N°267).

1.2. Dual pricing, below-market energy, and the trading system

WTO Members have long expressed concerns regarding dual-pricing practices, namely any government action or measure that contributes to keeping prices of raw materials (including energy) lower for domestic sales compared with export prices. Dual pricing often intersects with below-market energy, though they are not identical in scope. Below-market energy refers to any situation in which energy is sold to energy users at below-market prices, irrespective of whether market prices are international or domestic. The dual pricing of energy products refers, on the other hand, to a governmental practice whereby energy-exporting countries sell their energy resources, such as coal, natural gas, electricity, or petroleum products on the domestic market at a price lower than that which they could otherwise obtain on international markets, thereby generating differentiated pricing between domestic and export markets (World Trade Organization, 2010[7]; Marhold, 2021[8]). In certain instances, dual pricing may even push domestic energy prices below the full cost of production, thus failing to ensure that energy providers (generally state-owned[6]) earn an adequate remuneration for the provision of energy within the domestic market.

Dual pricing commonly takes the form of regulated, capped, or administered domestic prices set at a lower level than the reference market price, inconsistent with commercial considerations. The sale of discounted energy through state monopolies may also represent a form of dual pricing. Importantly, the imposition of export taxes or quantitative export restrictions (e.g. quotas and domestic market obligations) on energy resources or the establishment of qualified exporters list can lead to dual pricing (World Trade Organization, 2010[7]; Wüstenberg, 2019[9]). Although they often accompany or facilitate government support through below-market energy, export restrictions do not exactly coincide with below-market energy.[7]

Energy-exporting countries have traditionally used dual-pricing practices to redistribute the resource rent and promote industrial development by maintaining discounted energy prices for their domestic industries, including energy-intensive industries and industries using energy as feedstock. This strategy may contribute to increasing the competitiveness, both domestically and abroad, of downstream firms to the detriment of foreign firms producing like products, which do not benefit from below-market energy prices. As a result, dual pricing and other more targeted forms of below-market energy may entail trade distortions, as those downstream domestic industries for which energy constitutes an essential input could benefit from an unfair competitive advantage (OECD, 2019[4]).

Discussions concerning the consistency of dual-pricing practices with multilateral trade rules date as far back as the General Agreement on Tariffs and Trade (GATT) of 1947. They became more prevalent during the Uruguay Round negotiations, which established the World Trade Organization (WTO) and, later, in the course of the accession negotiations of energy-rich countries (UNCTAD, 2000[10]; Marhold, 2017[11]) (Box 1). These earlier attempts to better discipline dual pricing seemingly failed, however. No specific provision or generic discipline capturing this practice emerged over the course of the Uruguay Round negotiations. Neither did net-energy-exporting countries which acceded to the WTO after 1995 expressly commit to eliminate their dual-pricing systems although other WTO Members had voiced concerns (Box 1).

[6] It can be presumed that private energy providers would probably react to this situation by exiting the market rather than sustaining losses. In practice, dual pricing generally involves state enterprises on the supply side as will be discussed later in the report.

[7] Price arbitrage would normally ensure that any price difference between domestic and foreign markets caused by dual pricing disappears unless governments restrict exports in some manner. This does not hold where trade is not possible due to lack of infrastructure (e.g. lack of pipelines or insufficient interconnection capacity) or where below-market energy targets only specific users.

Box 1. Dual pricing within the multilateral trading system: From the GATT 1947 to the WTO accession of Saudi Arabia and Russia

In parallel to growing discussions on non-tariff barriers, dual-pricing practices became an issue of concern within the multilateral trading system during the oil crises of the 1970s. At the time, various countries used two-tier pricing, export restrictions, and other forms of government intervention aimed at creating artificial advantages for exports of oil-based products (USITC, 1985[12]).

During the Tokyo Round negotiations (1973-79), the United States endeavoured to address this issue by better disciplining export restrictions (Graham, 1979[13]). It nonetheless faced opposition from other industrial countries, as well as from developing countries (Jiménez-Guerra, 2001[14]). In the following years, however, some of the countries that had adopted export restrictions to cope with the oil crises of the 1970s progressively reduced or eliminated them. Canada, Mexico, and the United States, for instance, removed such practices in the 1980s (Jiménez-Guerra, 2001[14]). Other resource-endowed countries implemented similar policy changes in their gas and electricity markets during these years. In the EU, the progressive liberalisation of Member States' energy markets in the context of the creation of the EU internal gas and electricity markets, together with the application of the EU state-aid rules, led to the gradual elimination of these practices (Pogoretskyy, 2011[15]). Certain countries, notably those that were not GATT Contracting Parties, nonetheless continued to use such practices.

During the Uruguay Round and in the context of the Negotiating Group on Natural Resource-Based Products, the United States argued that export taxes, dual-pricing practices, and the high degree of government ownership and control in resource-based industries may contribute to distorting trade, as they permit the maintenance of price differentials potentially advantaging domestic industry. According to the United States, the negotiations needed to explore the possibility to address the issues that such interventionist practices could pose through a specific code or new GATT provisions (MTN.GNG/NG3/W/13, 8 June 1988). This view did not, however, garner consensus. While many participants, including the European Communities, argued that these practices should be addressed in a generic way (UNCTAD, 2000[10]), developing countries opposed the insertion of any binding rules on trade in natural resources.

No binding rules to discipline dual-pricing practices emerged as a result of the Uruguay Round negotiations. Attempts by some GATT Contracting Parties to include specific provisions under the Subsidies and Countervailing Measures (SCM) Agreement notably failed. Yet dual-pricing practices returned to the fore during the WTO negotiations over the accession of new energy-exporting Members. When Saudi Arabia acceded to the WTO, for instance, it committed to limiting the dual pricing of natural gas liquids by requiring operators to recover their full production and investment costs, as well as to make profits in the ordinary course of business (WTO, 2005[16]).

During the negotiations on Russia's accession to the WTO, some WTO Members voiced concerns with respect to the gap between the domestic price of natural gas regulated by the Russian government and the export price (WTO, 2011[17]). They argued that this wedge gave an unfair competitive advantage to industrial producers, notably energy-intensive industries and industries using gas as a feedstock, thereby hindering the ability of like imported goods to compete on the Russian market and potentially displacing Members' products from third-country markets (WTO, 2011[17]). Russia did not expressly commit to remove its price controls nor to eliminate its dual-pricing practices. Upon its accession to the WTO in 2011, it committed that "[p]roducers/distributors of natural gas in the Russian Federation would operate, within the relevant regulatory framework, on the basis of normal commercial considerations, based on recovery of costs and profits" (WTO, 2011[17]). Although the Russian government stated its intention to modify the regulation of gas prices in Russia and develop market-based principles for the domestic pricing of gas, it was allowed to maintain its regulated domestic price for natural gas (WTO, 2011[17]).

The US Trade Representative (USTR) has argued that Russia's progress in complying with its commitments and objectives has remained "modest and uneven" (USTR, 2021[18]). Similarly, according to the European Commission, between 2010 and 2018, Russian export prices of natural gas were more than three times higher than domestic prices (European Commission, 2020[19]). Although Russia

initiated in 2007 a long-term process aimed at equalising the gas price in Russia to the gas price in Europe after adjusting for export taxes, transportation costs, and transit tariffs, it has not yet introduced this "netback pricing" of gas, despite renewed calls from the country's trading partners.

The trade-defence frameworks of WTO Members often have provisions in place to counter dual-pricing practices through the imposition of duties on imports of energy-intensive goods, alleging either subsidisation or dumping of a key input (e.g. energy or a raw material). Under the United States' countervailing-duty legislation, for example, the existence of countervailable 'upstream subsidies' is considered as a potential ground to impose countervailing duties on downstream products. While there is no reference to 'input dumping' in the WTO Antidumping Agreement, the EU Antidumping Regulation (Regulation 2018/825/EU amending Regulation 2016/1036/EU) gives consideration to distortions within the country of origin of the raw materials, including for energy products. These distortions may include dual-pricing schemes, export taxes, quotas, or prohibitions, licensing requirements, minimum export prices, qualified exporter lists, or domestic market obligations.[8]

The issue of dual pricing, and preferential input pricing more generally, has recently returned to the fore in the context of the Trilateral discussions among the Trade Ministers of Japan, the United States, and the European Union, which aim *inter alia* at exploring avenues to strengthen rules on industrial subsidies and state-owned enterprises (SOEs). In September 2018, for instance, the Trilateral Trade Ministers acknowledged in a Joint Statement the necessity to tackle certain subsidy practices, which they view as particularly harmful, such as "preferential input pricing, including dual pricing."[9] Similarly, in their Joint Statement of 14 January 2020, the three Trade Ministers proposed a reversal of the burden of proof for certain types of subsidies having important harmful effects, including "subsidies that lower input prices domestically in comparison to prices of the same goods when destined for export."[10]

Government support in the form of below-market energy, notably where it coincides with a two-tier pricing system, has been and continues to be an important trade-policy concern. Yet beyond its potentially distortive trade effects, below-market energy may also generate harmful environmental effects. Energy prices set at below-market rates can contribute to increasing energy demand and favouring wasteful energy consumption, thus potentially hindering investments in energy efficiency and CO_2-emissions abatement and locking in dirtier technologies (Aldubyan and Gasim, 2021[20]; Calì et al., 2019[21]; Abeberese, 2017[22]). These negative consequences may prove especially problematic as atmospheric CO_2 concentration increases, leading a growing number of countries to commit to net-zero greenhouse gas (GHG) emissions by mid-century. Although the present report focuses exclusively on the trade dimension of below-market energy, complementary OECD work is addressing the question of the impacts of government support in various forms on GHG emissions.[11] Drawing on a previous OECD report examining government support in the aluminium sector (OECD, 2019[4]), as well as recent work on below-market finance (OECD, 2021[6]), this parallel work assesses the effect of specific types of government support (i.e. grants, tax concessions, and below-market borrowings) on firms' GHG emissions in the aluminium and steelmaking sectors. Preliminary results indicate that government support has contributed

[8] For a distortion to be found, however, the raw material concerned must account for not less than 17% of the dumped product's cost of production. See notably Recital of Regulation 2018/825/EU and Article 7(2a) of Regulation 2016/1036/EU as amended by Regulation 2018/825/EU.

[9] See the Joint Statement on Trilateral Meeting of the Trade Ministers of the United States, Japan, and the European Union, 26 September 2018, available at: https://ec.europa.eu/commission/presscorner/detail/en/STATEMENT_18_5915 (accessed on 2 February 2022).

[10] See the Joint Statement of the Trilateral Meeting of the Trade Ministers of Japan, the United States and the European Union, 14 January 2020, available at: https://trade.ec.europa.eu/doclib/docs/2020/january/tradoc_158567.pdf (accessed on 2 February 2022). Reversing the burden of proof for particularly harmful subsidies implies in this case that, should a WTO Member prove that such a specific subsidy exists, it would fall to the subsidising Member to demonstrate that the subsidy does not lead to serious negative trade or capacity effects and that it has been properly notified. Failure to bring such evidence would oblige the subsidising Member to withdraw the subsidy at issue immediately.

[11] That work is being undertaken under the Joint Working Party on Trade and Environment.

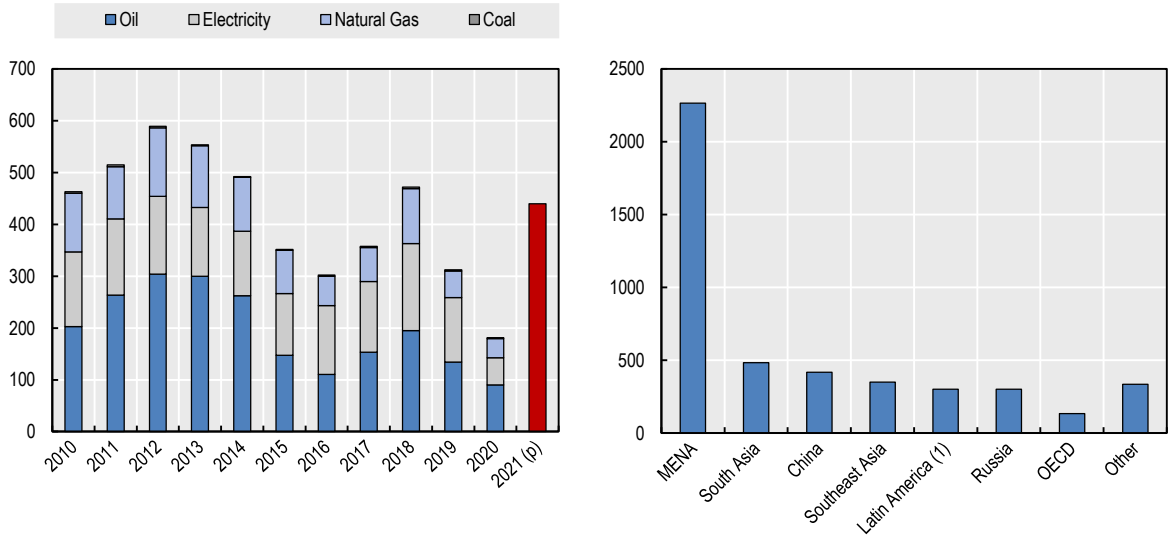
to increased emissions from aluminium and steelmaking activities, mainly through an increase in production output.

1.3. Available evidence suggests that energy subsidies for industrial producers could be sizable

Available data on fossil-fuel subsidies suggest below-market energy in these fuels to be sizable globally. Not all fossil-fuel subsidies take the form of below-market energy but those measured and reported by the International Energy Agency (IEA) specifically do.[12] This is because the IEA measures fossil-fuel subsidies as the gap between domestic energy prices for end users and a set of reference prices that represent the full cost of supply that would prevail in a competitive market.[13] Data available from the IEA thus indicate that below-market fossil fuels globally stood at about USD 380 billion annually over 2017-19, down from more than USD 500 billion annually in 2011-13 when oil prices were particularly high (Figure 1; left panel). The IEA's estimate for 2020 was the lowest on record, at USD 180 billion, although this reflected the exceptional, deflationary impact that the COVID-19 pandemic and lockdowns had on energy markets in that year. The inflationary turmoil that affected energy markets in 2021 then pushed that number higher again – at USD 440 billion – as governments worldwide attempted to mitigate the impacts of high energy prices on households and companies and energy consumption rebounded as pandemic restrictions were relaxed and economies re-opened (IEA, 2021[23]; OECD, 2022[24]).

Figure 1. Available data on fossil-fuel subsidies suggest that below-market energy is sizable globally and concentrated geographically

Left: Fossil-fuel subsidies taking the form of subsidised end-user prices, by energy carrier, USD millions
Right: Same data but aggregated over the period 2010-20 and grouped by region or country, USD millions



Note: Monetary values are expressed in constant 2020 USD. (1) Latin America does not include Chile, Colombia, Costa Rica, and Mexico, which are counted in OECD.
Source: IEA.

[12] This is also the case of the IMF's "pre-tax" or "explicit" consumption subsidies for fossil fuels.

[13] Reference prices can be import-parity prices in the case of net energy importers or can represent revenue foregone in the case of net energy exporters (i.e. an opportunity cost). Section 2 of this report discusses methodology in more detail. Information about the IEA's approach can be found at www.iea.org/topics/energy-subsidies#methodology-and-assumptions (accessed on 20 December 2021).

