THE USE OF AUCTIONS FOR DECOMMISSIONING COAL POWER GLOBALLY
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EXECUTIVE SUMMARY
This report examines the potential use of auctions as a price discovery mechanism facilitating accelerated decommissioning of the global coal fleet. Despite widespread recognition of coal power’s significant negative impact on climate and health as well as the urgency of acting in response to climate change, the transition away from coal power has been slow.

This report introduces the global coal power landscape in Section I and presents arguments for decommissioning coal power, including the potential for savings, mitigation of climate impacts, improved health outcomes, and significant employment opportunities in clean energy. It also details the likely challenges inherent in the transition—the need to ensure reliability, insulation of coal generation from competitive forces, and impacts on workers and communities—that will need to be managed and addressed. In addition, Section I introduces a framework examining the potential role of auctions that is explored further in the report.

Section II provides a broad overview of the geographic distribution of the global coal fleet and introduces key factors to assess the likelihood of the coal-to-clean transition in the near term. Ultimately, while it is difficult to universally categorize this complex transition, several major factors determine the shape of the transition in a particular country. These multifaceted factors include the following:

• Financial and economic context (power generation economics, investment environment, financing costs)
• Regulatory, policy, and market context (policy support for coal phaseout, market and contractual characteristics of the electricity and upstream sectors)
• Technical context (grid reliability, resource adequacy)
• Social context (relationship between local economies and coal activities)

Given the speed and scope of the transformation needed and the scarcity of public funds, it is important to allocate resources efficiently to ensure the transition is feasible on an ongoing basis. Here, auctions represent an opportunity to (1) determine the “price” of coal power plant closures through competition, and (2) accordingly allocate funding to minimize costs and maximize the impact of public finance.

Section III expands on the framework introduced in Section I to help stakeholders understand the potential role of auctions in the coal-to-clean transition. This framework suggests that the likelihood of a transition in the near term is a first-order question. After this is determined, it is important to ensure (1) there are enough bidders (and thus, sufficient competition) for an effective auction, and (2) the auction product is sufficiently attractive (considering any significant barriers and incentives for bidders to participate).

Section III also provides key considerations in creating an attractive auction product. This includes, but is not limited to, the need to standardize the auction product, consider product differentiation, and establish a feasible pay-for-performance structure.
Section IV analyzes the status of the coal-to-clean transition in three archetype country contexts and discusses the applicability of auctions in each context. While it is necessary to develop categories for a decision framework, it must be acknowledged that all countries sit on a spectrum around the potential role of auctions in coal power plant decommissioning. Each country has certain enabling factors for and barriers to deploying auctions, and their relative importance will ultimately determine how auctions are used (or not used) in a specific country.

Finally, Section V introduces items related to auction design and auction process implementation, such as auction format, eligibility and qualification requirements, auction budget size, and monitoring and verification systems. The section also lays out the next steps and importance of exploring auctions more deeply in the context of implementation.

The report concludes that coal power plant decommissioning is part of a multifaceted exercise in which auctions can play an important supporting role. The auction process, including the development of requirements and material obligations, requires a high degree of standardization. If designed well, it could allow for a coal transition mechanism to be allocated efficiently and transparently on a least-cost basis.
ONE

THE CASE AND OPPORTUNITY FOR DECOMMISSIONING COAL POWER GENERATION
Role of Coal in the Current Global Power System

Coal-fired generation is responsible for around three-quarters of carbon emissions from the global power sector and over one-fifth of all energy emissions.\(^1\) Most emissions mitigation pathways developed by the Intergovernmental Panel on Climate Change (IPCC) require the electricity sector to rapidly decarbonize and thereby facilitate emissions reductions in other sectors through electrification.\(^2\) The scale of coal use for power generation and its carbon intensity means that rapid abatement of coal power plants is critical in averting the worst effects of climate change.

