5. Businesses of the State and Climate Action

Introduction

Governments have comparative advantages in underwriting investments to advance the climate agenda, coordinating multiple actors around the common goal of decarbonization, and ensuring that the costs and benefits of a green transition are distributed equitably across society so that economic growth and poverty are tackled alongside environmental crises. The state can also choose to provide direct support for research and development (R&D) to create and scale up new low-carbon technologies, instead of providing tax incentives or imposing regulations. Any state intervention should be considered in the context of a menu of policy options that can achieve the same objective more efficiently and without deterring private investment. For example, restrictive regulations in these markets can slow the green transition by inhibiting private investment, innovation, and technology adoption. The presence of many businesses of the state (BOSs)—often operating in protected markets with nonfinancial mandates or benefiting from explicit or implicit advantages—can deter the private sector from engaging in climate action. Yet climate finance flows to developing countries should increase by a factor of 4–8 times (World Bank 2022a), in particular from private sector sources towards low- and lower-middle income countries where current private mobilization rates are low (OECD 2022).

For these reasons, it is essential to identify the state’s footprint through BOSs in high-emitting sectors and in sectors vulnerable to climate change and to design reforms to scale up climate action. It is also critical to understand how market regulations and market structures can influence and potentially deter both private investment in climate action and the mobilization of private climate finance.

- The new World Bank Global Businesses of the State (BOS) database unveils the extensive presence of the state across many potentially high-emitting sectors as well as sectors that are vulnerable to climate change. Current estimates focused on traditionally defined state-owned enterprises (SOEs) in fossil fuel–dominated economies show that SOEs are responsible for one-sixth of global greenhouse gas emissions, mostly driven by SOE emissions in the energy sector (Benoit 2019a, 2019b; Benoit et al. 2022). This share is likely an underestimate: the presence of BOSs in other high-emitting sectors (such as manufacturing, cement, and steel) has not been captured consistently largely because of a lack of data.
The share of BOSs in sectors that are at risk of experiencing the negative effects of climate change is also large, underscoring the vulnerability of these BOSs, the sectors in which they operate, and the importance of investing in their resilience, especially in infrastructure and network industries.

- The need to scale up finance for climate adaptation and mitigation is growing, particularly in credit-constrained low- and middle-income countries. Most BOSs in these sectors are less creditworthy than their sector’s revenue leaders and use state resources to boost their credit rating. So, when BOSs are present in sectors that call for large investments in climate action, their low profitability and creditworthiness impair their ability to engage in climate adaptation and mitigation. Such firms also add to governments’ financial burden when state guarantees notch up their creditworthiness. For these reasons, more efforts are needed to incentivize private capital to invest in adaptation and mitigation.

- Regulatory reforms are needed to encourage more private investment and to scale up climate action. BOSs in competitive markets are the least justified. They often operate in protected markets or benefit from explicit and implicit advantages, deterring the green transition. This chapter provides a deep dive into the cement industry, a hard-to-abate sector characterized by dominant market players, including BOSs, an unlevel playing field, and anticompetitive behavior—all of which can slow investment in new technologies and a low-carbon transition. The focus on the energy sector illustrates how regulatory reforms are still needed to support the entry of private players and speed the transition toward renewable energy and the diffusion of green technologies.

**State Presence in High-Emitting Sectors and in Sectors Vulnerable to Climate Change**

**BOSs in Potentially High-Emitting Sectors**

The state is an owner across high-emitting sectors, including many sectors outside power generation and sectors in fully competitive markets. It is likely responsible for a greater share of greenhouse gas emissions than assumed. To date, most estimates focus on the emissions in power generation, where BOSs hold about 50 percent of global generation capacity. New data on the state footprint across sectors and types of markets reveal the presence of BOSs in other high-emitting sectors too.

Globally, about one-fifth of BOSs in the World Bank BOS database operate in high-emitting sectors, underlining their role as a major source of greenhouse gas emissions. Of the 76,400 BOS firms with state ownership of at least 10 percent in the BOS database across 91 countries, 18 percent are in high-emitting sectors. This does not imply that they emit more emissions than their privately owned peers, but it does suggest that BOSs contribute to greenhouse gas emissions outside the power sector more than previously assumed. Because the BOS database does not include information on the
consumption of energy (fuels) or on the sectoral emissions of greenhouse gases, high-emitting sectors are defined in broad categories, such as mining, oil, gas, and chemicals (including petrochemicals, fertilizers, plastics); manufacturing (including pulp and paper, cement, steel, aluminum); transportation (rail cargo and passenger, air, freight and logistics, sea and water transportation); agriculture (including cattle farming, rice growing, logging); and power generation.²

However, the degree to which some sectors are effectively high emitters depends on the resources used and technology actually applied by the respective companies in the sector. For instance, the extent to which the power generation sector is a high-emitting sector very much depends on the country’s mix of fuels, because countries endowed with hydropower and renewable energy will be much less polluting than countries where fossil fuels dominate. An examination of the power sector provides more granularity on the country specifics of electricity supply and the mix of renewable and fossil fuels. Similar considerations apply in the case of (1) agriculture and land use, with the application of climate smart technologies playing an important role in the level of greenhouse gas emissions; (2) emission from buildings, with the type of construction material used and the introduction of a green building certification system focused on making buildings more resource-efficient having a strong impact on greenhouse gas emissions; or (3) transportation, with the mode of transportation (for example, road, railways, air, freight, and logistics) and the degree of electrification or reliance on heavy fuels playing a key role in determining the level of emissions.