Fossil-fuel subsidies taking the form of below-market energy appear to be concentrated geographically. Looking at the absolute amount of all such subsidies measured by the IEA over the period 2010-20 shows that the Middle East and North Africa (MENA) had the most support, followed by South and Southeast Asia, the People's Republic of China (hereafter "China"), Russia, and Latin America (Figure 1; right panel). When expressed as a percentage of GDP, Central Asia and the MENA region had the highest support, with Uzbekistan and Turkmenistan providing energy subsidies amounting to as much as 6.6% and 3.2% of their GDP in 2020, respectively.

In large part, the geographical distribution of the fossil-fuel subsidies measured by the IEA reflects the concentration of fossil-fuel reserves in specific regions of the world, where fuel subsidies are often seen by authorities as a way of redistributing resource rents to the wider population. Yet not all fossil-fuel-rich countries subsidise their consumption of fuel, while several countries subsidising fuel consumption are not large exporters of hydrocarbons. In fact, many are importers, and even at times net importers. For example, Kuwait, Mexico, and the UAE are net importers of natural gas, Indonesia is a net importer of crude oil, and China is a large net importer of coal, crude oil, and natural gas.[14] In some cases, the subsidies themselves have contributed to turning countries into net energy importers by encouraging higher levels of consumption.

The true scale of below-market energy benefitting industrial producers is, however, lower than the aggregate fossil-fuel subsidies estimated by the IEA. Despite their significance on a global scale, the vast majority of fossil-fuel subsidies measured by the IEA benefit the residential and transport sectors but do not necessarily represent large support to manufacturers. This is, for example, the case in India, where in fact industrial users pay higher electricity tariffs in order to cross-subsidise households and farmers (Abeberese, 2017[22]). On the other hand, below-market energy is also potentially broader in scope than fossil-fuel subsidies: some support could concern low-carbon energy sources, such as where the electricity from a hydroelectric dam or a nuclear power plant is sold below-cost to local manufacturers.

While it is difficult to assess accurately the global scale of below-market energy benefitting industrial users there is anecdotal evidence to suggest that firms operating in energy-intensive industries generally view energy subsidies as an important competitive factor that shapes their performance (Box 2). To the extent this enables firms to offer lower sales prices than competitors, or to produce and invest more than they would otherwise by artificially improving profitability, below-market energy can be expected to have trade and competition effects. In turn, this could harm trade partners, as well as exacerbate the effects that other support measures already have on markets.

Below-market energy may notably conceal firms' otherwise poor performance, such as where cheap energy enables less productive companies to nonetheless attain high operating margins.[15] Recent OECD work on government support in industrial sectors has, for example, found energy-intensive firms based in MENA countries to display strikingly high profit margins and rates of return on their assets (OECD, 2021[6]), a finding which might be related to the prevalence of below-market energy in the region.[16] Artificially high margins reduce in turn the need for governments to help companies through other means, be they government grants, tax concessions, or below-market finance. This shows the importance of considering government support in all its forms in order to paint an accurate picture of market distortions across countries and sectors.

[14] Some countries can also be net importers of crude oil but net exporters of refined petroleum products (e.g. India) and vice versa (e.g. Egypt).

[15] These firms could be deemed 'latent zombies' in that below-market energy keeps them profitable even though they might otherwise exit the market absent government support.

[16] In a 2011 note on the Saudi cement sector, financial services provider Aljazira Capital found, for example, that: "Saudi cement companies receive natural gas at a subsidized rate of USD 0.75/mmbtu from state-owned Saudi Aramco. […] Cement industry in Saudi Arabia operates at *the highest gross margin and net profit margin in the world*" (emphasis added). See also the example of SABIC in Box 2.

Box 2. Firms operating in energy-intensive industries generally view energy subsidies as an important competitive factor

- State-owned Chinese aluminium producer Qinghai Provincial Investment Group noted in a 2017 bond prospectus that: "In 2016, the Group continued to receive subsidies for electricity, being one of the principal costs incurred in producing aluminium, allowing it to purchase electricity at RMB 0.28 per kWh instead of the market price of RMB 0.33 per kWh."
- Argentinian steel producer Ternium noted in its 2019 annual report that: "the government's subsidies for natural gas and electricity have been gradually reduced and could be reduced further in the future. This could result in an increase in Ternium Argentina's energy costs, which may adversely affect Ternium Argentina's results of operations."
- Russian fertiliser producer Acron noted in its 2018 annual report that: "natural gas prices in Russia are regulated by the government instead of the market. In recent years, the government has been implementing a strategy of restraining higher gas tariffs. Risks related to changes in government priorities and greater increases in gas tariffs remain long-term risks."
- French cement producer Vicat noted in its 2019 annual report that: "In addition to the quasi-sustained decrease in sales prices, one should note the strong increase in electricity costs [in Egypt], which follows the gradual phase out of subsidies [there] […]. Production costs for cement makers therefore increased once again" [authors' own translation from French].
- In a report dated 6 December 2019 about the state-owned Saudi Basic Industries Corporation (SABIC), credit-rating agency S&P Global Ratings noted that: "SABIC's key strength is the strong profitability of its Saudi operations, which enjoy access to gas-based feedstock at prices well below the global market average […] SABIC benefits from very high ongoing support in that the government sets the price of the gases SABIC uses as feedstock in the production of petrochemicals, fertilizers, and steel in Saudi Arabia. This has a strong positive influence on SABIC's profitability […]."

Source: OECD research.

2. The definition and measurement of below-market energy

2.1. The scope of below-market energy

Below-market energy does not cover all forms of government support that help reduce firms' energy costs, but instead only concerns the provision of energy to industrial users at below-market prices. Direct transfers of funds by governments for the explicit purpose of helping firms cope with high energy prices would generally count as government grants, rather than below-market energy, unless the transfer amounts are directly tied to and vary with energy prices.[17] Reductions or exemptions from the taxes normally levied on energy use would count as tax concessions, in that they do not lower pre-tax prices below market level (e.g. the sum of crude-oil prices, the crack spread,[18] and distribution and marketing margins in the case of petroleum products). Likewise, below-market lending by state banks to finance the construction of a manufacturer's own captive power plant does not amount to below-market energy but rather is considered as below-market borrowings – even though it reduces that firm's average energy costs on an ongoing

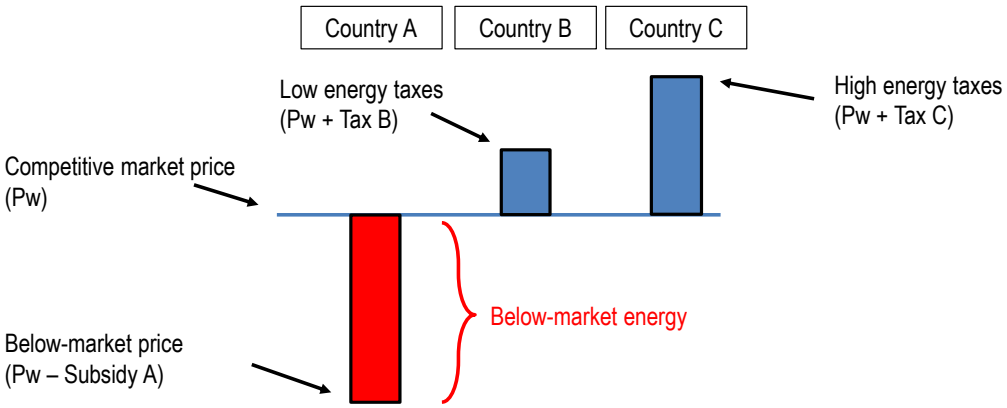
[17] As shown later in Box 5, there are also cases of governments providing grants to energy companies to compensate them for selling their output at below-market prices.

[18] In the oil industry, the crack spread is the price difference between crude oil and refined petroleum products.

basis. While existing OECD work already looks at grants, tax concessions,[19] and below-market finance, this is not yet the case for below-market energy.

The distinction between below-market energy and energy-tax concessions matters in particular from the standpoint of 'fair' competition and cross-country comparability. Given the extent to which energy taxes vary across countries (OECD, 2019[25]; Elgouacem and van Dender, 2019[26]), the monetary value of any given tax exemption (e.g. tax-free diesel fuel for farmers) will be larger in high-tax countries, all other things being equal. Simple comparisons can thus penalise countries that impose high fuel taxes, while favouring low-tax jurisdictions. A related concern is that countries can also differ in what they consider to be 'normal' energy taxation, with some treating exemptions as regular features of the tax system, while others treat them as tax expenditures (i.e. tax revenue foregone) (Box 3). These concerns in relation to the value of tax concessions do not apply to calculation of below-market energy, however, as the latter only refers to deviations from pre-tax market prices (Figure 2).

Figure 2. Below-market energy refers to deviations from pre-tax market prices, but does not include zero or lower rates of energy tax



Source: Authors' elaboration.

Box 3. Challenges in the estimation of the government support conferred through tax concessions

According to an earlier OECD definition, "[a] tax expenditure can be defined as a transfer of public resources that is achieved by reducing tax obligations with respect to a benchmark tax, rather than by a direct expenditure" (Kraan, 2006[27]). Finance Ministries and Treasury Departments in OECD member countries routinely estimate the monetary value of existing tax expenditures as part of their regular budgetary process. Estimates of tax expenditures often accompany the public release of yearly budgetary documents given that they can substitute for direct government spending.

Government officials generally estimate tax expenditures using the so-called revenue foregone method. In this method, calculations assume no behavioural changes on the part of taxpayers[1] such that a tax expenditure equals the product of the tax base and the difference between 'normal' tax rates and concessionary rates, similar to a price-gap calculation.

[19] Income-tax concessions (and property-tax abatements where possible) are covered in the data collected for the recent study of below-market finance (OECD, 2021[6]). Fuel- and energy-tax concessions are covered in the OECD's *Inventory of Support Measures for Fossil Fuels* (OECD, 2021[3]).

What constitutes 'normal' energy taxation is not straightforward, however, as shown by the example of fuel-tax exemptions for users of off-road vehicles (e.g. tractors or fishing vessels). Some countries, such as France and Germany, treat fuel taxes as both a revenue-raising mechanism for the general budget and a means for internalising externalities tied to fuel usage (e.g. CO_2 emissions and local air pollution). In such a system, the partial or full exemption of fuel taxes for off-road users constitutes a tax expenditure given that these users emit pollution, while also benefitting from general government services. By contrast, in countries such as Australia, New Zealand, and the United States, fuel-tax revenue is primarily earmarked for road construction and maintenance, meaning that the exemption of fuel taxes for off-road users is generally not considered by authorities to be a tax expenditure. This generates ambiguity in how the same measure – namely fuel-tax exemptions for users of off-road vehicles – is treated across OECD countries (OECD, 2015[28]; Elgouacem and van Dender, 2019[26]).

The same issue presents itself in the context of how countries choose to finance the guaranteed purchase prices (i.e. feed-in tariffs) that they often offer to generators of renewable energy. Some countries levy an additional surcharge on final electricity users to cross-subsidise renewable-energy generation, while others may opt to fund guaranteed prices from the general government budget. If, in the former case, certain electricity users are exempt from the surcharge, does that constitute a tax expenditure? What if these same levy-exempt users of electricity participate in an emission-trading scheme, while other non-exempt users do not participate in the scheme?

There are no easy answers to these questions, which underscore the complex challenges that characterise the estimation of support conferred through energy-tax concessions. Together with cross-country differences in energy tax rates (Figure 2), this makes such support currently not directly comparable in an international setting, in the absence of a situation where all countries tax energy use in exactly the same way.

1. The revenue foregone method also assumes that the removal of a tax expenditure does not affect the revenue from other taxes and that there are no "second-order effects" on the economy (Kraan, 2006[27]).

The OECD's taxonomy of support measures can help visualise the set of policies that below-market energy encompasses. In terms of the matrix shown in Table 1 below-market energy corresponds to the cells under column C ("Cost of intermediate inputs") and rows 3 and 5 ("Other government revenue foregone" and "Induced transfers", respectively). This covers the provision of below-market energy by governments themselves (row 3) and by state enterprises[20] such as state utilities or national oil and gas companies acting on behalf of governments (row 5). This also includes administrative measures or regulations that have the effect of keeping local prices below market levels, such as export restrictions, administered prices, price caps, and dual pricing.

[20] In this report, state enterprises refer to companies that owned, invested, or otherwise influenced by the state.

Table 1. Indicative OECD matrix of support measures, with illustrative examples

Transfer Mechanism (how a transfer is created)	Statutory or Formal Incidence (to whom and what a transfer is first given)							
		Production						Consumption
		A. Output returns	B. Enterprise income	C. Cost of intermediate inputs	Costs of value-adding factors			
					D. Labour	E. Land and natural resources	F. Capital	G. Knowledge	H. Unit cost of consumption
	1. Direct transfer of funds	Output bounty or deficiency payment	Operating grant	Input-price subsidy	Wage subsidy	Capital grant linked to acquisition of land	Grant tied to the acquisition of assets, including foreign ones	Government R&D	Unit subsidy
	2. Tax revenue foregone	Production tax credit	Reduced rate of income tax	Reduction in excise tax on input	Reduction in social charges (payroll taxes)	Property-tax reduction or exemption	Investment tax credit	Tax credit for private R&D	VAT or excise-tax concession
	3. Other government revenue foregone		Waiving of administrative fees or charges	Under-pricing of a government good or service		Under-pricing of access to government land or natural resources	Debt forgiveness or restructuring	Government transfer of intellectual property rights	Under-pricing of access to a natural resource harvested by final consumer
	4. Transfer of risk to government	Government buffer stock	Third-party liability limit for producers		Assumption of occupational health and accident liabilities	Credit guarantee linked to acquisition of land	Loan guarantee; non-market-based debt-equity swap and equity injection		Price-triggered subsidy
	5. Induced transfers	Import tariff or export subsidy; local-content requirements; discriminatory government procurement	Monopoly concession	Monopsony concession; export restriction; dual pricing	Wage control	Land-use control	Credit control (sector-specific)	Deviations from standard IPR rules	Regulated price; cross subsidy
	-- Including advantages conferred through state enterprises			Provision of below-cost electricity by a state-owned utility			Below-market loan by a state-owned bank		

2.2. Structural support versus emergency support for energy users

As with other forms of government support, a useful distinction can be made between, on the one hand, *structural* below-market energy that is long-lasting and helps improve industrial competitiveness (by design or not), and, on the other hand, *emergency* below-market energy that operates over a short time frame and is aimed at responding to an immediate energy crisis. While both forms of support aim to lower energy prices below market levels, they follow a different logic and have different policy implications.

As well as being transitory, emergency measures tend to be more targeted at households and small enterprises, with a view to alleviating energy poverty and improving affordability (Box 4). In crisis situations, it is, for example, not uncommon for governments to ask large energy-intensive industries to temporarily curtail their operations in order to preserve energy for residential and commercial customers.