Under the current policies and regulations, coal is likely to remain a primary source of electricity generation in many emerging and developing economies through 2050.\(^3\) There are many reasons for this: (1) local decision makers often view coal power as a low-cost source to support electricity generation and thus economic activity, and (2) coal is considered a resource that provides baseload generation and therefore a more secure and reliable energy supply, especially for countries lacking domestic natural gas resources and infrastructure as an alternative.

While rapidly shifting power generation economics imply new clean energy will be cheaper than existing coal power in many countries in the near term,\(^4\) currently, existing coal is cost-competitive in several markets and an affordable avenue for local stakeholders to support their country's economic growth. Finally, existing power sector institutions, processes, and systems—designed and developed to support large, highly centralized generation such as coal—add significant inertia to the coal-to-clean transition.

Transition Pathways Required to Meet Global Climate and Energy Goals

Massive expansion of the global electricity sector is essential to meet economic development and global climate goals. Over 770 million people around the world have no access to electricity,\(^5\) and electrification could support their upward mobility. The Sustainable Development Goals (SDGs) include a target for 100% of the world's population to have electricity access by 2030, up from 90% in 2019.\(^6\)

Furthermore, electrification is an important decarbonization solution for other sectors of the economy—such as buildings and transportation—but only if the grid is increasingly powered by clean energy. The International Energy Agency (IEA) estimates electricity's
share of total final energy consumption must increase from approximately 20% in 2019 to at least 50% by 2050 for a net-zero energy system to be feasible.

To support this rapid growth, investments in clean energy and the electric grid need to be massively scaled up. The IEA estimates that the share of renewable electricity generation must increase from 30% of electricity generation in 2019 to over 60% by 2030, translating to a $337 billion investment every year from 2020 to 2030.

Meeting 1.5°C-aligned climate goals (as represented by IEA’s Net Zero by 2050 scenario) requires advanced economies to phase out unabated coal power by 2030 and the rest of the world to do so by 2040. Achieving this entails halting the construction of new coal power plants and ensuring the transition of currently operating plants. Coal plays a significant role in the energy sectors of many countries, is often a major regional employer, and is considered a low-cost resource to support economic growth. All these factors pose significant challenges to the coal-to-clean transition. Fortunately, as discussed previously, the economics of electricity generation are changing quickly and represent a significant opportunity to maintain or improve affordability for customers and taxpayers through a rapid transition away from coal-fired power.

However, economics alone will be insufficient. Over 93% of the global coal fleet is insulated from competitive forces through either legacy contracts or utility tariff structures. This means that even if the majority of coal power plants become uneconomic in a particular context, they can continue to be profitable.

Accelerated action on all fronts is needed to support an energy transition in line with Paris Climate Agreement goals and coal transition mechanisms (CTMs) are emerging as solutions that leverage finance in the coal-to-clean transition. CTMs could be used (in tandem with policies and regulations) to support the transition of coal power plants, facilitate their replacement with clean energy, and support affected workers and communities. To deliver the required financial support, public finance institutions, including green banks and multilateral and bilateral development banks, can play an important role in designing and piloting innovative financial mechanisms, thereby bearing and reducing the initial risk. Private financial institutions such as investment banks, asset managers, asset owners, and credit rating agencies can also play a role in financial innovation in the transition. More importantly, the private sector is well-positioned to support the standardization of transition finance, thereby enabling it to scale (once those financial mechanisms are tested and “de-risked”).
Benefits of and Challenges to the Coal-to-Clean Transition

Successfully transitioning from coal to clean energy enables many technical, economic, environmental, and social benefits. However, as seen in Exhibit 1.1, certain trade-offs and challenges need to be managed, as is the case in any transition.