Slightly more than half of BOSs in high-emission sectors are in competitive markets—growing rice, raising dairy cattle, manufacturing cement, casting steel and iron, and so on—with a weaker economic rationale for state participation (figure 5.1)

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**FIGURE 5.1 Share of BOSs in Potentially High-Emitting Sectors, 2019**


Note: Distribution of businesses of the state (BOSs) in potentially high-emitting sectors, by type of market for 14,000 firms.
Although power generation is still the single most important high-emitting sector in which BOSs are active, transportation and crop and animal production have substantial shares. Power generation has the most BOSs (42 percent), followed by crop and animal production (23 percent), transportation (21 percent), manufacturing (12 percent), and extraction (2 percent).

The state footprint of BOSs in high-emitting sectors is heterogeneous across countries, and a closer assessment of emissions (depending on fuels used in the production process) is needed to draw policy implications. For at least 12 countries, BOSs in high-emitting sectors account for more than 50 percent of all BOSs in the country, by revenues (figures 5.2 and 5.3). The relative importance of high-emitting sectors ranges from 68 percent of BOS revenues in the Dominican Republic to 8 percent in the Comoros. Likewise, the presence of BOSs across the potentially high-emitting sectors varies, with more than half of BOSs in high-emitting sectors in power generation in eight countries, for example. Some of these firms may already have transitioned to renewable energy sources, whereas others still rely on fossil fuel. In Viet Nam (a country dependent largely on fossil fuel power generation) and the Kyrgyz Republic (a country dependent largely on the hydropower sector), only about 13 percent of BOSs in high-emitting sectors are active in power generation. These countries have significantly higher shares of high-emitting BOSs in manufacturing (Viet Nam) and crop and animal production (the Kyrgyz Republic).

The literature presents very limited systematic empirical evidence on the relationship between enterprise ownership and greenhouse gas emissions. And the limited evidence is inconclusive—leaving open whether BOSs are leaders or laggards in climate action. Yet the emerging evidence indicates the importance of several enabling factors regardless of ownership. These factors include sound institutions and regulations, foreign direct investment, and well-functioning domestic capital markets (Isungset 2022; Talukdar and Meisner 2001).

**BOSs in Sectors Most Vulnerable to Climate Change**

The presence of BOSs in sectors at risk of experiencing the negative effects of climate change is more pronounced than their presence in high-emitting sectors, underscoring their vulnerability. Of the 76,400 BOSs with state ownership of at least 10 percent in the 2019 World Bank BOS database, 44 percent operate in sectors likely to experience the effects of climate change—such as floods or storms impairing transmission lines or droughts reducing the capacity of hydropower plants (figure 5.4). These sectors include water supply, treatment, and collection (12 percent); followed by power production, transmission, and distribution; most means of transportation; construction; agricultural production and subsequent processing; finance (including insurance); tourism; information and communication technologies; and selected segments of manufacturing and wholesale or trade. In about 75 percent of International Development
FIGURE 5.2  Share of BOSs in Potentially High-Emitting Sectors, by Region and Country, 2019


Note: Distribution of businesses of the state (BOSs) in potentially high-emitting sectors, by country, for 14,000 firms. Because of a general lack of systematic firm-level data on greenhouse gas emissions, this report could not assess in greater detail the impact of ownership on the intensity of greenhouse gas emissions of firms. The level of emissions will differ by country, depending, to a large extent, on the energy mix.
Association countries (25 of 33), more than 50 percent of BOSs are in sectors with high adaptation needs (figure 5.5).

With such high exposure of BOSs to the effects of climate change, the risks extend beyond mere infrastructure damage to fiscal and debt sustainability. These risks can impair a country’s economy and financial standing through a range of channels (box 5.1). Such fiscal risks pose a particular threat to low-income countries, because of the 36 low-income countries, 16 countries are either in debt distress or have a high risk of debt distress. Understanding the climate risk exposure of their BOSs is thus vital.4
**FIGURE 5.5** Countries with a Large Share of BOSs in Highly Climate-Vulnerable Sectors, 2019

Sources: World Bank Global Businesses of the State (BOS) database. The climate vulnerability index source is from ND-GAIN (https://gain.nd.edu/our-work/country-index/rankings/), downloaded June 20, 2023.

**BOX 5.1**

**How the Exposure of BOSs to Climate Risks Can Have an Economic Impact**

The channels of climate-related risk transmission overlap, and the interplay of likely and recurring events and sources of risks and sectors could become a vicious cycle. For instance, the materialization of climate physical and transition risks could lead to a higher probability of loan default by firms, including businesses of the state (BOSs). Many of the guarantees on which BOS finance relies may have to be called.

And contingent liabilities could become more likely with climate change, leading to a gradual deterioration of a country’s public finance conditions. For example, guarantees provided to BOSs or minimum revenue guarantees under public-private partnerships could be activated under pressure from climate physical and climate transition risks. These events would lower the credit rating of BOSs and further tighten their lending conditions.

Disaster-related contingent liabilities could pose a significant risk to public finance frameworks, not only reducing the fiscal space of the government to invest in adaptation but also jeopardizing its debt sustainability as pending contingent liabilities increase the risk of default.

Thus, taking the lead in the transition to decarbonization and adaptation of state-owned enterprise holdings (and other state assets) should strengthen investor confidence, leading to a reduction in prevailing interest rates and facilitating a crowding in of private sector investment.

Difficulties in Mobilizing Climate Finance Action for BOSs

Outside Australia, Europe, and the United States, only 36 percent of climate finance comes from the private sector—in Sub-Saharan Africa, only 12 percent comes from the private sector, with the remaining 88 percent coming from public sources. This points to the importance of mobilizing private funds for low- and middle-income countries (Boehm et al. 2021; CPI 2021; IEGCF 2020). Private climate finance—and having fair and transparent competition rules and market structures—can attract private investors.