Emergency below-market energy raises several issues in relation to income distribution, environmental sustainability, and fiscal discipline. One concern in particular is that such assistance needs to be short-lived and time-limited; another is that it risks undermining incentives for energy efficiency and cleaner forms of energy (OECD, 2022[24]). While these are important policy issues – issues that echo the debates on reforming fossil-fuel subsidies benefitting low-income households – they do not concern the measures covered in this report, which focus exclusively on below-market energy provided on a sustained basis to large industrial users of energy.[21] In this report, the policy concern is primarily with the trade and competition effects that might arise due to structural below-market energy.

Box 4. Government support in the energy crisis of 2021-22

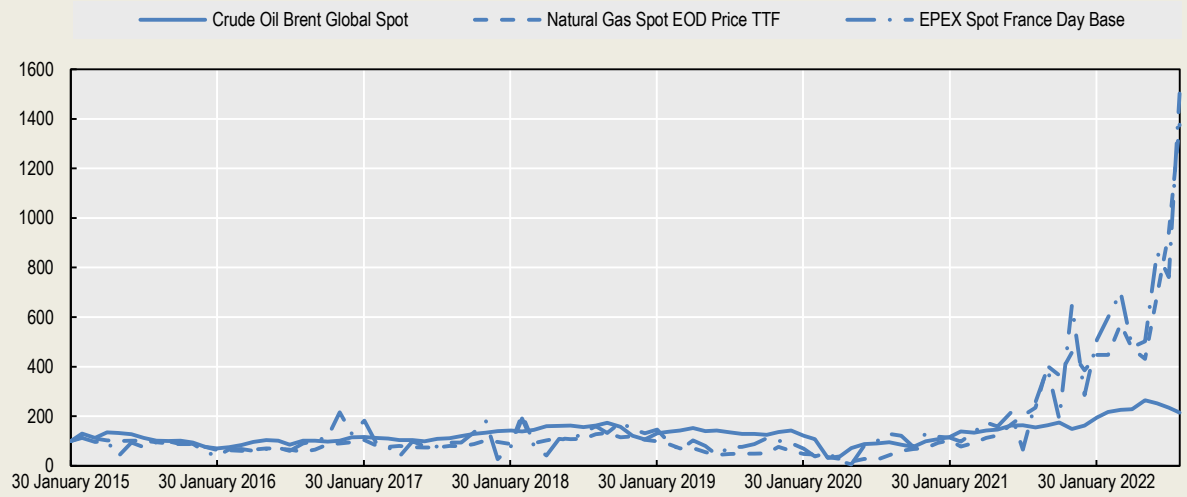
The 2021-22 energy crisis has considerably increased the number and magnitude of energy subsidies provided by governments. Even before Russia invaded Ukraine in February 2022, a combination of lower deliveries of natural gas from Russia into European storage sites and robust demand growth following the reopening of economies after the COVID-19 pandemic had generated considerable stress on energy markets (Figure 3). Russia's large-scale aggression against Ukraine aggravated the situation, with Russia cutting off its supply of natural gas to certain countries while others have imposed embargoes on Russian energy imports. The resulting price increases have been dramatic and have led governments to offer emergency subsidies to soften the impact on households and businesses. In this context, the European Commission took the exceptional step in March 2022 of loosening state-aid rules to enable EU Member States to help companies most affected by the energy crisis.* A number of large energy utilities have also been recapitalised by governments, including Germany's Uniper and France's EDF.

Most measures adopted as of June 2022 have taken the form of price controls rather than income support, partly because the former are easier to administer and faster to deploy (Figure 4) (OECD, 2022[24]). OECD estimates for member countries and key emerging economies indicate that the aggregate fiscal cost of the measures adopted since October 2021 and ending by December 2022 amounted to at least USD 246 billion, of which USD 169 billion supported fossil fuels (Ibid). Of those measures that were targeted toward particular energy users, the majority benefitted households more than firms (Figure 4).

[21] Much emergency assistance also takes the form of grants, tax concessions, or below-market loans rather than below-market energy proper.

Figure 3. Energy prices have increased dramatically since 2021, particularly in Europe

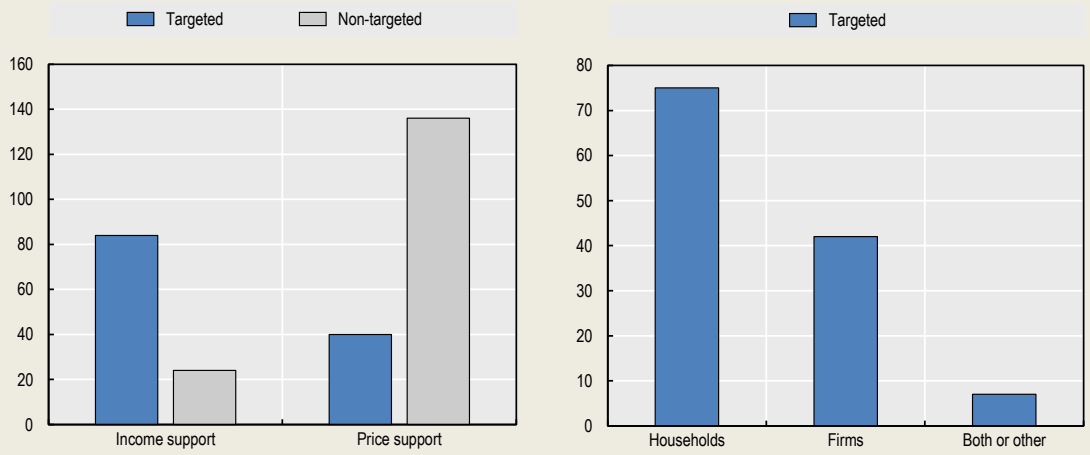
Monthly spot prices, January 2015 = 100



Source: Factset.

Figure 4. Most measures adopted since 2021 have taken the form of generalised price controls, but targeted measures benefit households more

Left: USD billions
Right: Number of measures



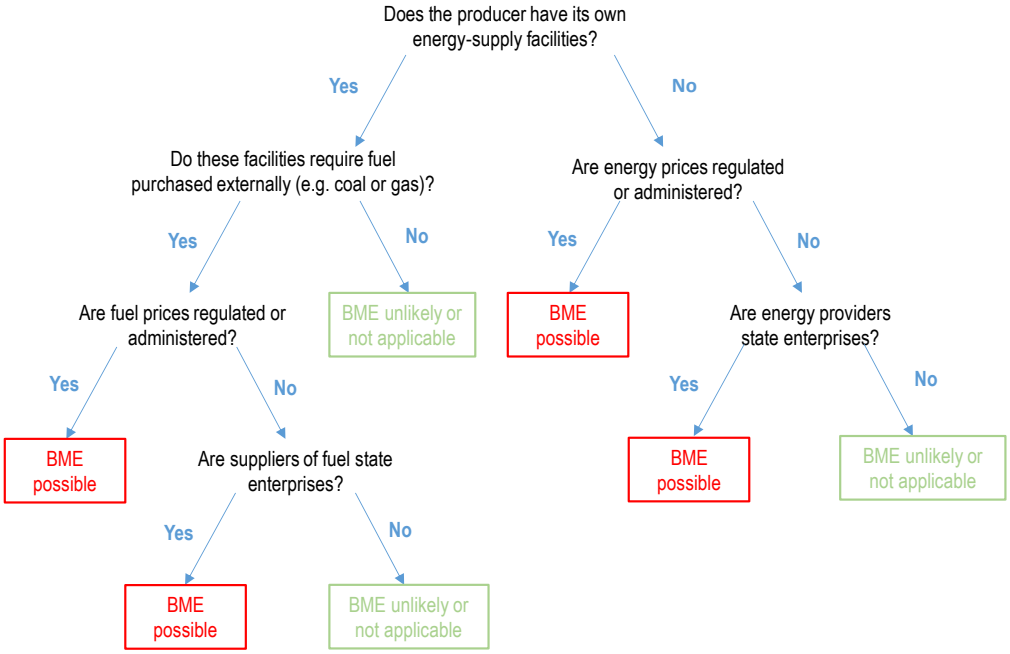
Note: * See https://ec.europa.eu/commission/presscorner/detail/en/statement_22_1949 (accessed on 18 August 2022).
Source: OECD (2022[24]).

2.3. How to detect below-market energy

Diagnosis

Having established the scope of below-market energy for the purposes of this study the next step is to find practical ways to detect its occurrence across countries, sectors, and energy carriers.[22] One starting point is to ask a series of questions that can help narrow search efforts at the level of particular firms or countries. The present study asks six such questions to determine whether the presence of below-market energy is: (i) unlikely or the concept is simply not applicable in that particular case; (ii) possible, in which case further empirical tests are necessary to not only confirm the presence of below-market energy, but also to quantify it where applicable and feasible, as will be explained later in this section (Figure 5).

Figure 5. How likely is below-market energy?



Source: Authors' elaboration.

The first question concerns whether or not industrial producers possess their own energy-supply facilities, such as a captive power plant or an oil-refining installation. This matters because the degree of vertical integration of industrial producers determines in turn what kind of energy inputs, if any, they need to purchase from external suppliers. It is fairly common for energy-intensive manufacturers to have their own power-generating equipment on site, with any excess, unused electricity sold back to the grid. In such cases, the electricity used on site cannot be deemed below-market since internal procurement does not involve a transaction between two separate market participants.[23] Several aluminium smelters have, for example, their own hydroelectric plant nearby, such that the generation of electricity forms part of the company's integrated production process. While other forms of government support cannot be ruled out

[22] It is more correct to refer to different energy inputs as being energy carriers rather than energy products since energy is never really 'produced' but rather transformed and transmitted using different forms or 'carriers'. See, for example, https://archive.ipcc.ch/publications_and_data/ar4/wg3/en/ch4s4-3-4.html (accessed on 17 January 2022).

[23] This can raise issues in relation to transfer pricing, but these do not have a direct bearing on government support. It is firms' own economic choice to integrate a given activity vertically or instead outsource it to another firm, i.e. the 'make-or-buy decision' in the economics literature.

(e.g. below-market financing for constructing or maintaining the dam), the concept of below-market electricity is not applicable in this particular example, as noted earlier.

The second question concerns whether producers' own energy-supply facilities require fuel purchased externally in order to generate the energy used in manufacturing. The example above of captive hydro-electric facilities is a case where such fuel is not necessary because the electricity is generated using flowing water. The same would be true of electricity based on geothermal, solar, wind, tidal, and wave energy. Thermal power plants, by contrast, require fuel that is burnt to generate high-pressure steam and move a turbine. This fuel will most often take the form of coal, natural gas, heavy fuel, or biofuels and waste.[24] Yet having a captive thermal plant does not guarantee that firms purchase fuel externally. Many steelmakers re-use blast furnace gas to generate their own electricity while others, such as US steel producer Nucor, even own natural-gas drilling operations.

In cases where manufacturers that own energy-supply facilities need to purchase their fuel externally, the next question concerns whether there are specific price regulations or controls in place that keep fuel prices at below-market levels. An industrial producer that generates the electricity it needs using coal or natural gas could gain an unfair competitive advantage over competitors by having access to coal or natural gas at below-market prices.[25] This would be the case where, for example, countries subsidise fossil fuels for industrial users by capping fuel prices or setting them administratively low. Below-market energy is highly likely in such situations, although its occurrence can only be verified through data collection and empirical assessments.

Even where fuel prices are not regulated or administered, there could be instances where state suppliers of fuel engage in below-market pricing to pursue industrial policy at the behest of government shareholders. While this situation may not be the most common, it nonetheless deserves particular attention in jurisdictions where the state plays a large role in the economy. The next question to be asked is, accordingly, whether suppliers of fuel are state enterprises. Should the answer be affirmative, further empirical assessments are needed before reaching conclusions as to the presence of below-market energy. By contrast, a finding that fuel suppliers are private and that prices are deregulated could indicate that below-market energy is unlikely. This is because transactions between private parties constitute in essence the market and cannot rightly be deemed 'below-market'.

A parallel set of questions applies where manufacturers do not possess their own energy-supply facilities and therefore resort to buying the energy carriers they need from external suppliers. In such cases, the first question to ask is again whether energy prices (e.g. electricity and natural gas) are regulated, capped, or otherwise administered by authorities. Where they are, below-market energy is likely, requiring data to confirm the finding. Where they are not, the next question is whether energy suppliers are state enterprises that could practice below-market pricing.

Towards a triangulated approach to data collection

To answer the six questions laid out above and in Figure 5, this study takes a 'triangulated' approach, whereby information is sought from three different perspectives, namely, that of recipients (i.e. industrial producers), that of energy providers, and a more macro angle. Searching for information and collecting data from these three complementary angles increases robustness and cross-validation. It also contributes to filling in information gaps that may persist by relying on one or two sources only, thus increasing data availability. This helps overcome the challenges caused by the lack of transparency that surrounds below-market energy inputs. For instance, an industrial producer may not disclose the exact electricity price that it paid in its corporate reporting; however, national or local legislation may publish the prices paid by certain categories of energy users (e.g. industrial users, or those in a particular sector), which in turn helps approximate the energy price that applies to this particular industrial producer. In general, the data necessary for estimating below-market energy inputs are often scattered over different sources. The

[24] While fuel for thermal plants also includes uranium, it is generally not possible for individual manufacturers to build and operate their own captive nuclear power plants (e.g. for cost and regulatory reasons). The development of small modular reactors could, however, make this a future possibility.

[25] It is also possible that the presence of below-market energy deters industrial producers from investing in their own captive power-generation capacity, thereby reducing competition in the power-generation market.

triangulated approach described below broadens the scope of data collection and connects the dots between various pieces of information in order to identify and measure below-market energy inputs.

The recipient angle

The recipient angle looks at industrial producers themselves who are the users of energy carriers and acquire them by paying either market-consistent or below-market prices. Typical sources of information from this angle are companies' annual reports, sustainability reports, bond prospectuses, other official documents, or their websites. These documents may report directly, although this is rare, the energy prices paid by a firm. Prices could be expressed in numbers, in formulas, or described in plain text, for example when stating that the price is regulated by the government or set by state utility companies. Even where such data are not disclosed, more and more companies are reporting the amount of energy they purchased or consumed, often differentiated by energy carriers or broad fuel categories, particularly in the context of efforts to meet environment, social and governance (ESG) reporting requirements. Combined with firms' energy costs, which are at times disclosed in annual reports, it may be possible to infer the energy price paid by a firm by dividing for each carrier the cost of energy consumed or purchased by the corresponding volumes. Where information on energy consumed or purchased is not provided, data on companies' output volumes may also be used to estimate the amount of energy consumed based on typical energy-per-unit-of-output requirements for similar technologies or production processes (e.g. MWh per metric tonne). In the particular case of steel and aluminium, the analysis also uses data purchased from commercial provider CRU (www.crugroup.com), which offers estimates of energy consumption by carrier for every operating plant globally.

Data collection from the recipient angle has the potential to provide granular information, if not clues, related to all of the six diagnostic questions above, i.e. whether the producer has its own energy-supply facilities, whether the producer requires fuel purchased from external sources, the prices they paid for energy or fuel, and, at times, information on their energy providers and state regulations affecting energy prices.