**EXHIBIT 1.1**

<table>
<thead>
<tr>
<th>Benefits of and challenges to coal-to-clean transition</th>
</tr>
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<tbody>
<tr>
<td><strong>TECHNICAL</strong></td>
</tr>
<tr>
<td>Renewable energy can be distributed and modular in nature, which could reduce causes and impacts of large-scale failures in the grid.</td>
</tr>
<tr>
<td>Ensuring adequate and reliable energy supply must be the cornerstone of a coal phaseout. This needs detailed consideration of the grid’s generation mix, the availability of balancing resources, and a feasible timeline for implementation.</td>
</tr>
<tr>
<td><strong>ECONOMIC</strong></td>
</tr>
<tr>
<td>Renewables enable low-carbon and low-cost end-use sector electrification along with system-wide efficiencies. The coal-to-clean transition has the potential to reduce energy costs in the long run. In 2020, up to 40% of the global coal fleet was uneconomic compared with building new renewable energy capacity. This number is expected to rise to 78% by 2025. By then, the costs to replace coal will be offset by the savings of replacing it, thereby producing global net economic benefits of $107 billion annually. Access to low-cost capital to cover transition and replacement costs will be a challenge in geographies with underdeveloped capital markets and insufficient overseas financing. Over 93% of global coal power capacity is insulated from competitive market forces via long-term contracts and applicable utility tariffs, and transitioning such capacity requires concerted efforts from many stakeholders. The process of a rapid and far-reaching energy transition may raise short-term costs or challenges, potentially impacting the deployment of clean power. A managed transition requires carving out support for the remediation and restoration of polluted sites (ash ponds, coal mines, etc.) that impact local communities. These costs may be borne by a combination of customers, taxpayers, and plant owners.</td>
</tr>
<tr>
<td>The coal-to-clean transition could reduce dependencies on upstream fuel supply chains, thus reducing exposure to coal price disruptions and shocks and related geopolitical crises (especially in net coal importing countries).</td>
</tr>
<tr>
<td><strong>ENVIRONMENT AND HEALTH</strong></td>
</tr>
<tr>
<td>Transitioning coal is a critical lever to reduce global CO₂ emissions from the power sector, thereby helping prevent the worst effects of climate change. Abating coal helps mitigate the significant health and environmental burdens coal power and mining place on local communities.</td>
</tr>
<tr>
<td><strong>SOCIAL</strong></td>
</tr>
<tr>
<td>• The coal-to-clean transition will create regional and national jobs, tax revenues, and economic diversification.</td>
</tr>
<tr>
<td>• More than 80% of coal is produced in coal-dependent regions. In these regions, coal mining is a major employer and often supports a range of domestic economic activities.</td>
</tr>
<tr>
<td>• Closing coal power plants will inevitably displace coal mining and power sector jobs and impact the tax and revenue base of corresponding localities.</td>
</tr>
<tr>
<td>• Ensuring continued assistance to affected workers and communities in a rapid and complicated transition will be a significant challenge.</td>
</tr>
</tbody>
</table>

THE USE OF AUCTIONS FOR DECOMMISSIONING COAL POWER GLOBALLY 7
Recent Rise in Momentum for the Coal Transition

**COP26 in Glasgow was marked by several pledges to transition away from coal.** The Glasgow Climate Pact was signed by nations to accelerate efforts toward the phasedown of unabated coal and fossil fuel subsidies. Furthermore, 28 members joined the Powering Past Coal Alliance (PPCA), bringing the member count to 48 nations and 48 subnational governments. To become a member of the PPCA, a country that is a member of the Organisation for Economic Co-operation and Development (OECD) or the European Union must commit to phasing out coal by 2030. All other countries must make a commitment to phase out coal by 2050.

**Power generators and coal power plant owners are committing to phasing out coal power plants, although this often does not align with climate targets.** In 2021, major utilities managing coal-dominant power systems, including Eskom in South Africa and PLN in Indonesia, set specific coal phaseout targets. However, these commitments need to be followed by concrete action plans aligned with Nationally Determined Contributions (NDCs) aimed at preventing the worst impacts of climate change.