Global climate finance—that is, mitigation and adaptation finance together—almost doubled in the last decade, with a cumulative US$4.8 trillion in climate finance committed over 2011–20, or US$480 billion a year, on average, during this time. Climate finance reached US$632 billion on a 2019/20 biennial average and is expected to continue to grow. Despite a cumulative average annual growth rate of 7 percent over the last 10 years, climate finance is not increasing enough to meet a 1.5°C global warming scenario, which would require climate investment to increase at least seven times by the end of this decade as well as to align all other financial flows with Paris Agreement objectives. Three-quarters (75 percent) of climate finance was concentrated in East Asia and Pacific (led primarily by China), North America, and Western Europe, with very limited finance reaching low- and middle-income countries. Voluntary actions and domestic policies to reduce emissions in East Asia and Pacific, North America, and Western Europe have provided a significant push for climate finance in those regions. For example, China has set mandatory targets to reduce its national energy intensity, which has contributed to an increase in investment in China’s manufacturing capability in solar (Naran et al. 2022).

Adaptation finance is particularly underfunded, both in general and by BOSs. Finance for climate adaptation increased by 53 percent, from US$30 billion in 2017/18 to US$46 billion in 2019/20. Despite exhibiting a cumulative annual growth rate of 16.7 percent over the last 10 years, total adaptation finance remains far below the scale necessary to respond to existing and future climate change. The United Nations Environment Programme’s Adaptation Gap Report 2022 estimates that annual adaptation costs in low- and middle-income economies will be in the range of US$155 billion to US$330 billion by 2030 (UNEP 2022a, 2022b). Multilateral and national development finance institutions continued to deliver most of the public finance for adaptation (together 69 percent or US$31 billion of the US$46 billion total). BOS investments in adaptation are marginal, at only US$119 million globally (biennial average 2019/20) (box 5.2). Although this is a steep increase from US$11 million in 2019, it constitutes only 0.3 percent of global adaptation finance in 2019/20 and only 11 percent of what private corporations and investors invested in adaptation in 2019/20 (CPI 2021).

The weak financial capacity of many BOSs impairs their ability to engage in climate action. Large global leaders across the high-emitting sectors can also access more internal resources to support their investment in mitigation than the average BOS firm.
Profits of companies are an important indicator as to whether they can afford to invest in climate action because part of a company’s profits can usually be applied toward new equity investments or be used to service additional debt. However, average profits of global leaders are 29 to 185 times higher than those of the highest revenue-generating BOSs. The average equity of global leaders (that is, assets in excess of external claims on assets, some of which may be available to serve as additional collateral) is 24 to 218 times higher than that of the top tier of BOSs.

Most BOSs are less creditworthy than their sector’s revenue leaders and use state guarantees to boost their credit rating. If a BOS firm—for example, a utility—is credit-worthy, it will be able to raise commercial finance; but BOSs tend to have low credit-worthiness. Baseline credit assessments for 89 electricity BOSs in middle- and high-income countries show that 65 percent are rated as “investment grade” and 35 percent as “junk” (table 5.1). This analysis likely overestimates the average credit rating of BOSs: ratings of electricity BOSs in low-income countries are likely even lower because most of them lack an international credit rating. If electricity BOSs lack a credit rating or have only a “junk” rating, below Baa3 or BBB−, they have very limited prospects to access capital markets. And, if they do have access, loan conditions and terms will be onerous, increasing their cost of capital and pushing future climate mitigation actions out of (financial) reach. In this sample, the credit ratings of 67 out of 89 BOSs were boosted by state guarantees, by an average of 1.85 notches. Without state support, BOSs might face challenges in accessing capital at affordable rates, delaying their climate mitigation and adaptation investments.

### BOX 5.2
**Why Firms Lag in Adaptation Investments**

The general underinvestment in adaptation is surprising, given that the Global Commission on Adaptation found that the overall rate of return on investments in improved resilience is very high, with benefit-cost ratios ranging from 2:1 to 10:1. One reason adaptation still does not receive the attention it should is that most decisions do not internalize the impacts of climate change. Firms deciding whether to invest in climate adaptation should consider the many ways that climate puts expected outcomes at risk. Examples of such investments include fortification of their assets—for example, bridges or ports; utilities deciding whether to build a new power plant; agricultural producers deciding to switch to drought-resistant crops; or firms deciding to diversify their supply chain to buffer remote effects of climate change transmitted via supply chains. Research has identified several barriers to attracting the volume of private finance needed to advance most developing countries’ adaptation agendas. They fall into three broad categories: (1) lack of country-level climate risk and vulnerability data and information services that can be used to guide investment decision-making; (2) limited clarity on the government’s capital investment gaps to achieve adaptation goals, and/or on where private investment is needed; and (3) low perceived or actual returns on investment.

*Sources:* CPI 2021; Global Commission on Adaptation 2019, 2022; Li 2022; Tall et al. 2021.
Regulatory reforms are needed to accelerate private sector climate action in high-emitting sectors and to scale up climate finance in industries critical for the green transition. Governments have advantages in underwriting the scale of investments to advance the climate agenda, coordinating multiple actors around the common goal of decarbonization, and ensuring that the costs and benefits of a green transition are distributed equitably across society so that poverty is tackled alongside environmental crises. The state can also support R&D to develop and scale up new low-carbon technologies. But the presence of BOSs in competitive markets can deter private sector climate action, innovation, and technology adoption. In other markets, many BOSs are incumbents and benefit from a dominant market position, slowing the green transition and dampening private participation.