The provider angle

The provider angle shifts the focus to entities that sell electricity or fuel to industrial users. This covers utility companies and energy suppliers irrespective of their ownership status.[26] Useful documents published by energy providers can include, for instance, national or local legislation according to which energy prices are set for particular users (e.g. industrial or residential users, certain sectors) and annual reports and bond prospectuses that disclose energy providers' financial performance. In the latter set of documents, utility and energy companies may flag to potential investors that they are mandated by government to sell energy at prices that are below market levels, or below the levels that would maintain their economic viability. Sales of energy carriers at below cost could result in losses for energy provider companies, which would then be visible in annual financial results (Box 5).[27]

Information collected and found from the provider angle can reveal the relevant energy prices or even signal the possibility of below-market energy. This helps answer the diagnostic questions of whether energy or fuel prices are regulated or administered by the government, but also whether energy providers are state enterprises. Similar to the recipient angle, this approach is, however, conditioned on providers being sufficiently transparent in disclosing the necessary information. Their degree of transparency in that regard varies.

[26] Energy providers can be state enterprises; privately owned firms; and/or firms subject to direct government regulation and oversight.

[27] Losses may only be visible at the level of individual market segments (e.g. domestic sales downstream or sales to large industrial users) so that looking only at consolidated results may provide a misleading picture.

Box 5. Evidence of below-market energy from the provider side: Some examples

- State-owned Gazprom noted in its annual report for 2013 that *"[t]he regulated wholesale gas prices that are currently in effect [in Russia] are set below those which are economically viable."*
- Saudi state oil giant Aramco noted in its bond prospectus dated 1 April 2019 that: *"certain of the Company's downstream products sold in the Kingdom [of Saudi Arabia] are sold at regulated prices mandated by the Government. The regulated prices often have been lower than the prices at which the Company could otherwise have sold such refined products. As a result, prior to 2017, the downstream business incurred losses in its operations. As at 1 January 2017, the Government implemented an equalisation mechanism to compensate the Company for revenue directly foregone as a result of compliance with the mandates related to crude oil, kerosene, diesel, heavy fuel oil and gasoline, with equalisation compensation recorded as other income related to sales."*
- The state-owned Saudi Electric Company (SEC) noted in a bond prospectus dated 15 September 2020 that: *"[E]lectricity tariffs in the Kingdom [of Saudi Arabia] are not set by SEC and, as a result, may not reflect commercial or market terms, including any increases in the SEC Group's cost of production […] The electricity tariff in force in the Kingdom had remained largely unchanged from 2000 and 2010. In July 2010, a revised tariff structure was implemented, with further revisions taking place effective as of January 2016 and January 2018. The current electricity tariff reflects […] a flat rate tariff for industrial and health and education users of SAR 0.18 per KWh."*
- South African state electricity company Eskom noted in a bond prospectus dated 23 January 2015 that: *"While the Electricity Regulation Act, 2006 […] provides that the Group must recover the full cost of its licensing activities, including a reasonable margin or return, the electricity tariffs that the Group charges its customers in South Africa, which are determined by NERSA [the National Energy Regulator of South Africa], are inevitably sensitive to political and economic considerations and have historically not been cost-reflective. […] In the early 1990s, when the Group still benefited from excess generation capacity, it entered into a number of customised pricing agreements with its major industrial customers, mainly to supply low-priced electricity to energy-intensive industries and to further the Government's growth and job creation objectives for the South African Development Community ("SADC") region. […] Currently, two special pricing contracts […], both of which relate to aluminium smelters owned by one of the Group's customers in KwaZulu-Natal, remain in place. In October 2012, the Group submitted an application to NERSA to review the final outstanding contracts to make them cost-reflective."*

The macro angle

The macro angle draws information and data from existing country-level estimates of energy subsidies, such as those produced by the IEA and the IMF. This third angle of the triangulated approach helps make informed assumptions about the possible existence of below-market energy in a given country in order to narrow down search efforts for firm-level data. For instance, existing reports or studies may note that industrial users in certain countries have an obligation to cross-subsidise poorer and smaller energy users like households and farmers, in which case below-market energy for industrial users is unlikely, although not completely impossible. Further research may then be necessary to confirm this presumption. In other cases, aggregate data may suggest that countries are subsidising the energy consumption of their industrial users. On that basis, efforts to estimate below-market energy inputs thus prioritise these particular countries.

Macro-level data coupled with sector-level energy balances, can also generate a reference point which acts as an upper-bound and plausible value for estimating below-market energy. This third angle therefore provides information that can help answer diagnostic questions related to energy price regulations and state involvement in energy supply.

2.4. How to quantify below-market energy: The crucial choice of market benchmarks

After the diagnosis and data-collection stages, the next step in the analysis is to quantify the scale of below-market energy inputs at the level of each industrial company covered by the study. The estimation process begins by identifying and narrowing down the type of energy carriers that a firm acquired from external sources (e.g. coal, natural gas, diesel fuel, and electricity). For each such carrier, the study compares the price that the firm paid to obtain certain amounts of this carrier against a corresponding benchmark energy price. The price difference (or gap) is then multiplied by the volume of energy purchased (or consumed) to calculate a monetary value for below-market energy. This calculation is often done at the plant level, following which numbers are consolidated at the company level.

The three important inputs necessary to estimate below-market energy are the actual energy prices paid by firms, the applicable benchmark energy prices, and the volume of energy acquired or consumed.

To estimate the energy prices actually paid by firms, this report uses, for each energy carrier purchased externally, sets of data in the following descending order of priority:

- *Individual energy prices*, as reported in sources published by firms themselves (i.e. the recipients), such as annual reports, bond prospectuses, sustainability reports, electricity contracts, fuel-supply agreements, etc. Where the relevant energy prices are not disclosed in value but in the form of a calculation formula, the prices are estimated by replicating the formula.
- *Implied energy prices*, estimated, on the basis of firm-level reporting, by dividing for each carrier its cost by the corresponding volume of energy consumed or purchased at the level of individual plants or firms.
- *Presumed energy prices*, which are the prices assumed to apply to a firm at the point of purchasing energy. This generally takes the form of the regulated prices in effect at the time in the country where firms operate. Where prices are differentiated by user categories, such as industrial users, large-scale users, or for certain sectors, the appropriate choice is made to match the characteristics of the energy-purchasing firm. The price information may be published by the government or state utilities (i.e. energy providers). If the price itself is not published,[28] an average effective price is calculated by dividing the revenue that national energy providers obtain from selling energy to industrial users (or an appropriate user category) by the corresponding volume.

Another critical input for quantifying below-market energy are *benchmark energy prices* (i.e. market reference prices). In this report, benchmark prices are selected largely on a case-by-case basis, such that they vary for each firm according to its location and other factors. This is because the availability of local energy sources, access to imported energy (e.g. natural gas imported via pipelines versus LNG tankers), and procurement methods vary by location and there is no one-size-fits-all benchmark price that is applicable globally to all firms. For the same reason, applicable benchmark prices can differ by plant locations within the same company and are in this case selected based on a careful assessment of a company's situation at the plant level rather than at its headquarters' location.

Table 2 shows some of the generic situations that may arise when selecting benchmark prices for each energy carrier. In a nutshell, benchmark energy prices seek to represent in a consistent way the alternative price that would prevail in a competitive market. Yet benchmark prices can be approached from different directions depending, for example, on whether the jurisdiction where a plant is located is a net energy exporter or importer. If the plant is situated in a net-energy-importing jurisdiction, benchmark energy prices essentially represent the cost that would have to be incurred by an energy buyer if the energy were imported. For a net energy exporter, benchmark energy prices represent the price that energy suppliers could expect to receive for selling energy on international markets, net of extra transport costs (which in theory should be identical to the price for domestic buyers absent government intervention).[29]

[28] This happens notably where long-term energy purchase agreements between energy providers and industrial firms are treated as confidential or commercially sensitive.

[29] This amounts to an opportunity cost or sales revenue foregone, similar to how the IEA estimates fossil-fuel subsidies in the case of net energy exporters.

Table 2. The determination of benchmark energy prices

Energy carrier	Export/Import status	Benchmark prices
Natural gas	Net importer	Spot market price (e.g. Platts JKM LNG price, which is considered to represent global LNG demand) Import prices through nearby gas pipeline routes
Natural gas	Net exporter	LNG or pipeline netback energy price Export parity price
Diesel fuel	Net importer	Unsubsidised market price in neighbouring jurisdictions or local price applicable to non-subsidised users
Coal	Net importer	Spot market price, adjusted for local transportation costs
Electricity	n.a.	Prices normally applied to industrial users in the area of plant location or in geographical proximity Prices that should be charged by electricity suppliers in order to cover their operational expenses (low estimate) Prices that should be charged by electricity suppliers in order to cover their operational expenses and an adequate rate of return per kWh of electricity sold (high estimate)

Importantly, where there are two or more alternative ways for firms to obtain the energy they need, and hence multiple possibilities for applicable market prices, lower bound and upper bound benchmark prices are utilised to provide a range of low and high estimates for below market energy. This is especially important in light of the possibility that lower observed prices could at times result from long-term contracts for energy supply that lock in prices for several years.

Another important caveat concerns the possibility that net exporters of fossil fuels could be large enough to affect global markets, such that benchmark prices cannot be considered independent of below-market energy. In this case, below-market energy may increase global market prices by increasing domestic consumption, and thus reducing the quantities of energy carriers available for export. This implies that price gaps can potentially over-estimate the size of the support conferred to local industrial producers. While this is undoubtedly a valid concern, there are no easy ways of addressing it in the absence of a detailed model of world energy markets, combined with estimates of supply and demand elasticities for relevant energy carriers. The analysis in this report therefore makes the assumption that countries are small enough that they do not affect benchmark market prices.

As for the third input into the calculation, namely the volume of energy acquired from external sources and consumed, data can be found in documents issued by recipients, as firms often disclose such information in their annual reports and sustainability reports. Information was also obtained from commercial data provider CRU in the case of steel and aluminium producers, as noted earlier. Where energy consumption volumes are not explicitly reported in any sources, CO2 emissions data, such as those found in sustainability reports, can be used to infer the consumption volume of a particular energy carrier through the use of standard CO2 emissions factors.

3. Results from an illustrative sample of energy-intensive companies

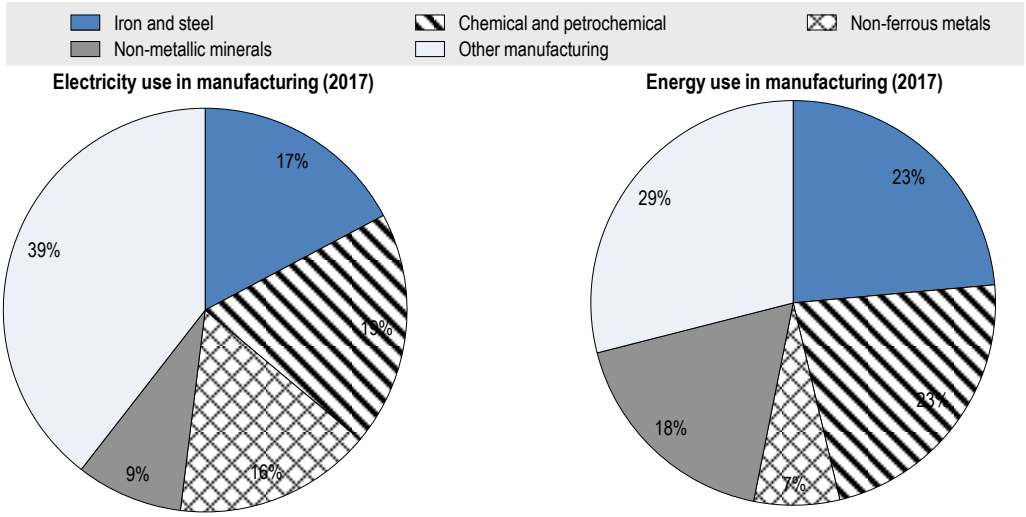
3.1. Sample description and coverage of the study

Given that it would be neither practical nor feasible to estimate below-market energy for all industrial sectors and firms, this study instead focuses on a set of industries most likely to obtain such support, namely energy-intensive industries. In practice, these industries are: aluminium smelting; cement; chemicals (including fertilisers and petro-chemicals); and steelmaking. For each industry, the analysis considers a selection of the top producing firms, following the approach in earlier OECD work on government support in industrial sectors.

The anecdotal evidence presented in Box 2 has already shown that companies operating in these energy-intensive industries tend to view energy subsidies as important factors in competitiveness. While energy costs also matter for other industrial activities (e.g. semiconductor fabs or battery factories), the role played by energy inputs in the four selected industries is unparalleled, with the notable exception of the fossil-fuel industry, which is the subject of other OECD work looking at government support for fossil fuels (OECD,

2021[3]).[30] Collectively, iron and steel, chemicals and petro-chemicals, non-ferrous metals (which include aluminium), and non-metallic minerals (which include cement, glass, and ceramics) use about 60% of all electricity and 70% of all energy used in manufacturing worldwide (Figure 6). Aluminium smelting alone is a significant user of electricity: it takes between 12-16 kWh of electricity to produce one kg of primary aluminium, with energy accounting for close to 40% of the costs of aluminium smelting. Although New Zealand has only one aluminium smelter (Tiwai Point, hydro-powered) with an annual capacity of 373 thousand tonnes, the non-ferrous metals sector consumes as much as 13% of New Zealand's electricity. For Bahrain, the corresponding percentage is as much as 40%. Iceland's three smelters together use an impressive 75% of the country's electricity. The fertiliser industry, for its part, is also known to be a major consumer of energy and feedstock, with Canada's PotashCorp[31] noting in its 2017 annual report that "natural gas can make up 70-85 % of the cash cost of producing a tonne of ammonia."

Figure 6. A few industries account for most of the energy used in manufacturing globally



Source: Extended world energy balances 2020, IEA.

The number of firms covered in the empirical analysis is limited for at least three reasons, two of which relate to the availability of information, and one to the likelihood of below-market energy in certain sectors.

Firstly, significant time is needed to obtain information from companies on their use of energy and to generate detailed estimates for below-market energy. While the OECD devoted considerable effort to the inclusion of important players in the four industries covered, the resulting sample may not always be fully representative for some of these industries. Coverage of aluminium smelting is reasonably comprehensive and representative – including due to the OECD's prior work on the sector (OECD, 2019[4]) – but the estimates presented in this report for steel, cement, and chemicals should be viewed as illustrative rather than fully representative.

Secondly, the time needed is exacerbated by the lack of transparency of many companies regarding the energy they use and the costs at which they obtain this energy. The opacity that surrounds many industrial firms' energy consumption is often greater than that observed in the context of earlier OECD studies on government support. Even firms that consistently report the government grants and income-tax concessions they receive do not always disclose the necessary information for assessing the possible

[30] Joint work between the OECD Trade and Agriculture (TAD) and Environment (ENV) Directorates. See www.oecd.org/fossil-fuels/. Other notable energy-intensive industries include glass, ceramics, and pulp and paper but they could not be covered in the present report.

[31] PotashCorp, also known as the Potash Corporation of Saskatchewan, merged in 2018 with Agrium to form the Canada-based Nutrien group.

presence of below-market energy. In general, this lack of transparency was found to be more severe in China, with exceptions.