**Financiers are increasingly committing to cease financing for new coal-fired power projects, though these commitments have not translated to sufficient action.** Thirty-three private sector financial institutions—including project- and corporate-level financial service providers—have signed the PPCA Finance Principles, which commit to phasing out financial services and investments in unabated coal-fired power and investing in clean energy. In addition, major overseas financiers of power generation projects, including China, Germany, Japan, South Korea, and the United States, have pledged to stop financing overseas coal projects. According to data tracked by Global Energy Monitor, the volume (in dollars) of coal power project finance deals increased between 2012 and 2018 but subsequently decreased by 50% between 2018 and 2021. However, the total underwriting amount by the world’s 60 largest banks to the top 30 coal production companies and the top 30 coal-fired power generators did not materially decrease between 2016 and 2020.

**Several multinational programs have been recently launched that aim at using CTMs to financially support emerging economies in the coal-to-clean transition.** The European Union, France, Germany, the United Kingdom, and the United States launched the Just Energy Transition Partnership, committing an initial $8.5 billion to support South Africa’s energy transition and decarbonization efforts. The Asian Development Bank launched the Energy Transition Mechanism (ETM) to accelerate the coal transition in Indonesia, the Philippines, and Vietnam. Finally, in 2021, the Climate Investment Funds Accelerating Coal Transition Program (CIF ACT) was officially launched and received an initial funding commitment of $2 billion from the G7.
Use of public finance for a coal-to-clean transition requires efficient allocation and cost minimization. As discussed previously, public finance will play a leading role in jump-starting the global coal transition. However, as taxpayers and philanthropy are the primary sources of funding, funds must be allocated efficiently to maximize their social impact. Auctions, such as those being implemented in Germany to incentivize the accelerated closure of hard coal power plants, are one tool that could allow for transparent price discovery in support of energy transition objectives.

Business Models for Coal Power Transition and Just Transition Considerations

There are several alternative business models, or combinations therein, that countries could consider depending on their national context and the set of coal plants that they target. The Business Models for Transition of Coal Generating Capacity paper provides a comprehensive summary of appropriate implementation scenarios and lessons learned from various coal transition business models, including policy-based closures, plant buyouts, repurposing, swaps or replacements, refinancing, as well as auctions. The most common themes across all business models are the need for system-wide planning and that markets that can provide clean price signaling. Even if a country's government does not formally adopt policy-based closure, providing a clear market signal and plan for coal transition can substantially mitigate the technical risks associated with retiring coal. The need for government support for coal transition is a common theme across all business models since this directly impacts the perception of coal plants' economic viability and incentivizes owners to consider options for transition. The determination of the level of compensation to be offered to coal plant owners can be particularly challenging. Thus, auctions can serve as an effective price discovery mechanism to determine the “price” of coal power plant closures through competition. Their applicability in different contexts needs to be assessed further.

This report examines the possible use of auctions for decommissioning coal power generation and notes that other important factors must be addressed in parallel to support the broader coal-to-clean transition such as economic assistance for a just transition, site remediation, grid reliability, and replacement power. In particular, coal power generation is inextricably linked with coal mining and any program to decommission coal power plants will need to consider the upstream effects on the mining sector. This report acknowledges the need for a just transition for people directly and indirectly impacted by closures or along the coal value chain. Additional study of these issues in particular jurisdictions will be needed if an auctions program to decommission coal power generation is planned and implemented.
An auction is an allocation mechanism and a price discovery mechanism. By selecting winners primarily based on price, an auction assigns the obligation to perform to auction winners and helps set prices in a manner that is efficient and that maximizes value (typically resulting in either the least cost for a purchase or the highest revenue in a sale). An auction mechanism can play a critical role when public funds are not widely available, and such funds are required to be allocated efficiently and transparently. An auction is a powerful tool that can be leveraged to support climate change initiatives by reducing emissions and/or promoting clean energy projects.

Auctions have been widely used to incentivize the adoption of renewables and other products that assist in decarbonization:

- Renewables auctions have been held in various regions around the world. Such auctions may take place when the country government, state government, or local utility issues a competitive bid process or tender to procure new renewable resources. Project developers participating in such auctions are usually required to submit a bid with a price per unit of electricity or per renewable energy credit (REC) at which they would develop the project. The bids are evaluated based on price and, at times, other non-price criteria. Winners sign a long-term Power Purchase Agreement (PPA) or REC agreement to develop the project.