**Cement**

BOSs in competitive markets, and their implicit and explicit advantages, can undermine the green transition. When BOSs receive preferential treatment or dominate the market, they may deter private sector investors from engaging. BOSs can also weaken the productivity and competitiveness of the value chain when they are dominant market players upstream or downstream. These market distortions can lower the private sector’s readiness to innovate and invest in low-carbon technologies. And regulatory restrictions on competition that benefit BOSs may limit the ability of proper market forces to reduce emissions by shifting market shares to “cleaner and more productive” market players.
The case of the cement industry shows how market regulation and anticompetitive behaviors can undermine the low-carbon transition. With its long and diverse supply chain, cement is central to the construction industry. With growing global population, increasing urbanization, and rapid infrastructure development in many emerging, low-income, and middle-income economies, the demand for cement is projected to grow between 12 percent and 23 percent by 2050 (IEA 2018).

Among all industries, cement is the second-highest emitter of greenhouse gas emissions. It emits about a quarter of industry’s carbon dioxide (CO₂) emissions and between 5 percent and 8 percent of global CO₂ emissions (Andrew 2019; Czigler et al. 2020; Ellis et al. 2020; Lehne and Preston 2018). It generates the most emissions per revenue dollar, and its emissions intensity is highest among hard-to-abate industries, producing about 6.9 kilograms of CO₂ per revenue dollar, almost five times that of iron and steel and nine times that of oil and gas (Czigler et al. 2020). The cement industry is a hard-to-abate sector because most of its emissions are generated directly by the chemical production process. A marginal abatement approach by trying to improve efficiency or similar measures will therefore not work, calling for more substantial investments in R&D to yield the required greenhouse gas emission reductions.

Global cement BOSs are among the key market players. The *Global Cement Report*, listing about 2,300 integrated and clinker grinding plants outside China, shows that BOSs (with a state holding of at least 10 percent) account for about 13 percent of all integrated and grinding cement plants (CemNet.com 2022) (see box 5.3). Larger shares of BOS plants are in the East Asia and Pacific and Middle East and North Africa regions and in middle-income countries. About 2 percent of the plants are owned either wholly or partly by foreign BOSs in various regions, particularly by Chinese and South African BOSs. Globally, BOSs are also among the key players in the cement market: 4 of the top 10 global cement producers by installed production capacity are BOSs, and BOSs among the top 110 cement producers in 2020/21 accounted for close to 40 percent of the installed production capacity of the top 110 producers and about 27 percent of installed production capacity of all cement producers (figure 5.6). BOSs tend to be less productive and to emit more CO₂ per revenue dollar than their private peers. Because of their weak financial health, they have limited ability to adopt climate mitigation technologies. The top global cement BOSs are less productive and have lower profit margins than their private peers, but they have higher CO₂ emissions intensity than that of their private counterparts (figure 5.7).

The well-documented high concentration and dominance of large players in the cement industry are largely due to structural features. The cement industry in many economies is characterized by high levels of market concentration and relatively low competition (Kirchberger and Beirne 2021; World Bank 2016). In about 40 percent of countries, just one firm accounts for more than 50 percent of the country’s total cement capacity (Kirchberger and Beirne 2021). The concentration is high mainly because of
**BOX 5.3**

**State Presence in the Cement Industry in China**

China is the main producer of cement, accounting for about 57 percent of global cement production in 2020. As in most countries, the industry is highly concentrated. The top 10 cement companies accounted for about 57 percent of the market in 2020 (FitchRatings 2021a).

Businesses of the state (BOSs) have a significant presence in China’s cement industry, even after waves of market consolidation. In 2002, about 72.7 percent of the 4,626 cement firms were owned by national, provincial, and local governments (Ligthart 2003). In 2019, out of the 3,363 cement firms, the top five companies in clinker production capacity are BOSs, accounting for about 46 percent of the total clinker production capacity in China (Thomas 2021, supplemented with desk research).

BOSs in China are also significant emitters of carbon dioxide (CO₂). Of the 15 cement firms in the 2021 “China Listed Companies Carbon Emission Ranking” covering 100 high-carbon-emitting companies listed on A-shares and Hong Kong, China’s stock exchanges, 10 are entities in which national and provincial governments hold ownership stakes of 10 percent or more, emitting 782 metric tons of CO₂ in 2020. Their emissions represented about 64 percent of the industry’s CO₂ emissions and about 12.4 percent of China’s total emissions in 2020. These top 10 high-carbon-emitting cement BOSs are also less productive, and their average emissions intensity—CO₂ per revenue dollar—is twice that of average private non-Chinese counterparts (figure B5.3.1).

**FIGURE B5.3.1 Performance of the Top 10 Non-Chinese Cement Privately Owned Enterprises and the Top 10 Chinese BOSs, 2020–21**

![Graph showing performance comparison between top 10 non-Chinese privately owned enterprises and top 10 Chinese BOSs in terms of labor productivity and emissions intensity.]

*Source: Based on desk research (as of January 24, 2023).*

*Note: BOSs = businesses of the state; CO₂ = carbon dioxide.*

a. This measure of productive efficiency (revenue per worker) has some shortcomings in general, but in the cement industry, it has the additional drawback that the price of cement is often distorted by regulation and anticompetitive practices.
high barriers to market entry, high initial capital investments to reach sufficient economies of scale, spatial location due to high transportation and storage costs, and access to key raw materials and markets. The industry has vertically integrated supply chains and often a captive clientele. These structural features—in addition to the behavioral characteristics of the industry, such as multimarket contacts and the presence of influential producer associations—are also why the industry is susceptible to collusive conduct characterized by pervasive economic cartels.