Thirdly, the limited number of firms covered in some sectors stems from the finding that below-market energy was judged unlikely or not applicable in several instances. Estimates for steel or cement cover only a few firms because many large producers in these industries do not appear to benefit significantly from below-market energy. This is either due to these firms operating only in countries with little or no below-market energy, or because of the specifics of their energy supply and use (as per Figure 5). A significant number of steelmakers possess their own captive power plants, in which blast furnace gas is re-used as fuel to generate electricity.[32] ArcelorMittal's steel plant in Dunkirk (Northern France) self-generates about 90% of the electricity it needs, for instance, much of it fuelled using blast furnace gas in the nearby DK6 combined cycle gas turbine. Some of Nippon Steel's largest steel plants in Japan (e.g. in Kashima, Kimitsu, and Nagoya) likewise re-use their blast furnace gas as fuel in nearby power plants, as does the China Baowu Group's very large Baoshan plant.[33] In these cases, the scope for below-market electricity is therefore limited.[34]

Moreover, the relatively low prices for coal[35] and its wide availability also explain partly why the analysis has not found much below-market energy in the steel and cement industries. Roughly 90% of the energy used in cement kilns is thermal energy and the remaining 10% take the form of electricity (UNIDO, 2014[29]). Coal accounts for the lion's share of all thermal energy in some of the largest cement markets, particularly in Asia.[36] With the IEA estimating coal to account for less than 1% of fossil-fuel subsidies worldwide over the period 2010-20, this implies a limited potential for significant below-market energy in many large cement markets. Exceptions include several cement kilns in the MENA region that use natural gas alone or in combination with other fuels, which cement producers purchase from state entities at regulated prices.

The resulting sample comprises 33 firms and their subsidiaries, many of which are large multinationals with production plants in different regions of the world (Annex A). This implies that the jurisdictions providing below-market energy do not necessarily correspond to the jurisdictions in which parent companies are based, as will be discussed later in this section. For each sampled company, plant-level data that can span several locations and countries are aggregated and consolidated at the group level to match companies' financial results. In so doing, the ownership of plants and the support they receive are attributed to corporate owners on the basis of their equity participation in individual plants. For example, if the Random Metal Co. owns 40% of a production plant, and if this plant obtains USD 100 million annually in below-market energy, then USD 40 million are attributed to the Random Metal Co.

Geographical coverage spans OECD countries, Argentina, China, Egypt, Russia, South Africa, and several member countries of the Gulf Cooperation Council (GCC).[37] The analysis did not identify significant below-market energy benefitting large industrial users in certain other key emerging economies (e.g. Brazil and India), although these countries do often provide below-market energy to households and other energy users (e.g. farmers). There are also countries for which the IEA indicates that there are fossil-fuel subsidies but that the analysis was unable to cover, either due to lack of transparency or lack of time. These include: Algeria, Angola, Azerbaijan, Bangladesh, Bolivia, Ghana, Iraq, Iran, Kazakhstan, Kuwait, Libya, Nigeria, Pakistan, Trinidad and Tobago, Ukraine, and Venezuela.

[32] As noted in the *OECD Glossary of Statistical Terms*, "[b]last furnace gas is produced during the combustion of coke in blast furnaces in the iron and steel industry. It is recovered and used as a fuel partly within the plant and partly in other steel industry processes or in power stations equipped to burn it."

[33] According to plant-level data available from CRU.

[34] Even if there were below-market tariffs applicable to the relatively small amounts of electricity that these plants obtain from the grid, the resulting support estimates would be comparatively small.

[35] This refers to market prices. Accounting for negative environmental externalities would make coal a lot less competitive fuel source.

[36] Solid waste and biomass are also used as fuel in certain cement kilns in replacement of coal, natural gas, and petroleum coke, e.g. in Europe and Egypt.

[37] Member countries of the Gulf Cooperation Council are Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, and the United Arab Emirates.

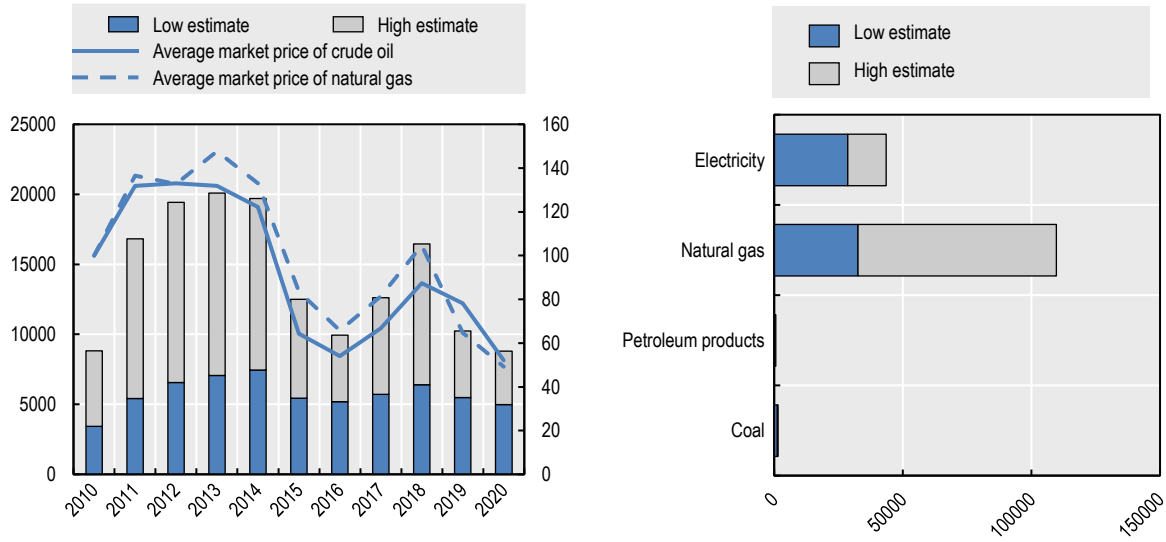
3.2. Key results and discussion

Using the illustrative firm sample described earlier, analysis in this report finds that below-market energy ranged between USD 63 billion (low estimate) and USD 155 billion (high estimate) over the entire period 2010-20 (Figure 7; left). This corresponds to an annual average subsidy of USD 6-14 billion. Yearly estimates appear to track world energy prices closely, which largely reflects fluctuations in the value of price benchmarks used in the price-gap calculations.

Together, natural gas and electricity account for almost all the support identified, leaving very little below-market energy attributable to coal and petroleum products (Figure 7; right). In the case of coal, as explained earlier, low relative prices make it generally affordable to industrial users without the need for subsidies, absent sudden and large fluctuations in coal markets. In the case of petroleum products, this is because gasoline, kerosene, and diesel fuel are mainly used in transportation and heavy machinery rather than as fuel for industrial processes. Overall, coal, electricity, and natural gas thus remain the energy carriers of choice for large industrial users. For the entire sample, the average subsidy for natural gas is USD 0.4-1.3 per million British thermal units (BTU)[38] and the average electricity subsidy USD 0.02-0.03 per kWh.

Figure 7. Below-market energy totalled USD 63-155 billion over 2010-20, mainly in the form of natural gas and electricity

Below-market energy in current USD millions; average energy prices 2010 = 100



Note: Average market prices for crude oil and natural gas are the simple averages of annual values for a basket of common price benchmarks: Brent, Dubai, and West Texas Intermediate for crude oil; Japan-Korea Marker, Dutch TTF, and Henry Hub for natural gas.
Source: OECD research; average energy market prices are from the *BP Statistical Review of World Energy*.

Using the information collected for individual plants and firms, the results indicate that below-market energy can represent a multiple of firms' estimated energy costs. This implies that some companies only pay a small fraction of the benchmark energy prices. The gap is highest for natural gas but also considerably large for petroleum products and electricity (Figure 8; left).[39] Partly as a result, the 25% of sampled companies that obtained the most below-market energy tend to have remarkably high profit margins and returns on assets (Figure 8; right). Given that these firms all operate in energy-intensive sectors, it is reasonable to assume that subsidised energy might be having a large impact on profitability. Anecdotal

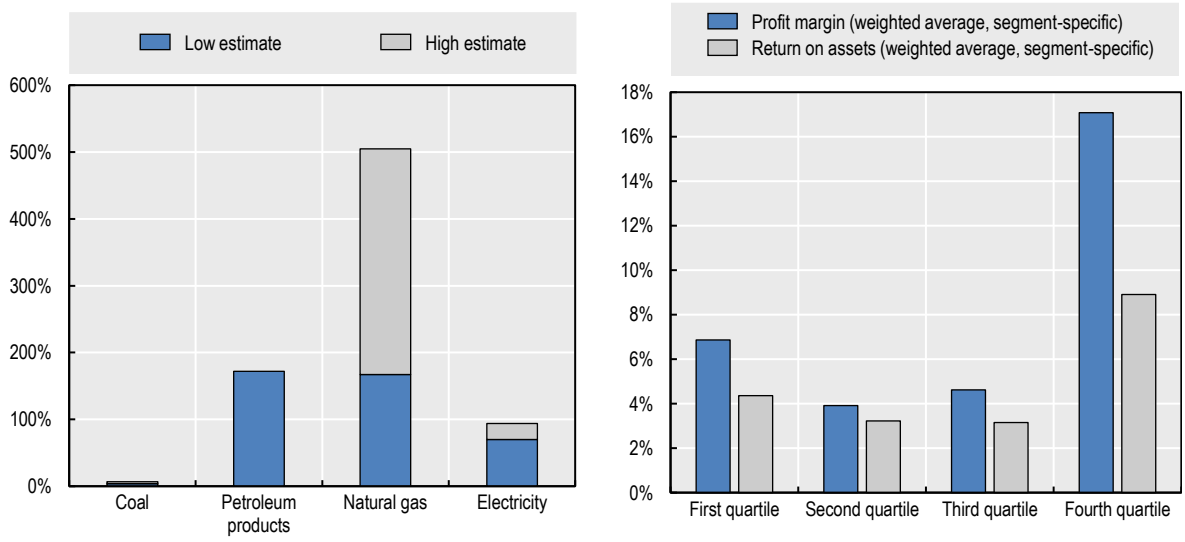
[38] For reference, market benchmarks for natural gas delivered by pipeline over the same period averaged about USD 5 per million BTU.

[39] Even if petroleum products are not used by firms intensively in their operations, companies can nonetheless benefit from a large price gap on the relatively small quantities of petroleum they purchase.

evidence presented in Box 2 suggests indeed that companies themselves view it as such. This helps answer a question raised in earlier OECD work on below-market finance (OECD, 2021[6]), which noted that some state enterprises in heavy industries had abnormally high profit margins that did not find their source in government grants, tax concessions, or below-market borrowings.[40]

Figure 8. Some firms only pay a small fraction of the benchmark energy prices, helping them increase their profits considerably

Left: Below-market energy, % of firms' estimated energy costs by energy carrier
Right: Firm profits by quartile of below-market energy, low estimate



Note: Energy costs are estimated by multiplying firms' consumption volumes of particular energy carriers with the corresponding prices that the OECD estimates to apply effectively. Note that there can at times be uncertainty over these exact prices. Quartiles of below-market energy are defined such that the first (fourth) quartile comprises the 25% of firms that receive the lowest (highest) amount of below-market energy in the sample.
Source: OECD research.

Looking at the jurisdictions that provide below-market energy (and bearing in mind the caveats that apply given the limited sample size), the analysis finds GCC members to far surpass other economies covered in the study in USD terms (Figure 9; left). This is consistent with the IEA's finding that GCC countries alone accounted for nearly 20% of global fossil-fuel subsidies over the same period (2010-20), as well as having relatively high subsidisation rates. It is also consistent with some of the anecdotal evidence presented in Box 2 and Box 5. In addition to having relatively large price gaps, GCC economies are also characterised by a heavier reliance on natural gas in manufacturing, as opposed to countries such as China, India, and Indonesia that rely on coal relatively more. As noted earlier, natural gas tends to be more heavily subsidised than coal, which partly explains the results obtained in this report. Although GCC economies are large oil exporters, the same is not true for natural gas, with the important exception of Qatar. Kuwait, Oman, and the UAE are, for example, importers of natural gas from Qatar, either via the Dolphin pipeline connecting Qatar to the UAE and Oman, or in liquefied form via regasification terminals. Saudi Arabia is, meanwhile, constrained in its supply of natural gas since it relies almost entirely on associated gas that is extracted along with crude oil.[41]

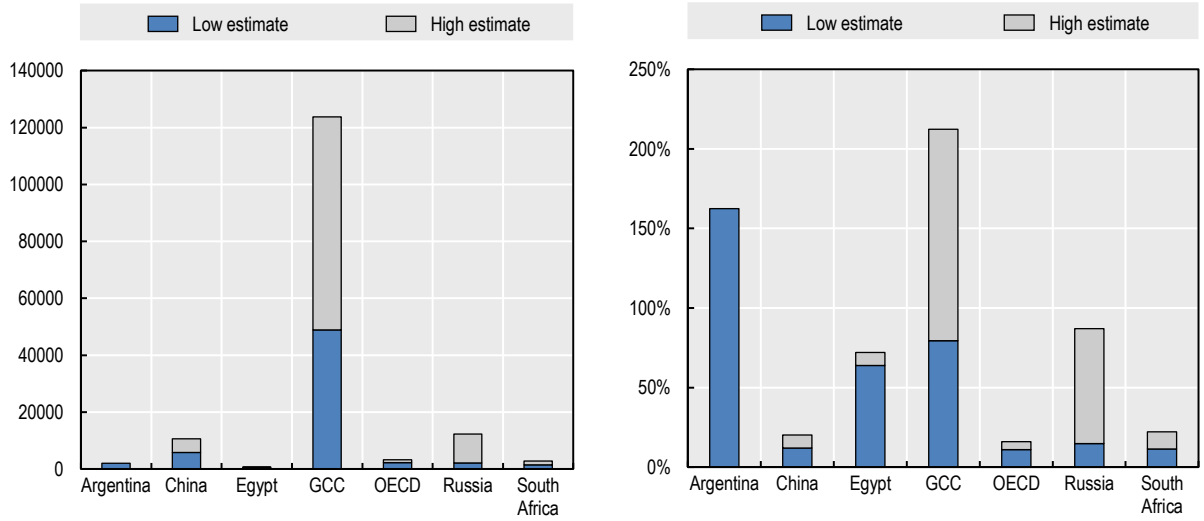
[40] See Figure 9 in OECD (2021[6]) in particular.

[41] See, for example, www.kapsarc.org/research/projects/future-of-natural-gas-in-saudi-arabia/ (accessed on 30 August 2022), which notes that: "[t]he rapid increase in natural gas demand for power generation and industrial development in past decades has put pressure on natural gas supply in Saudi Arabia. While developments are underway to ramp up domestic natural gas production, supplementing domestic supply with LNG imports becomes an option for the Kingdom. […] KAPSARC's past studies indicate that in the absence of LNG imports, *the projected long run marginal value of domestic gas in Saudi Arabia is potentially [USD] 9/MMBtu*" (own emphasis).

When expressed as a percentage of firms' estimated energy costs, GCC countries retain their first position using the high estimate, followed by Argentina, Russia, and Egypt (Figure 9; right). China, South Africa, and OECD countries have, meanwhile, relatively lower below-market energy. Although OECD countries appear to provide the lowest amount of below-market energy in relative terms (and the third lowest in absolute terms), it should be noted that several firms in the sample that are based in OECD countries have operations in other jurisdictions in which they obtain below-market energy. As a result, OECD-based firms account for either a sizable portion or the majority of the support found for Argentina, Egypt, and South Africa. Although it is more modest, the support that OECD-based firms obtain in GCC countries is not negligible either.