- The World Bank's Pilot Auction Facility for Methane and Climate Change Mitigation (PAF), which features a pay-for-performance mechanism encouraging investment in projects that lower GHG emissions, uses an auction to set the floor price for such emissions reductions in the future. The auction product was structured as a put option that allows auction winners to turn in emissions reductions to the PAF to receive the floor price or sell their emissions reductions elsewhere if they receive a better price in the market. The competitive auction helps allocate the put options at the minimum price required by the private sector to make such investments.

The auction is a tool that can help allocate the concessionary benefit. As such, the auction is not the primary mechanism but is rather used to support the allocation and price discovery of the primary mechanism. In the two examples above, the primary mechanism (or auction product) would be the terms of (1) the underlying PPA or REC agreement in a renewables auction, or (2) the put option in the PAF auction.

The above two examples exemplify how auctions can be used to incentivize climate-aligned behavior and actions. These auctions provide price signals for efficient market entry and effectively accelerate the adoption of renewables and greenhouse gas abatement projects. In contrast, auctions designed to accelerate coal power plant decommissioning are different in two key aspects.
First, the auctions are intended for participants to exit the market (as opposed to entering the market) and the payment would be for nonperformance of an activity (i.e., cessation of plant operations) rather than performance of an activity (i.e., clean power generation or emissions reduction activities). Second, winners in auctions for renewables or emissions reductions are expected to develop more projects in the future and replicate and scale such activity as part of their business models. However, this would not be the case for winners in auctions for coal power plant closure, as the activity is not contemplated to be replicated or scaled in an analogous manner. As such, auctions for coal power plant closure need to consider the aforementioned differences.

While this report studies the enabling conditions for the use of auctions to transition coal, it does not provide specific auction design recommendations. It rather provides a framework introducing the steps and questions that must be addressed to determine the role that auctions may play in a given context (see framework below). This framework comprises three main steps:

1. Assess the likelihood of the coal-to-clean transition in the near term (this is explored in Section II of this report).
2. Assess whether there is sufficient competition for an auction to be conducted.
3. Assess whether the auction product would be attractive to potential bidders and explore factors to be considered in such assessment. Steps 2 and 3 are investigated further in Section III of this report.

**EXHIBIT 1.2**
Framework to understand if and how auctions could support coal power plant decommissioning

Note: The answer to whether the auction product is attractive rests on a spectrum and is not binary. The more attractive the auction product is to potential bidders, the more likely it is that auctions can be used for coal power plant decommissioning in the near term to support the coal-to-clean transition. In some cases, policy interventions and market reforms may be needed to use auctions for coal power plant decommissioning in the near term.
TWO
SECTOR OVERVIEW
Overview of the Global Coal Power Fleet

To understand the global coal power plant fleet, it is essential to assess its geographic location, capacity trends, operating status, and technical features. Two broad trends underlie the global coal fleet—a set of geographies appear to have reached the peak of their fleet sizes, while another set will reach that peak in the coming years.

The first set of geographies tend to be developed economies where coal has become the most expensive power generation option due to a variety of factors—coal power plants are old and costly to maintain, access to low-cost capital is robust, clean energy supply chains and ecosystems are well-developed, and natural gas generation is readily available.

The second set of geographies tend to be emerging economies, several of which are in Asia. In these countries, the coal fleets have grown significantly over the past two decades and are expected to continue doing so in the short term. In many of these countries, considering the shortage of natural gas and the need to power rapid economic growth, coal-fired power represented (and often still represents) the most affordable avenue to fuel that growth while ensuring grid reliability.

Globally, there are 2,074 GW of operational coal power plants and 450 GW announced, planned, permitted, or under construction. China, India, and the United States hold the top three positions for currently operating coal power plants. Exhibit 2.1 breaks down the operating global coal fleet by region, with the top three coal regions, namely, East Asia (China, Japan, and South Korea), South Asia (Bangladesh, India, Pakistan, and Sri Lanka), and North America (Canada and the United States), accounting for over 80% of global coal power capacity. Asian countries account for about 87% of all announced coal power and roughly 95% of all coal power plants under construction globally.