Cement BOSs also benefit from regulations that limit their competition with privately owned incumbents. Regulatory restrictions on competition in the cement manufacturing industry appear to be related to the presence of BOSs in the industry. In 6 of the 10 countries currently covered by the data set, BOSs benefit from explicit advantages, such as involvement in policy making (Pakistan) and exemption from public procurement laws (Angola, Pakistan), as well as from implicit advantages, such as when entry into the manufacture of cement is allowed by official initiatives only (Argentina).\textsuperscript{11} Cement prices are regulated in Ethiopia, and foreign direct investment is restricted in Angola. In Angola, cement BOSs are involved in regulating entry, and they benefit from regulations that limit their competition with privately owned incumbents. In some of these countries, BOSs are dominant market players (controlling about 40 percent of production capacity in Viet Nam and 30 percent in Angola).
The market power of cement producers can influence their response to climate mitigation actions. Cement prices in Sub-Saharan Africa tend to be significantly higher than in other regions (Kirchberger and Beirne 2021; World Bank 2016). Although higher profits may enable firms to afford climate-mitigating technologies, inefficient and less innovative producers can remain in operation, thus limiting the
creation and adoption of innovative solutions for climate actions (box 5.4). Cartels have been linked with deteriorating allocative, productive, and dynamic efficiency (Günster, Carree, and van Dijk 2012). Although quantity-restricting cartels could tame production and contribute to climate goals in carbon-intensive industries, such as cement, the main goal of all economic cartels is higher profits. Thus, the market share rules of cement cartels can induce “overproduction” because cartel members would find it more profitable to sell more in their local market, as in the case of the Norwegian cement industry cartel, which may harm climate abatement efforts (Röller and Steen 2006).

**Energy**

Government interventions in contestable and natural monopoly sectors can unlevel the playing field between BOSs and private operators and disincentivize private participation and climate action in these markets. Of 89 public utilities in Organisation for Economic Co-operation and Development countries, 67 obtained implicit or explicit state guarantees boosting their credit ratings and giving them a comparative advantage over private operators (Prag, Röttgers, and Scherrer 2018). In China, the share of solar power plants invested in and held by the private sector plummeted from more than 70 percent of total capacity in 2018 to less than 40 percent by the end of 2019, a result of the decision to phase out subsidies for solar photovoltaic (World Bank 2022b).

Government fossil fuel support remains a barrier to achieving global climate goals. Globally, fossil fuel subsidies amounted to about US$5.9 trillion (6.8 percent of gross domestic product) in 2020 and are expected to increase to 7.4 percent of gross domestic product in 2025 as the share of fuel consumption in emerging markets (where price

**BOX 5.4**

**Climate Action and Anticompetitive Behavior in Competitive Markets**

Although cartels generally involve agreements to fix prices and markets, they also may involve agreements to delay the adoption of green technology. For instance, the European Commission in July 2021 fined five automakers—BMW, Daimler, and Volkswagen group (Audi, Porsche, and Volkswagen)—for breaching its antitrust rules by limiting competition in emissions cleaning for new diesel passenger cars, although they had superior cleaning technology. For hard-to-abate sectors, it may be more effective to achieve sustainability goals if competition laws allow for legitimate collaborations among competitors on green initiatives (OECD 2020). However, regulators must be watchful of “cartel greenwashing” under sustainability initiatives. For example, the European Union Consumer Detergents cartel engaged in price fixing and market sharing when implementing an initiative via its trade association to improve the environmental performance of detergent products (European Commission 2011).
gaps are generally larger) continues to climb (Damania et al. 2023; Parry, Black, and Vernon 2021). Moreover, global fossil fuel subsidies in 2020 alone were 23 percent higher than the total global investment in climate finance during 2011–20. Immediate action to remove dependence on fossil fuel, including subsidies, would free up resources for more sustainable investments, create much-needed fiscal space, improve incentives for investments in renewable energy, result in environmental benefits (including reduced greenhouse gas emissions), and lead to eventual stability in energy sources (Black et al. 2023; CPI 2022).

Governments also intervene in the energy sector through BOSs, which are important investors in high-carbon fossil fuel technologies. The BOS share of energy investment in global energy investment was 36 percent in 2019, down from nearly 40 percent in 2015 (figure 5.8, panel a). However, BOSs still play an outsized role in low- and middle-income countries, accounting for about 60 percent of energy investment (figure 5.8, panel b), a much higher percentage compared with 10 percent in high-income economies. BOSs invest substantially in fossil fuel power generation. Half of their investments in energy were in fossil fuel generation in 2019, up from 43 percent in 2015.

In some instances, BOSs have encouraged renewable energy investment in high-income economies such as Sweden and Switzerland (Prag, Röttgers, and Scherrer 2018).12 The energy sector offers commercially feasible low-carbon solutions, regardless of ownership structure. Such investments may reflect the purposeful use of BOSs by governments in these economies to promote a “green agenda” and the possibility of preferential access by BOSs to finance, especially for risky and long-term renewable energy projects (Prag, Röttgers, and Scherrer 2018). A regression analysis of 46 Organisation for Economic Co-operation and Development and other G-20 firms during 2000–14 shows a statistically significant positive relationship between state ownership of electricity generation and renewable energy investment (Prag, Röttgers,
and Scherrer 2018). However, higher market concentration is found to hamper investment in renewable energy.