Figure 9. GCC countries surpass other economies covered in the study

Left: Current USD millions
Right: % of firms' estimated energy costs

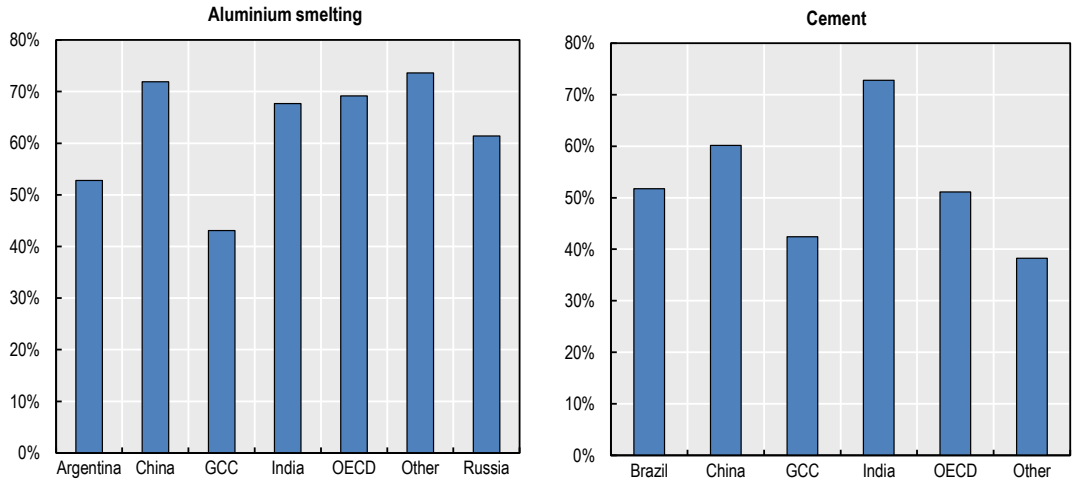


Note: Energy costs are estimated by multiplying firms' consumption volumes of particular energy carriers with the corresponding prices that the OECD estimates to apply effectively. Note that there can at times be uncertainty over these exact prices.
Source: OECD research.

Although the firm sample is arguably too small to be deemed representative, the results are nonetheless consistent with what can be seen by looking at input costs for a broader set of companies. Average input costs (expressed as a percentage of revenue) for the world's largest aluminium smelters and cement producers indicate that firms based in GCC countries have access to considerably cheaper intermediate goods and services (Figure 10). Given the importance that energy has in total costs for these two sectors, this would be consistent with the scale of below-market energy that GCC-based firms obtain, although many other factors can also affect the cost of firms' intermediate inputs (e.g. proximity with suppliers and longstanding commercial relationships). Access to low-cost hydroelectricity could similarly explain part of the differences observed between regions, with aluminium smelters in Brazil, Canada, Iceland, Norway, and Russia benefitting from their proximity to dams. Overall, average input costs are nevertheless consistent with findings in this report.

Figure 10. GCC-based firms have access to cheaper intermediates, which would be consistent with the scale of below-market energy they obtain

Average input costs, % of revenue

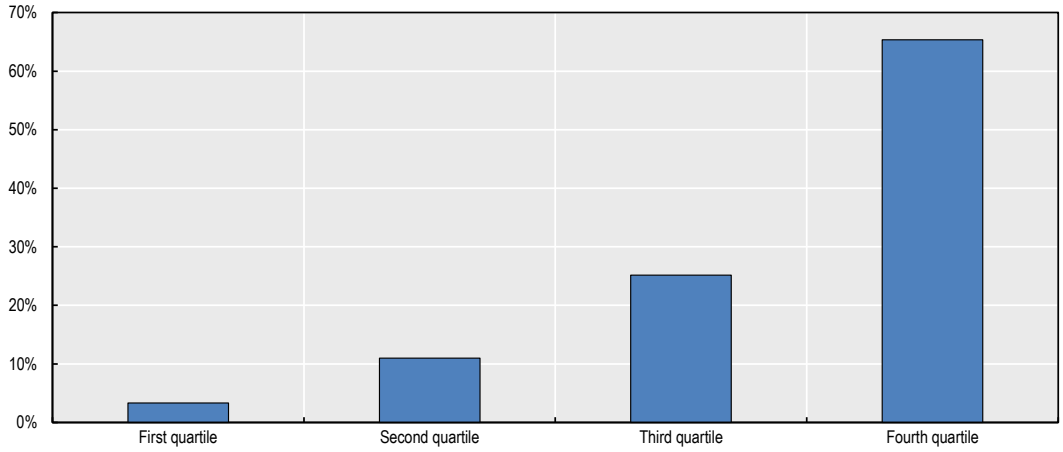


Note: Input costs are estimated by subtracting labour costs, depreciation, and amortisation from companies' cost of sales or total expenses. The companies covered include all firms included under aluminium and cement in the OECD's firm-level database of government support in industrial sectors. See OECD (2021[6]) for more information about the database. "Other" includes Egypt, Nigeria, Southeast Asia, and Chinese Taipei. Some of these other jurisdictions (e.g. Egypt) used to have sizable energy subsidies in place before they were reformed in recent years.
Source: OECD research.

Not only is the majority of below-market energy provided through state energy companies, but large recipients also tend to have larger government ownership (Figure 11). The fourth quartile of firms – i.e. the 25% of firms in the sample that received the highest amount of below-market energy – had on average 65% their shares owned by governments, compared with only 3% for the first quartile – i.e. the 25% of firms in the sample that received the lowest amount of below-market energy. As with below-market finance (OECD, 2021[6]), these findings underscore that certain forms of support often coincide with larger state involvement in particular sectors of the economy (e.g. banking, energy, but also heavy industries). This raises questions in relation to the role of the state, particularly in economies where the state traditionally plays an important role in the economy (Box 6).

Figure 11. Large recipients of below-market energy tend to have larger government ownership

% of government ownership by quartile of below-market energy, high estimate



Note: Using the low estimate instead does not change the findings of this graph. Quartiles of below-market energy are defined such that the first (fourth) quartile comprises the 25% of firms that receive the lowest (highest) amount of below-market energy in the sample.
Source: OECD research.

Box 6. Government involvement in China's electricity market: Implications for below-market energy

Continued involvement of the National Development and Reform Commission (NDRC) and provincial authorities in electricity pricing, together with the presence of excess capacity in (majority state-owned) coal-based power generation (Annex B), have raised concerns that China's electricity prices may not be cost-reflective and that they may confer support to industrial users. The IEA estimates that China's electricity subsidies amounted to USD 242 billion (in 2020 prices) over the period 2010-20, corresponding to an annual average subsidy of USD 22 billion. These estimates are for the whole of the country, however, and the proportion benefitting industrial users is unclear.

Several observers of China's energy sector (including the IEA) have noted that electricity prices for large industrial users tend to be significantly higher than those for residential and agricultural users, similar to the situation in India. This results in large cross-subsidies going from manufacturing to households (Hernández Alva and Li, 2018[30]), which are reflected in the estimates of electricity subsidies published by the IEA. According to Rawski (2019[31]), tariffs for "large-scale industry" in China have in fact exceeded prices charged to US industrial electricity users throughout 2005-16, leading the author to argue that "this observation contradicts claims […] that Chinese manufacturers enjoy cheap electricity supplies". While some of China's Western provinces have comparatively low electricity tariffs, this does not necessarily imply that there are subsidies either. A special report by the IEA on solar-PV supply chains recently noted that "[l]ow electricity prices in China are a result of access to relatively low-cost coal, particularly in Xinjiang, Inner Mongolia and Jiangsu, where it makes up three-quarters of the generation mix" (IEA, 2022[32]).[1]

The firm-level data collected by the OECD and shown in Figure 10 appear consistent with these findings, suggesting that the input costs of Chinese aluminium smelters and cement producers do not represent an abnormally low proportion of their revenue, unlike what can be seen in, for example, GCC countries. Other financial data collected for China's Big 5 power generators likewise do not suggest the presence of electricity subsidies on a large scale. The revenue that these companies generate from selling their electricity to grid companies at the regulated on-grid tariffs are in most years sufficient to cover these firms' operating expenses, of which fuel prices account for a large portion.[2] Consistent with this report's high-estimate benchmark for electricity (Table 2), these regulated tariffs may, nevertheless, fall short of covering what might be considered adequate rates of return on assets (i.e. returns that are large enough to enable debt and equity investors to earn market-consistent returns).

Yet this report has also found unambiguous evidence of preferential electricity rates benefitting certain producers of primary aluminium in China (e.g. see Box 2).[3] One way to reconcile these seemingly opposite findings is to consider below-market electricity in China to be a localised policy pursued mainly by sub-national authorities willing to attract industrial activity. While the evidence above does not suggest that China offers large amounts of below-market electricity on an economy-wide scale, it is not incompatible with the presence of significant support for particular firms, provinces, or municipalities. Examples would include the provincial support found for aluminium producers Qinghai Provincial Investment Group and Yunnan Aluminium, both of which are provincial state enterprises that obtained below-market electricity from local authorities (OECD, 2019[4]).

While below-market energy for industrial users may not be a widespread policy in China, below-market finance is (OECD, 2021[6]), and the coal power sector has been a large beneficiary in the form of below-market loans for expanding capacity. Between 2005 and 2011, 3% of all bank loans to coal power companies were from policy banks (e.g. the China Development Bank) and another 70% were from state banks (e.g. the Bank of China, the China Construction Bank, and the Industrial and Commercial Bank of China) (Hervé-Mignucci et al., 2015[33]). An earlier OECD study of government support in the aluminium value chain (OECD, 2019[4]) found SPIC (one of the Big 5) to have received considerable amounts of below-market borrowings. Other large power-generation state companies seem able to access financing at relatively low cost. This again underscores the importance of

considering government support in all its forms in order to paint an accurate picture of distortions in international markets.

Notes:

1. In the particular case of Inner Mongolia, the combination of an independent provincial grid, a lack of interconnection capacity (except to parts of Shaanxi), and large coal resources could explain the relatively low electricity prices.

2. Operating expenses include fuel costs, but also labour, maintenance, repairs, depreciation, etc. The finding that regulated tariffs are sufficiently high to cover the Big 5's operating expenses is consistent with Hervé-Mignucci et al. (2015[33]).

3. The European Commission likewise noted in 2019 that "the electricity rates paid [in China's steel sector] are preferential depending on the individual enterprises, sector of industry, or their geographical location." See https://eur-lex.europa.eu/legal-content/EN/TXT/PDF accessed on 5 September 2022). While noting that there are valid reasons for observing low electricity tariffs in certain parts of China, the IEA warned that "these prices may not represent the true cost of power, as additional subsidies or preferential rates can apply at the provincial level" (IEA, 2022[32]).

3.3. Three key implications

The findings above have three important policy implications from a trade perspective. First is the fact that heavy and opaque state involvement in energy pricing, and energy supply more generally, can significantly complicate efforts to detect and quantify below-market energy. Where governments set or otherwise guide energy prices, it can be very difficult to identify a suitable benchmark for quantifying below-market energy. The absence of unambiguously market-consistent prices or cost-reflective tariffs in the country requires further assumptions for filling in the gaps that can affect the accuracy of estimates. This in turn hampers efforts to improve transparency with regards to government support (see also the discussion of benchmarks in the next section).

A second implication concerns the finding that below-market energy in certain economies (e.g. China) is not widespread but rather specific to certain companies, sectors, or regions. While broad-based below-market energy can often be detected by looking at energy providers (Box 5) or government regulations and decisions, proving the existence of specific contracts or local decisions awarding companies below-market energy can be much more difficult. In this case, the identification and estimation of below-market energy is almost entirely dependent on the degree to which companies transparently report on the terms and conditions of their energy supply. Such transparency is, however, not common.

A final implication is that it is necessary to consider government support in all its forms in order to correctly diagnose market distortions in international markets. GCC countries and China provide contrasting examples in that regard. Earlier OECD work (OECD, 2021[6]) did not find industrial firms based in GCC countries to have obtained large amounts of governments grants and below-market borrowings. Income-tax concessions are also not very common in the region since companies are generally subject to the *zakat*.[42] This can lead to the conclusion that GCC firms obtain on average very modest amounts of government support, even as they feature some of the highest profit margins globally. This report has shown, however, that these firms obtain very significant amounts of below-market energy that increase their operating margins. By contrast, this report has not found evidence of large amounts of below-market energy benefitting Chinese firms, but earlier work has shown that they do obtain considerable support in the form of government grants, tax concessions, and below-market finance (OECD, 2021[6]). This suggests that looking at only one type of government support could potentially lead to erroneous conclusions regarding the size and scope of market distortions.

[42] See https://taxsummaries.pwc.com/saudi-arabia/corporate/taxes-on-corporate-income (accessed on 6 September 2022). "Saudi citizen investors (and citizens of the GCC countries, who are considered to be Saudi citizens for Saudi tax purposes) are liable for Zakat, an Islamic assessment. […] Zakat is charged on the company's Zakat base at 2.5%. Zakat base represents the net worth of the entity as calculated for Zakat purposes."

4. Observations on below-market energy and multilateral trade rules[43]

This section discusses the relationship between below-market energy and the WTO subsidy rules enshrined in the SCM Agreement comparing the various types of below-market energy uncovered in this report with the criteria for actionable and prohibited subsidy.[44] This section does not aim to provide an authoritative interpretation of existing trade rules, nor to indicate how the rules should be construed and provide specific answers as to how they should be improved. Instead, the purpose of this section is simply to identify potential gaps within the WTO subsidy rules in relation to below-market energy and to reflect on possible solutions and channels to address such gaps, with a view to informing policy discussions and efforts to revisit those rules.

4.1. Four different scenarios involving below-market energy

The data collected for this report reveal the existence of various channels through which governments can provide below-market energy. Drawing upon Figure 5 above, the following outlines four different scenarios corresponding to actual instances of below-market energy. Each of these scenarios is examined in turn. Taking stock of the results in the empirical analysis, this exercise aims at identifying where legal challenges relative to the SCM Agreement may emerge. This is done bearing in mind that for below-market energy to be challenged in the WTO, there would need to be a 'financial contribution' by a government, 'public body', or 'private body entrusted or directed by the government' conferring a specific benefit to one or a selective group of recipients, which causes adverse trade effects to the interests of other WTO Members.[45]

In Scenario A**,** the energy provider or fuel supplier is a state enterprise and provides energy carriers at tariffs regulated, capped, or administered by the government. The tariffs distinguish between different categories of consumers (e.g. residential, agricultural, commercial, and industrial users) but do not differentiate among industrial users. While these tariffs remain below market levels, they are not specific to any individual or group of industrial users. These stylised facts may represent the most prevalent scenario involving below-market energy.

In Scenario B, the energy providers or fuel suppliers are either private and state enterprises or private companies only. The government regulates, caps, or administers tariffs for the relevant energy carriers. As for Scenario A, the tariffs, which are at below-market levels, differentiate between various categories of users but do not distinguish among industrial users. While this factual pattern is less common than the previous scenario, it has been detected in certain cases.