**EXHIBIT 2.1**
Operating coal by region (GW)

Note: “Rest of World” includes Latin America, Non-EU Europe, Australia, and New Zealand.
Source: Global Energy Monitor, Coal Plant Tracker, January 2022
Within the currently operating coal fleet, there are significant regional variations in the age of coal power plants. As is seen in Exhibit 2.2, coal power plants in Asian and emerging economies tend to be much younger (average age of 13 years) than their counterparts in Europe and North America (average age of over 41 years).

Recent growth in electricity demand in emerging economies is primarily met with additions to the countries’ coal fleet, leading to increased reliance on younger coal power plants. This is reflected in the role coal power plays in the electric grids of these countries. For example, the average share of coal generation in non-OECD country grids is 45% compared with 20% in OECD members. Exhibit 2.3 shows the share of coal generation in the power mixes of the top 15 most coal-reliant countries in the world, with South Africa producing over 86% of its electricity from coal and Türkiye around 34%.
Additions to the global coal fleet are slowing. Various factors are driving this slowdown, but the quickly changing economics of power generation (as discussed previously) is a significant factor. Moreover, the share of canceled, shelved, or decommissioned coal power plants has risen across the world over the past few years—around 2,300 GW has either not been built or been taken offline.

As Exhibit 2.4 illustrates, Canada and the United States have decommissioned the largest amount of coal capacity (over 140 GW), while countries in East Asia have cancelled, shelved, or mothballed the most coal power (over 700 GW). While additions to the global fleet have slowed, around 170 GW of coal power plant capacity is in construction and 250 GW is in the planning pipeline in Asia (the region that will host most of the world’s new coal power).
Despite the increasingly favorable economics of renewables and the significant momentum for transitioning from coal, financial mechanisms are necessary. The recent uptick in national and international commitments to phase out coal and the increasingly attractive economics of building new clean energy compared with operating existing coal are accelerating the pace of the coal transition. However, the global economy is moving away from coal at a pace far slower than the shifting economics of renewables would otherwise indicate. This is because the vast majority of coal power (~93%)\textsuperscript{36} can continue to be profitable even after it becomes uneconomic, because it is insulated from competitive forces through long-term contracts or utility tariffs. Thus, innovative financial mechanisms—along with strong policies and regulations—are an important lever to decommission coal power plants as they become uncompetitive and build up the necessary renewables capacity.
Characteristics Enabling Near-Term Coal-to-Clean Transition

To understand the role auctions could play in coal power plant decommissioning, it is important to analyze how likely the coal-to-clean transition is in the near term and the underlying factors driving that possibility. A variety of conditions—technical, policy-related, regulatory, financial, economic, and social—can contribute to enabling or impeding such a transition. These conditions vary across geographies and depend on the structure of the sector, the broader historical context of the country, and the trends in the country’s economy.

Trends in the economics of new clean energy compared with existing coal generation will inform the pace and scalability of the transition, especially for private sector participation. While economics alone do not dictate the viability or speed of the transition, favorable economics provide an opportunity to save costs and earn profits. The former bolsters the political viability and affordability of the transition, while the latter incentivizes strong private sector participation (an important ingredient for the transition). Key factors influencing the economics of renewables include resource potential and financing cost.

The investment environment of a country and the financing costs in its electricity sector significantly impact the viability of a near-term coal-to-clean transition and the robustness of its clean energy ecosystem. In the context of the coal-to-clean transition, finance is required at every step of the process. Low-cost transition finance enables coal power plant decommissioning, and low-cost project and corporate financing ensure the replacement clean energy is built—all while saving customers and/or taxpayers money. Public and private capital needs to be affordable, easily accessible, and available. Here, the country’s investment environment (perceived investment risk, financial stability) plays a significant role.