Across the world, the private sector has been the major driver of investment in renewable energy generation, in particular initially, when small-scale solar and on-shore wind offered investment opportunities that were attractive for private investors because of their modular design, limited complexity, and smaller scale. The private sector has contributed about 40 percent of new generation capacity in low- and middle-income countries since 1990. Until 2010, coal was the dominant technology for the private energy generation projects of independent power producers, but renewable energy sources have since increased (figure 5.9). About 68 percent of total wind capacity and 78 percent of solar capacity added during 1990–2016 were funded by the private sector, compared to 45 percent of thermal capacity.

Continuing emphasis on fossil fuel (especially coal) electricity may reflect the desire of governments to maintain the value of sunk-cost investments, leading to so-called carbon lock-in. Firms with many carbon-intensive thermal power assets, regardless of ownership, have a commercial incentive to avoid investing in renewable generating capacity—and potentially to oppose policy support or even shun renewable energy investment. The more fossil fuel power plants a company owns and the higher their combined net present value, the more it stands to lose from energy policies that support and promote the market entry of producers of renewable electricity. Incumbent energy generators in fossil fuel—many of them BOSs—oppose such policies in an effort to protect the value of their assets (Prag, Röttgers, and Scherrer 2021). South Africa initially attracted private investors to renewables;

**FIGURE 5.9** Public and Private Investments in the Energy Sector, by Type of Energy Generation, 1990–2016

however, because of obstructions by the state-owned utility, the renewable energy agenda was not as successful as it could have been (box 5.5). Episodes of policy reversals in the renewable energy sector have occurred in Mexico as well.

Employment in fossil fuel power generation is another reason for the continued engagement of BOSs in this sector. Several economies with participation of BOSs in high-emitting sectors have high investment in coal mining, and an early decommissioning of coal plants can have major adverse impacts on jobs and poverty, particularly in poor coal-dependent communities (box 5.6). The total number of workers currently engaged in the coal mining sector is 4.7 million globally. The economies with the largest

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**BOX 5.5**

**Businesses of the State and Private Investment in Renewable Energy Generation: The Cases of Mexico and South Africa**

Mexico’s first three clean energy auctions, held in 2016–17, were seen as an unqualified success, bringing major new solar and wind developers into the market and delivering stunningly low prices as much as 29 percent below previous prices for solar and 35 percent for wind (IRENA 2017). The changes were intended to benefit the Federal Electricity Commission (CFE), Mexico’s fossil fuel–dependent state-owned electric utility, by prioritizing CFE at the expense of private power contracts and permits. The amendments would modify dispatch rules to benefit power plants owned by CFE. Power produced by CFE plants (including thermal plants) would be fed into the power grid first, displacing lower-cost renewable energy from private producers. Under the proposed changes, CFE would no longer be required to purchase energy for basic supply via auctions. Instead, it would be able to buy from its own power plants, even if the energy generated was more expensive. The amendment would also require the revision and potential termination of certain power purchase agreements. Existing power purchase agreements between CFE and independent power producers would be reviewed and could potentially be terminated or renegotiated. These new provisions and regulations will possibly reduce new private generation projects in Mexico.

South Africa successfully implemented well-designed renewable energy competitive tenders, but incumbent energy businesses of the state obstructed efforts to allow grid access to low-cost, low-carbon renewable energy. Under the Renewable Energy Independent Power Producer Procurement Program, South Africa carried out four rounds of competitive bidding between 2011 and 2015 to facilitate private investment in grid-connected renewable energy generation. Competition was fierce, with more than 300 submissions, resulting in significant price drops from US$345/MWh in 2011 (IRENA 2017) to US$64/MWh in 2015 (Eberhard and Kåberger 2016). Projects awarded under the latest bidding round indicate that both solar photovoltaic energy and wind energy are now 40–50 percent cheaper than energy from Eskom’s new coal-fired plants (Montrone, Ohlendorf, and Chandra 2022). In 2015, they were also among the lowest-priced grid-connected renewable energy projects in the world. To ensure that these lost costs are passed through to the consumer, an intergovernmental framework agreement was signed. But Eskom reportedly refused to sign the winning bidders’ purchase agreement. This obstruction of government policy is fueling calls for Eskom to be restructured, with various parties arguing that the utility’s conflict of interest is due to its vertically integrated model and that its obstructive behavior threatens the survival of the independent power producer program in South Africa.
numbers of employment in coal mining include China (3.2 million jobs), India (416,000), Indonesia (240,000), the Russian Federation (150,000), Poland (110,000), and South Africa, Ukraine, and Viet Nam, each with about 75,000–110,000 coal mining jobs, excluding employment in the sector value chain beyond mining (Ruppert Bulmer et al. 2021; Springer, Shi, and Kudrimoti 2022). Even if the power generation is not state dominated, heavy investment in thermal generation may sustain an extensive fossil fuel supply chain that is state dominated, extensive, and resistant to downsizing. For example, although electricity generation in India is only 16 percent state owned, this activity is at the nexus of important state-owned monopolies. In Indonesia, where about three-quarters of coal production is purchased by the wholly state-owned electricity company (PLN), which owns 73 percent of installed generation capacity (FitchRatings 2021b), coal pays more than most other sectors, and coal jobs are highly concentrated in two regions. In South Africa, the wholly state-owned monopoly electricity company (Eskom) relies on coal, whose production provides jobs (Ruppert Bulmer et al. 2021).