Scenario C corresponds to instances where bilateral contracts or national legislation enables energy providers or fuel suppliers, notably state enterprises, to provide energy carriers to specific industrial users at prices below the market rate. The initial empirical analysis has detected several such cases. They involve low contractual prices, benefitting one or more industrial users, which are distinct from the – at times regulated – price paid by the other industrial users.

The last scenario, Scenario D, which appears to be the least common, corresponds to the situation where the government does not explicitly intervene in the pricing of energy or fuel, although the energy provider or fuel supplier is a state enterprise. Despite the absence of any explicit government interference with prices, there may be instances where the energy provider acts on behalf of the government to provide

[43] Any observation in this section is without prejudice to any reviews that may be conducted by investigating authorities or under the WTO dispute settlement procedures on subsidies and countervailing measures, as well as any views of WTO Members.

[44] Under the SCM Agreement, a domestic measure amounts to a subsidy a 'financial contribution' by a government, 'public body', or 'private body entrusted or directed by the government' conferring a benefit (Article 1.1 of the SCM Agreement). A subsidy is actionable if it benefits specific recipient and cause adverse effects to the interests of another WTO Member (Articles 2.1, 5, 6, and 15 of the SCM Agreement). A subsidy is prohibited within the meaning of the SCM Agreement if it is contingent on exports or on the use of domestic over imported products (Article 3.1(a) and (b) of the SCM Agreement).

[45] See Articles 1, 2, 5, 6, 14, and 15 of the SCM Agreement.

energy carriers at below-market rates. Such a situation may occur in jurisdictions where the government plays traditionally an important role in the economy.

It bears mentioning that the analysis in this report has also identified instances where energy companies, often state enterprises, are themselves recipients of government support aimed at compensating them for their sales of energy carriers at below-market prices (e.g. see Box 5). Yet the presence of subsidies benefitting upstream energy companies may not be a necessary condition for there to be below-market energy. The presence of regulated, capped, or administered energy prices below the market rate constitutes more direct evidence. Subsidies upstream may, nevertheless, be indicative of the presence of government support across the production chain. It may also attest to the important role played by the state in the energy sector.

Specific legal issues arise under each of the scenarios described above (A-D) in relation to WTO subsidy rules. In what follows, this section focuses on the issues that may represent challenges for demonstrating that the identified instances of below-market energy amount to actionable subsidies consistent with the SCM Agreement. Table 3 summarises the various scenarios and the associated key legal questions that might arise.

Table 3. The different scenarios involving below-market energy

	Factual matrix	Potential issues
Scenario A	• State energy providers or fuel suppliers • Regulated, capped, or administered tariffs • Single tariff for all industrial users	(i) The concept of 'public body' granting: a 'financial contribution' where energy companies are entirely or predominantly state-owned, or -invested, or -influenced (ii) The identification of an appropriate market benchmark under the notion of 'benefit' where the government in question administratively controls all energy prices in the country (iii) The assessment of 'specificity' where the advantageous tariff does not distinguish between industrial users
Scenario B	• Mix of public and private energy providers or fuel suppliers • Regulated, capped, or administered tariffs • Single tariff for all industrial users	(i) The concept of 'private body entrusted or directed by the government' to provide energy' (ii) The identification of an appropriate market benchmark under the notion of 'benefit' where the government in question administratively controls all energy prices in the country (iii) The assessment of 'specificity' where the advantageous tariff does not distinguish between industrial users
Scenario C	• State energy providers or fuel suppliers • Regulated, capped, or administered tariffs • Specific energy price for selective industrial users	(i) The concept of 'public body' granting: a 'financial contribution' where energy companies are entirely or predominantly state-owned, or -invested, or -influenced (ii) The identification of an appropriate benchmark under the notion of 'benefit' where the government in question administratively controls all energy prices in the country
Scenario D	• State energy providers or fuel suppliers • Energy or fuel prices not subject to control by the government • Single price for all industrial users	(i) The concept of 'public body' or 'private body entrusted or directed by the government' (ii) The identification of an appropriate market benchmark under the notion of 'benefit' (iii) The assessment of 'specificity' (iv) Potential 'pass through' test if the energy providers or feedstock suppliers are not a 'public body'

Source: Authors' elaboration.

4.2. The role of the state in energy markets and implications for trade rules

At heart, the question of below-market energy is linked to that of government involvement in energy markets. As noted in the previous section, the energy companies involved in the provision of below-market energy to industrial users are often state enterprises **(**Scenarios A, C, and D). So are many large beneficiaries of below-market energy that have government entities as major shareholders (Figure 11). Moreover, this report has found several governments to intervene directly in energy pricing, including in some cases by keeping prices constant over many years. The extent to which the state is involved in energy markets has in turn important implications for trade rules and the ability of countries to challenge below-market energy in the WTO.

The fact that an energy supplier is a state enterprise may not suffice to prove that it is a 'public body' granting a 'financial contribution' within the meaning of Article 1.1 of the SCM Agreement. The WTO Appellate Body has notably interpreted the meaning of 'public body' as "an entity that possesses, exercises or is vested with governmental authority",[46] which has proven to be a matter of debate (Cartland, Depayre and Woznowski, 2012[34]; Miranda and Sánchez-Miranda, 2020[35]).[47] It is unclear whether this concerns some of the energy providers identified in this report that are state enterprises. Were it to be the case, proving the existence of a 'public body' under the Appellate Body interpretation could require additional evidence concerning the relationship between the energy provider and the government concerned, and in particular elements suggesting that the entity is meaningfully controlled by the government when exercising its functions. There is in this regard no clear guidance with respect to the adequate range of evidence needed.[48] The finding that some state energy companies have received government support in compensation for their sales of energy carriers at below-market prices could help, however.

Another question concerns whether private conduct can be attributable to a government or a public body under the SCM Agreement, and what this may imply for below-market energy. This question could arise in a context where private energy providers sell energy carriers at tariffs that are regulated, capped, or administered at below-market levels set by the government (Scenario B). According to Article 1.1(a)(1)(iv) of the SCM Agreement, a private body is deemed to make a 'financial contribution' if it is entrusted or directed by a government (or a public body) to carry out one of the three types of 'financial contribution' listed in Article 1.1(a)(1)(i) to (iii). However, showing that a private body is used as a 'proxy' to provide a 'financial contribution' might, under the Appellate Body interpretation, require hard-to-obtain evidence, e.g. demonstrating the commercial unreasonableness of the private entity's conduct (i.e. the private actor acting against its own commercial interests).[49] A related question is whether a private body providing energy at tariffs controlled by the government (Scenario B) could be suggestive of the government's direction to the private entity, namely its exercise of authority over a private body.

Government control over domestic energy prices could, meanwhile, complicate attempts to determine the existence of a 'benefit' within the meaning of the SCM Agreement. Identifying an appropriate market benchmark is a central step to decide on the presence of a 'benefit' (and thus a 'subsidy') under the Agreement but doing so can be difficult in the presence of widespread government intervention in energy pricing. This is particularly the case where governments set energy prices outright or otherwise suppress them significantly, thereby raising the issue of whether it is possible to identify market-consistent prices that could be used as benchmarks in the countries concerned. In such situations, it may be necessary to

[46] Appellate Body Report, *US-Anti-dumping and Countervailing Duties on Certain Products from China*, para 317.

[47] See, for instance, WT/DSB/M/294, 9 June 2011, paras 97, 103, 106-107, 109, 113, 114, 117, 119, and 127; WT/DSB/M/354, 16 February 2015, paras 1.22, 1.31, and 1.32. In a more recent Appellate Body report, one member of the Appellate Body division drafted a dissenting opinion, qualifying the Appellate Body's attempt to define the term 'public body' as "an entity that possesses, exercises or is vested with governmental authority" as an "original mistake." See Appellate Body Report, *US-Countervailing Measures (China) (Article 21.5)*, WT/DS437/AB/RW, adopted 15 August 2019, para 5.245.

[48] As noted below, the absence of a clear definition of 'public body' may, in turn, have implications for WTO Members' compliance with their subsidy notification obligation under Article 25 of the SCM Agreement.

[49] Appellate Body Report, *Japan-DRAMs (Korea)*, WT/DS336/AB/R, adopted 17 December 2007, para 138 and Panel Report, *EC-Countervailing Measures on DRAM Chips*, para 7.59.

use independent market prices found in third countries.[50] For this purpose, however, and under the Appellate Body's interpretation, it is necessary to prove first that the market at issue within the country concerned is significantly distorted. There is also no clear guidance as to which benchmarks would be appropriate.[51] Altogether, widespread government involvement in energy pricing may contribute to making it difficult for WTO Members to establish the existence of a benefit in the case of below-market energy.

4.3. The widespread availability of below-market energy and the specificity of government support

In many cases encountered in the analysis conducted for this report, countries extend the provision of below-market energy to entire user groups or even entire segments of their economy. Several governments that offer natural gas and electricity on below-market terms apply, for example, the same prices to all industrial users. In other cases, prices are differentiated according to the voltage level at which industrial users obtain their electricity. In still other cases, countries set a single price for natural gas applicable to all enterprises and commercial users. The availability of below-market energy on such a large scale may raise issues for trade rules in relation to the specificity of government support.

The requirement of specificity contained in Article 2 of the SCM Agreement might constitute the most important hurdle for below-market energy to be captured by WTO subsidy disciplines, especially under Scenarios A and B (Table 3). For a subsidy to be actionable pursuant to the SCM Agreement, it must be specific to "an enterprise or industry or group of enterprises or industries."[52] By contrast, a subsidy that is generally available throughout the economy is deemed non-actionable. Absent specificity, WTO Members can neither challenge the subsidy at issue before the WTO dispute settlement system nor impose countervailing duties. In this regard, Article 2 of the SCM Agreement distinguishes between *de jure* and *de facto* specificity. While subsidies explicitly limited to certain enterprises would be classified as *de jure* specific, other subsidies having an 'appearance of non-specificity' may still be deemed *de facto* specific under Article 2.1(c) if in practice the subsidy is received by one or a specific group of recipients.

Below-market energy may, in some cases, be explicitly limited to certain enterprises (Scenario C). The data collected for this study contain examples where state energy companies have concluded bilateral contracts with specific industrial users for the provision of energy carriers at below-market prices.[53] In this scenario, the provision of energy or feedstock at below-market price may be deemed *de jure* specific as the price is expressly limited by virtue of the individual contracts to one or several industrial producers. In another instance, however, the state energy company concerned did not publish the contractual price agreed with the industrial producer. As a result, not only is the determination of a 'benefit' difficult, but the absence of any express reference to the individual price paid by the industrial producer concerned (or the contract itself in an official act) may impede the classification of support as *de jure* specific, within the meaning of the SCM Agreement.

Specificity is especially difficult to demonstrate in instances where the government administratively controls the energy prices paid by all users (Scenarios A and B). In this case, prices may differ from one user category to another (e.g. residential, agricultural, commercial, governmental, and industrial users) but a single price applies nevertheless to all industrial users in the economy. This raises the question of whether this price should be viewed as specific within the meaning of the SCM Agreement or as broadly available. In *US-Softwood Lumber IV*, the panel concluded that the provision of timber, which could be used by approximately 23 different industries, producing over 200 separate products nonetheless amounted to a

[50] See also Panel Report*, US-Softwood Lumber IV*, WT/DS257/R, adopted 17 February 2004, paras 7.32, 7.39, and 7.40*; Appellate Body Report, US*-Softwood Lumber IV, WT/DS257/AB/R, paras 95 and 103.

[51] See on this point, Appellate Body, *US-Softwood Lumber IV*, paras 106 and 108 and Panel Report, *US-Anti-Dumping and Countervailing Duties (China)*, para 10.188. This prompted the Trade Ministers of the United States, Japan, and the European Union, to observe that the provisions enshrined in the SCM Agreement are "insufficiently prescriptive" to determine the appropriate benchmark when dealing with the provision of goods by a government in a jurisdiction where the domestic market is distorted. On this basis, they recommended to amend the relevant provision of the Agreement "to describe the circumstances in which domestic prices can be rejected and how a proper benchmark can be established, including the use of prices outside the market of the subsidizing Member."

[52] Article 2.1 of the SCM Agreement.

[53] These prices can be artificially low and distinct from the – at times regulated – price paid by other industrial users.

specific subsidy.[54] However, the general availability of certain natural resources may not be comparable to the usage – albeit wide – of timber (Herghelegiu and Rubini, 2021[36]). Relying on an observation of the panel report in *US-Softwood Lumber IV*,[55] the Appellate Body has held that the provision of certain natural resources, such as oil, natural gas, and water, would not be automatically specific because they may be used by an indefinite number of industries.[56] Many instances of below-market energy might therefore not be captured by the WTO subsidy discipline owing to a lack of 'specificity' under the Appellate Body interpretation.

4.4. Lack of transparency creates further obstacles

As with many other forms of government support, the lack of transparency surrounding below-market energy constitutes a major obstacle for reform efforts. Domestically, lack of transparency on below-market energy prevents taxpayers from getting a clear view of how public resources are spent or mobilised, thus undermining policy evaluation and government accountability. Internationally, lack of transparency hampers efforts to evaluate trade distortions and improve trade rules.

The transparency deficit around subsidies is not specific to below-market energy; rather, it constitutes a systemic issue across the various types and forms of government support. However, certain elements underpinning the lack of transparency in relation to below-market energy are peculiar to this type of government support. WTO subsidy notification rules do not appear to cover non-specific subsidies, such as below-market natural gas offered without distinction to all industrial producers. Many governments also provide little information on the reasons behind regulated or administered tariffs, as well as the energy or fuel prices at which companies purchase or sell energy carriers.

The obligation imposed on WTO Members by virtue of Article 25 of the SCM Agreement to notify their subsidies before the SCM Committee is at the heart of the WTO subsidy discipline. Yet Members' overall compliance with their notification obligation has remained 'chronically' low since 1995.[57] As recently noted by the chair of the SCM Committee, 109 Members out of 164 had failed to submit their subsidy notifications for 2021, although these notifications were due by 30 June 2021.[58] Moreover, in 2021, 78 Members had still not submitted their 2019 notifications, while 67 Members had failed to notify their subsidies for 2017.[59]

Improving notifications through a mixture of carrots and sticks may not be enough to prompt WTO Members to report their below-market energy consistently, however. Gaps would likely remain even if all WTO Members were to notify the measures that they themselves consider to be subsidies. One reason is that WTO Members might not all agree as to what exactly constitutes below-market energy, choosing instead to notify only those measures that they view as subsidies (Shaffer, Wolfe and Le, 2015[37]; Bown and Hillman, 2019[38]). Diverging views could concern whether or not state enterprises providing energy carriers at below-market prices are 'public bodies'. Members might also disagree as to what price ought to constitute an adequate market benchmark for electricity or natural gas.[60]

Another reason for why subsidy notifications may remain incomplete in relation to below-market energy could stem from the requirement that governments notify only domestic subsidies that they deem specific

[54] Panel Report, *US-Softwood Lumber IV*, paras 7.120-7.121.

[55] Panel Report, *US-Softwood Lumber IV*, para. 7.116.