Over the last decade, 2.4 million coal mining jobs have been lost worldwide in net terms, reflecting coal phase-out in some countries, expansion in others, and sector productivity gains in most. Countries that have transitioned away from coal production—so-called advanced transitioners—experienced coal mining job losses long before the recent contraction in the last decade. Looking back to the 1980s, coal mining employment was over 416,000 in Poland, 365,000 in Germany, and 172,000 in the United Kingdom; in these countries, governments took phase-out measures to close mines, which translated into lower employment numbers. Today, the United Kingdom employs fewer than 1,000 workers in the sector, Germany's coal mining employment is under 15,000, and in Poland, where mining activities are ongoing, total coal mining employment is about 93,000. Given the importance of coal mining in many countries and potential job

**BOX 5.6**

**Poland’s Coal Mining Reforms and Jobs**

In Poland, the reduction in coal mining jobs from about 260,000 in 1990 to 110,000 at present “generated persistent economic challenges in mining communities,” including about 40 percent long-term unemployment and even higher unemployment among workers above the age of 45 (Ruppert Bulmer et al. 2021, 68). Separation assistance for redundant Polish miners during 1998–2002 amounted to 0.75 percent of gross domestic product (Ruppert Bulmer et al. 2021). In response to these declines, policies have been implemented to restructure the mining industry, for example, through SRK, the Mine Restructuring Company, to bolster the competitiveness of the sector, and to reduce unemployment among former coal workers. These policies to address the social and economic consequences of mine closures include early retirement, and dedicated welfare allowances, paired with one-time bonuses for workers who found a new job or through special allowances that enabled mines to cover the mining companies’ expenditures associated with pension payments to former employees (Śniegocki et al. 2022).
losses induced by an energy transition away from coal, it is of crucial importance for governments to develop clear road maps to phase out coal and protect workers, their families, communities, and the environment. It is equally important for government to also support investments in energy efficiency and low-carbon, renewable energy.

In addition to introducing some sort of carbon pricing mechanism, to decarbonize the energy sector many countries will have to liberalize markets, pursue ambitious BOS reforms, and create level playing fields between private and state-owned actors. Enabling a shift toward increased investment in renewables implies allowing third parties to access the transmission and distribution networks often owned and controlled by state-owned utilities. Such access needs to be granted at regulated tariffs so that private investors in renewables can sell directly to eligible customers without discrimination. Doing so will lead to the creation of open wholesale and balancing markets that will make investment market driven, not government driven. It will require adjusting the market structure, unbundling state-owned utilities, and establishing an independent regulator.

**Annex 5A Fossil Fuel Power Systems in Select Low- and Middle-Income Countries**

SOEs are dominant in fossil fuel power generation, largely because of their strong involvement in coal generation. Data for a few countries with a large share of fossil fuel generation confirm that technology is a key driver of ownership. With 70 percent of installed capacity, SOEs are dominant in fossil fuel power generation. They are even more dominant in coal-fueled power plants, where they account for 84 percent of total installed capacity. Even more striking is their dominance in hydro and nuclear power, where their role grows to 94 percent (Vagliasindi 2023). By contrast, the private sector owns about 80 percent of the nonconventional installed capacity of renewable energy.

In countries dominated by coal production, such as Poland and South Africa, SOEs have contributed the bulk of installed capacity in fossil fuel power generation (figure 5A.1). The private sector portfolio is more balanced toward a combination of fossil fuel and renewable energy in Poland and is almost exclusively clean in South Africa. In Pakistan and Türkiye, SOEs hold a higher share of installed generation capacity in renewable energy (hydropower) than the private sector, which generates power largely from fossil fuels in both countries.

The potential competitive issues reported in this chapter may be due to the much larger size and dominance of the electricity incumbent in the market (figure 5A.2). For instance, in South Africa, the vertically integrated power company Eskom dominates the power market with a 90 percent market share. In Pakistan, the Pakistan Water and Power Development Authority is a government-owned public utility with a market share close to 40 percent, although it does not manage thermal power. In Türkiye, the state-owned Electricity Generation Inc. (EÜAŞ), despite having a much lower 20 percent market share,
**FIGURE 5A.1** Installed Generation Capacity in Select Countries, by Fuel and Ownership, 2021

- **a. Pakistan**
- **b. Poland**
- **c. South Africa**
- **d. Türkiye**

Source: Preliminary estimates provided by Vagliasindi 2023, based on World Resources Institute Global Power Plant database.

**Note:** RE = renewable energy; SOE = state-owned enterprise.

**FIGURE 5A.2** Market Share Held by the Electricity Incumbent in Select Countries, 2021

Source: Preliminary estimates provided by Vagliasindi 2023, based on World Resources Institute Global Power Plant database.
still ranks first in terms of production capacity. In Poland, four companies control most of the electric power market: Polska Grupa Energetyczna (PGE)—Tauron Polska Energia, Energa, and Enea—holds a market share of 40 percent. Poland's transmission grid is owned and operated by state-owned Polskie Sieci Elektroenergetyczne (PSE). In October 2020, PGE published a new strategy by 2030 and a transformation plan aimed at achieving climate neutrality of the group in 2050. The key directions of PGE's development will be offshore and onshore wind energy, photovoltaics, grid infrastructure, and low-emission heating and energy services. The area of divestment and limitation of activity will include coal energy and hard coal trade.

Notes

1. High-emitting sectors were identified using the World Greenhouse Gas Emissions in 2019 by sector and converted into Statistical Classification of Economic Activities in the European Community (NACE) code. This research was also supported by relevant literature. Some of the sources used include Climate Watch (2023); Ge, Friedrich, and Vigna (2020); Ritchie (2020); and Ritchie, Roser, and Rosado (2020).

2. The high-emitting sectors in which BOSs are located include extraction of crude petroleum; extraction of natural gas; growing of rice; raising of dairy cattle; raising of other cattle and buffaloes; raising of swine or pigs; raising of poultry; logging; manufacture of pulp; manufacture of paper and paperboard; manufacture of corrugated paper, paperboard, and containers of paper and paperboard; manufacture of household and sanitary goods and of toilet requisites; manufacture of paper stationery; manufacture of wallpaper; manufacture of other articles of paper and paperboard; manufacture of coke oven products; manufacture of refined petroleum products; manufacture of other inorganic basic chemicals; manufacture of other organic basic chemicals; manufacture of fertilizers and nitrogen compounds; manufacture of plastics in primary forms; manufacture of synthetic rubber in primary forms; manufacture of cement; manufacture of basic iron and steel and of ferro-alloys; manufacture of tubes, pipes, hollow profiles, and related fittings of steel; aluminum production; casting of iron; casting of steel; production of electricity; manufacture of gas; passenger rail transportation; interurban, freight rail transportation; urban and suburban passenger land transportation; taxi operation; other passenger land transportation; freight transportation by road; sea and coastal passenger water transportation; sea and coastal freight water transportation; inland passenger water transportation; inland freight water transportation; passenger air transportation; and freight air transportation.

3. The sectors prone to the negative effects of climate change were identified using the risk classification by sectors and converted into NACE code. The risk classification was corroborated with results from the literature, including Arent et al. (2014); Baum et al. (2020), Benoit (2019a, 2019b); Cho (2019); Dunz and Power (2021); EPA (n.d.); Kling et al. (2021); and Richmond et al. (2021).

4. The World Bank Group and the International Monetary Fund work with low-income countries to produce regular debt sustainability analyses, which are structured examinations of low- and middle-income-country debt based on the Debt Sustainability Framework. The data are sourced from https://www.worldbank.org/en/programs/debt-toolkit/dsa#:~:text=The%20World%20Bank%20Group%20and,on%20the%20Debt%20Sustainability%20Framework.

5. Based on currently available information, Climate Policy Initiative estimates suggest that the 2021 flow of climate finance amounted to between US$850 billion and US$940 billion, representing a 28 percent to 42 percent increase from 2019/20 averages, reaching an all-time high (CPI 2021).
6. Based on a comparison of 31 revenue leaders in electricity, oil and gas, iron and steel, and cement, including 8 with substantial state ownership (such as Baowu Steel, CNBM, Électricité de France, KEPCO, and Saudi Aramco), with 491 BOs in these sectors from 27 emerging market or low- and middle-income economies.

7. A stand-alone benefit-cost analysis provides a comprehensive assessment of an enterprise's ability to service debt using its own balance sheet resources, without recourse to additional government or other external assistance. The benefit-cost analyses in this compilation already take regular ongoing subsidies from the government into account.

8. In the cement industry, 60 percent of the CO₂ emissions are due to the underlying chemical process (calcination) and cannot be abated, unless cement is replaced by other construction material (laminated wood). Of the remaining 40 percent of emissions, about 10 percent can be abated by improving energy efficiency and a further 10 percent can be abated by burning waste (plastics). The cement sector's main abatement potential would be realized through new technologies, cement substitutes, circular economy business models, and carbon capture (Czigler et al. 2020).

Generally, the cement sector is considered a hard-to-abate sector. The consensus that efficiency improvements may only generate up to 10–20 percent abatement suggests that significant carbon reductions may only come from substantial investment in R&D. Even among the top 10 global cement producers, which are in a better position to undertake such investments, their sustainability strategies suggest that their emission mitigation efforts mostly involve tinkering at the margin, such as improving energy efficiency, although some strategies involve structural innovation (such as developing alternative raw materials to reduce the rate of clinker incorporation, developing alternative fuel sources including biomass, and investing in carbon capture R&D). Among the top 10, these mitigation strategies seem to be common among both privately owned firms and BOs.

9. The top 110 global cement producers by installed production capacity are headquartered in 47 countries; together, they account for 72 percent of global capacity. Out of the top 110, 19 firms are BOs from 14 countries and 4 of the top 10 are BOs.

10. Even among the top 110 global cement producers for which a concerted effort was made to obtain actual emissions data, a sizable number of the top companies do not disclose their emissions levels in sustainability or annual reports. Stronger and more concerted efforts are required to collect and analyze greenhouse gas emissions data to understand better how market and ownership structures affect the climate agenda.

11. The 10 countries covered are Argentina, Angola, Ethiopia, Nepal, Pakistan, Peru, the Philippines, Serbia, Türkiye, and Viet Nam.

12. Between 2000 and 2014, unlisted SOEs and governments increased their yearly capacity additions of renewables (excluding large hydro and nuclear) from 0.63 gigawatt to almost 34 gigawatts, boosting their share in the market for new renewables from 9 percent to 23 percent (Prag, Röttgers, and Scherrer 2018).

13. For example, although India now gets 74 percent of its electricity from coal-fired plants, only 16 percent of electricity generation capacity is state owned. But coal is mined by a quasi-monopolist "public sector undertaking"—Coal India Limited—and transported via railways managed by the Ministry of Railways and operated by the Indian Railways, a public sector undertaking. Bharat Heavy Electricals Limited, an engineering and manufacturing public sector undertaking under the Ministry of Heavy Industries, manufactures products for the power sector, such as turbines and boilers for thermal power plants and transmission lines (Montrone, Ohlendorf, and Chandra 2022).

14. In the province that provides 93 percent of coal jobs, coal jobs represent 11–26 percent of employment in four municipalities. Compared with national averages, coal jobs are more likely to provide protections, a pension, and unionization.
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