[56] Appellate Body Report, *US-Carbon Steel (India)*, para 4.393, n 1036.

[57] See, for instance, the statement of the chair of the SCM Committee in G/SCM/M/113, 25 February 2021, para 96.

[58] See the WTO website, 'Members review subsidies and countervailing measures, call for enhanced transparency', 26 October 2021, available at: www.wto.org/english/news_e/news21_e/scm_26oct21_e.htm (accessed on 15 February 2022).

[59] Ibid.

[60] In this regard, the Trade Ministers of the United States, Japan, and the European Union noted in January 2020 the "insufficiently prescriptive" character of the current subsidy rules when determining the appropriate benchmark for subsidies consisting of the provision or purchase of goods by a government "in situations where the domestic market of the subsidising Member is distorted." See the 'Joint Statement of the Trilateral Meeting of the Trade Ministers of Japan, the United States and the European Union', dated 14 January 2020.

within the meaning of Article 2 of the SCM Agreement. In this respect, the SCM committee's notification questionnaire requires Members to notify "(a) all *specific* subsidies […]."[61] As noted earlier, however, many instances of below-market energy may not be viewed as *de jure* nor *de facto* specific. Governments in such cases tend to set energy prices that are applicable to all industrial users without distinction (Scenarios A and B). In the absence of a difference of treatment between industrial users, some WTO Members may consider that their pricing of energy carriers is not specific, and hence not subject to any reporting obligation before the SCM Committee.

Even in cases where the provision of below-market energy might be deemed specific within the meaning of the SCM Agreement (Scenario C), governments have at times failed to notify their support to the WTO. While there could be many reasons for these incomplete notifications (e.g. lack of administrative capacity and inter-agency co-ordination), another explanation might be that some resource-endowed countries often view their resources as enabling them to provide below-market energy to their domestic industries. They would argue that the benefit arising from such advantage should not be deemed incompatible with the SCM Agreement (Ripinsky, 2004[39]; Pogoretskyy, 2009[40]).[62]

Complicating matters is the possibility that lack of information about energy prices and sales obscures the presence of downstream trade effects arising from upstream below-market energy. Although assessing the presence of such 'pass through' is not pertinent to demonstrate the existence of a benefit under Article 1.1(b) of the SCM Agreement, it may be relevant to determine whether the subsidy at issue has caused adverse trade effects. In the context of multi-staged production chains, it might prove particularly difficult to demonstrate the causal relationship between the adverse trade effects experienced by the downstream domestic industry of one WTO Member and the provision upstream of energy at below-market rates in another Member (Shadikhodjaev, 2012[41]). This demonstration might also involve looking for the presence of export restrictions along the value chain (e.g. export duties on natural gas or primary metals) or government monopolies in energy markets.[63] Lack of transparency with respect to energy policy and prices only makes this exercise even more difficult. This in turn hampers efforts to better understand the trade effects of government support and prevents assessment of the benefits that would come from subsidy reform.

5. Conclusions

Below-market energy counts as one of the most complex forms of government support owing to lack of granular data and widespread government intervention in energy markets. Firms do not often disclose all the information that is necessary for identifying and quantifying below-market energy, even more so than for government grants, tax concessions, and below-market borrowings. This generates considerable opacity around the extent to which some firms owe their competitive position to government support, particularly in energy-intensive industries where energy accounts for a very significant share of production costs.

The opacity that characterises below-market energy is first and foremost a hindrance to domestic efforts to scrutinise energy subsidies and their fiscal and environmental consequences. Lack of transparency prevents accountability and discussion of policy alternatives in a context where energy is becoming more

[61] A questionnaire format was adopted by the SCM Committee in July 1995 and revised in 2003, providing WTO Members with a standard framework for their notifications. See G/SCM/6, 9 August 1995 and G/SCM/6/Rev.1, 11 November 2003, para 1 (emphasis added). Note that the questionnaire also requires governments to submit subsidy notifications with respect to "(b) all other subsidies, which operate directly or indirectly to increase exports."

[62] Report of the Working Party on the Accession of the Russian Federation to the World Trade Organization, WT/ACC/RUS/70, WT/MIN(11)/2, 17 November 2011.

[63] See in this regard earlier work by the OECD on government support in the aluminium value chain (OECD, 2019[4]). The presence of export restrictions or government monopolies is often a key factor in permitting upstream below-market energy to pass through to downstream industries, for otherwise upstream companies would have an incentive to sell their products abroad at higher prices rather than sell them domestically (absent technical obstacles to trade such as a lack of interconnection capacity or pipelines with neighbouring countries).

expensive and environmental pressures are getting more severe. From a trade perspective, lack of transparency also poses significant challenges by hampering progress in the WTO and elsewhere on addressing market-distorting government support. It is in this regard difficult to improve disciplines on measures on which we know so little.

Energy markets are arguably more complex than most other markets, including due to widespread government involvement through the regulatory and price channels, but also through direct government ownership of key market participants. Widespread government involvement in turn can add to the opacity that characterises below-market energy by making it harder to judge whether particular transactions are 'market-based' or 'market-consistent'. This has implications for trade rules, including with regard to the role that state energy companies sometimes play in channelling government support to industrial producers.

Finally, this report shows that government support needs to be considered holistically in order to paint an accurate picture of trade distortions in international markets. Governments can use a variety of tools to offer support to industrial companies, and it is their interaction and overall effect that eventually determines the scope and scale of market distortions. Some countries rely on government grants or below-market finance relatively more. Others will make more intensive use of below-market energy. Yet it is the total effect that needs to be considered from a trade and competition perspective. This underscores the need to strengthen efforts to collect more and better data on government support in order to orient discussions of reforms where they are the most needed.

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Annex A. Illustrative firm sample

Industrial activity	Firm name	Other firm names	Home economy
Chemicals	Acron	Akron PAO; Акрон	RUS
Aluminium smelting	Alba	Aluminium Bahrain B.S.C	BHR
Aluminium smelting	Alcoa	Alcoa, Inc.	USA
Aluminium smelting	Alouette	(joint venture between AMAG, Norsk Hydro, Investissement Québec, Marubeni, and Rio Tinto)	CAN
Aluminium smelting	Aluar	Aluar Aluminio Argentino S.A.I.C.	ARG
Cement	Arabian Cement	Arabian Cement Company S.A.E.; الشركة العربية للاسمنت	EGY
Steel	ArcelorMittal	ArcelorMittal S.A.	LUX
Aluminium smelting	Century Aluminum	Century Aluminum Company	USA
Aluminium smelting	Chalco	Aluminum Corporation of China Limited; 中国铝业股份有限公司	CHN
Aluminium smelting	China Hongqiao	China Hongqiao Group Ltd.; Shandong Weiqiao Aluminum & Power; 中国宏桥集团有限公司	CHN
Cement	CR Cement	China Resources Cement Holdings Limited, 華潤水泥控股有限公司	CHN
Aluminium smelting	East Hope	East Hope Management; 东方希望企业管理有限公司	CHN
Aluminium smelting	Emirates Global Aluminium	Part of Mamoura Diversified Global Holding PJSC (formerly Mubadala)	ARE
Cement	HeidelbergCement	Heidelberg Cement	DEU
Aluminium smelting	Hydro	Norsk Hydro ASA	NOR
Steel	Hyundai Steel	Hyundai Steel Co., Ltd.; 현대제철	KOR
Cement	LafargeHolcim	LafargeHolcim Ltd.	CHE
Aluminium smelting	Maaden	Ma'aden; معادن	SAU
Steel	MMK	PJSC Magnitogorsk Iron and Steel Works; ПАО Магнитогорский металлургический комбинат	RUS
Steel	NLMK	OJSC Novolipetsk Steel; NLMK Group; ОАО Новолипецкий металлургический комбинат	RUS
Steel	POSCO	Pohang Iron and Steel Co., Ltd.; 주식회사 포스코	KOR
Cement	Qatar National Cement	Qatar National Cement Company Q.P.S.C.; قطر للأسمنت	QAT
Aluminium smelting	QPIG	Qinghai Provincial Investment Group; 青海省投资集团有限公司	CHN
Aluminium smelting	Rio Tinto	Rio Tinto plc; Rio Tinto Ltd.	AUS
Aluminium smelting	Rusal	UC Rusal; United Co. RUSAL Plc; РУСАЛ	RUS
Chemicals	SABIC	Saudi Basic Industries Corporation; سابك	SAU
Chemicals	SASOL	Sasol Limited	ZAF

Industrial activity	Firm name	Other firm names	Home economy
Cement	Saudi Cement	Saudi Cement Company SJSC (SCC); الإسمنت السعودية	SAU
Chemicals	SIBUR	PJSC SIBUR Holding; СИБУР	RUS
Aluminium smelting	South32	South32 Limited	AUS
Steel	Ternium	Ternium S.A.	ARG
Cement	VICAT	Groupe Vicat; Vicat S.A.	FRA
Aluminium smelting	Yunnan Aluminium	Yunnan Aluminium Co.; 云南铝业股份有限公司	CHN

Annex B. The structure of China's electric power sector

Since the 2002 reform of its electricity system, China has had separate, unbundled entities for power generation, transmission, and distribution, such that generation companies sell their electricity to the grid companies, which then sell it to consumers. Power generators include: those owned by central authorities, such as the so-called 'Big 5'; regional power generators, which are usually owned by provincial governments; and, to a much smaller extent, foreign companies. As much as 45% of China's electricity continues to be produced by the 'big 5' state generation companies[64], namely: the China Energy Investment Corporation (CEIC), the State Power Investment Corporation (SPIC), the Huaneng Group, the Huadian Group, and the Datang Group.

There are three grid companies. The State Grid Corporation of China (SGCC) provides 66% of China's total consumed power and is located in the middle of China. To the south, the China Southern Power Grid (CSG) provides 15% of the total consumed power. Lastly, the Inner Mongolia Power Grid provides only 3% of the total consumed power, being the only independent provincial grid operator covering the middle and western parts of the Inner Mongolia Autonomous Region.[65] On the demand side, manufacturing accounts for more than half of all final electricity use in China according to the IEA.[66]

The electricity price for end users in China is the sum of the generation price, the transmission and distribution (T&D) prices, and the government funds and special charges. Generation prices – otherwise known as 'on-grid prices' – are what grid companies pay to power-generation companies when purchasing their electricity. They are decided by provincial price bureaus under the guidance of China's NDRC. Electricity prices in China vary significantly across provinces. These tariffs are also differentiated by energy source, with, for example, higher tariffs for renewable energy than for coal-based power. A so-called 'fair dispatch' rule , meanwhile, sets the number of hours during which plants using a given technology are allowed to operate (Rawski, 2019[31]; Hernández Alva and Li, 2018[30]).[67] T&D prices form the revenue of grid companies and represent the difference between retail tariffs and generation prices. Government funds and special charges are also collected by grid companies.[68] Additionally, the electricity prices set by provincial price bureaus differentiate between four user groups: residential users; agricultural producers; large industrial users; and general industrial, commercial and other users.

The economic boom that followed the market-oriented reforms of the 1970s and 1980s led to a surge in demand for electricity. The main focus of energy policy from then on was thus to increase power capacity so that it would match demand and improve the reliability of the grid (Ma and He, 2008[42]).[69] It was not until 1997 that cost and efficiency considerations began to play a larger role in policy choices, although generation assets and prices remained firmly in state hands. Subsequent reforms in 2002 then unbundled the electricity sector by separating generation from T&D and led to the establishment of the Big 5 state generation companies and new regulatory bodies. The pricing mechanism was also changed in 2004 to become more cost-reflective, including by partially linking electricity prices to coal prices. Despite this, power companies still lacked incentives to control costs and improve efficiency while prices remained largely non-market-based (Lei et al., 2018[43]; Rawski, 2019[31]). Reforms undertaken in the 2010s – such as the 2015 reform agenda described in "Document No. 9" – have consequently amplified efforts to move

[64] See www.spglobal.com/commodityinsights/en/market-insights/latest-news/coal/060721-chinas-big-5-power-producers-face-uphill-battle-in-meeting-peak-emissions-targets (accessed on 2 September 2022).

[65] See, for example, https://huihongxun.github.io/files/Presentation/20160717_IEEE_PES_Boston.pdf (accessed on 1 September 2022).

[66] Based on the IEA's *Extended world energy balances*.

[67] This differs from the merit dispatch order practised in most other countries, whereby the lowest marginal-cost sources (e.g. renewables and nuclear) are called in first to supply power.

[68] As in other countries, government funds and surcharges are mainly intended for contributing to the construction of public utility infrastructure (e.g. dams) and supporting renewable energy.

[69] A footnote in Rawski (2019[31]) recalls, for example, that the author was "touring factories by flashlight during the summer of 1982", at which time power outages were a common occurrence in China.

toward a more market-based pricing mechanism (Hernández Alva and Li, 2018[30]). Government involvement in pricing and the fair-dispatch rule remain in place, however.

Despite China's stated aim to reflect fuel costs in electricity pricing, there continues to be significant time lags between real-time fluctuations in coal prices and the government-led adjustments to electricity prices. Between 2004 and 2019, the national coal-power benchmark on-grid tariff only underwent a total of 12 adjustments.[70] Under the current system, authorities adjust power tariffs when coal prices change by more than 5% compared with the previous period, which inevitably causes time lags until coal prices are reflected into electricity prices. Rapid increases (decreases) in coal prices have thus often resulted in significant losses (profits) for power generators, a situation which Rawski (2019[31]) describes as a "financial roller coaster". Sharp increases in coal prices in 2021,[71] for instance, caused operating losses at some of China's Big 5 power generators.

Overinvestment in thermal power generation has, meanwhile, contributed to excess coal-based capacity (Hernández Alva and Li, 2018[30]), amplified by the fair-dispatch rule that caps the number of operating hours for power plants. This has translated into comparatively low utilisation rates and a relatively recent fleet of power plants.[72] Some attribute the overinvestment to the government decision in 2014 to transfer the authority for approving new power projects to local authorities, with "coal power approval rates [having] tripled after approval authority was decentralised" (Ren et al., 2021[44]). Although central authorities have since taken steps to limit project approvals,[73] "[t]he emergence of massive excess capacity beginning in 2014 did not induce a major pullback in investment spending that that one would anticipate in a market system" (Rawski, 2019[31]).

[70] See https://news.bjx.com.cn/html/20200212/1042122.shtml (in Mandarin Chinese; accessed on 5 September 2022).

[71] The China Qinhuangdao spot price for coal averaged USD 154 per tonne in 2021 but stood at USD 83 in 2020 according to data from the *BP Statistical Review of World Energy*.

[72] China's coal-based power plants are only 14 years old on average according to www.carbonbrief.org/mapped-worlds-coal-power-plants/ (accessed on 5 September 2022). The IEA noted in 2018 that capacity factors for most coal-based power plants in China stood below 50%, with three provinces having capacity factors of less 30% (Hernández Alva and Li, 2018[30]).

[73] See, for example, ***关于推****进供给侧结构性改革防范化解煤电产能过剩风险的意见* ("Opinions on Promoting Supply-side Structural Reform to Prevent and Defuse the Risk of Overcapacity in Coal Power"), available at www.nea.gov.cn/2017-08/14/c_136525062.htm (in Mandarin Chinese; accessed on 5 September 2022).

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