Policy support for the coal phaseout is a critical enabler of the coal-to-clean transition and a signal of the government sponsor’s interest and willingness to implement policies that accelerate the transition from coal in a just and transparent manner. National and local climate commitments indicate the country’s position on and policy support for the energy transition and decarbonization. National commitments (such as NDCs and coal phaseout signatories) and sector-specific commitments or plans (such as power sector net-zero or renewable energy targets) set a foundation for the more concrete policies and regulations that must follow. Furthermore, they encourage follow-up action by private and other public actors.

Market and contractual characteristics of the electricity sector (and upstream sectors) in a country reveal the distribution of risks and benefits and underlying incentives under which various actors operate. The more consolidated and regulated a country’s electricity sector—whether through a vertically integrated state-owned enterprise or investor-owned utility—the more the sector tends to be insulated from power generation economics and competition. On the other end of the spectrum, a deregulated wholesale market allows generators to bid based on the prevailing demand and supply dynamics and is thus more subject to competition.
Given the rapidly shifting economics of existing coal versus new clean energy, a highly consolidated and/or monopolized sector that insulates plants from competitive forces can diminish the incentives for an early transition and thus slow the coal-to-clean transition.

Long-term contracts can also be an insulating force, and their dominance in a country's power sector may indicate additional barriers to rapid coal power plant decommissioning. Furthermore, the structure of the country's coal mining sector and its relation to coal power are important factors. Analogously, long-term Fuel Supply Agreements (FSAs) between coal power plants and coal mines can also be a significant challenge to the transition.

Grid reliability and resource adequacy are critical constraints (and key enablers) for the coal-to-clean transition. A reliable grid must have excess capacity available to supply uncertain load requirements. In keeping with this, utilities and grid operators must ensure additional capacity is available for dispatch at all times ("reserve margin") and extra electricity can be delivered to load centers via existing transmission and distribution lines.

Two indicators of resource adequacy and grid reliability are reserve margins (current and projected) and transmission constraints (current and expected). A reserve margin consistently higher than minimum requirements indicates that a coal transition may not need immediate replacement, while a lower reserve margin likely indicates that (clean) replacement resources must come online before coal power plant operations are stopped. Even if there are enough generation resources, insufficient transmission capacity can be a significant constraint on the coal-to-clean transition, as it restricts the movement of electrons needed to bring replacement electricity online (since replacement resources may be situated far from existing load centers).

Coal mining can play an outsized role in local and regional economies. While coal's contribution to revenues at the national level is often small, local and regional economies can be highly dependent on the coal industry (especially coal mining) for tax revenues, community assistance, and employment. Coal can represent up to 35% of the regional GDP in certain regions such as East Kalimantan and South Sumatra in Indonesia, the Silesian Coal Basin in Poland, and the Quang Ninh Basin in Vietnam. These regions host coal mines that employ workers and sometimes also the mine-to-mouth coal-fired power plants that give that coal most of its value. Some countries also rely on the coal mining sector to subsidize (through tax revenues) social programs and other sectors of the economy (such as transportation).

No one factor dictates the pathway to a country's coal-to-clean transition. Various characteristics (technical, political, financial, economic, social) have been discussed thus far, and while they are all important, none of them singlehandedly determines the shape of the transition.

The factors should be viewed as a collective to assess the likelihood of a near-term transition. The answers are rarely binary (i.e., either “feasible” or “not feasible”) but rather rest on a spectrum. Exhibit 2.5 below summarizes the metrics corresponding to the key power sector characteristics discussed above, along with relevant examples.
**EXHIBIT 2.5**
Metrics for and examples of key power sector characteristics influencing the likelihood of near-term coal-to-clean transition

<table>
<thead>
<tr>
<th>CONTEXT</th>
<th>CHARACTERISTIC</th>
<th>INFORMATION OR METRIC USED</th>
<th>EXAMPLES</th>
</tr>
</thead>
</table>
| FINANCIAL AND ECONOMIC CONTEXT | Power generation economics | Year in which over half of a coal fleet's long-run marginal cost is greater than the levelized cost of electricity of new clean energy plus four-hour storage (rated at half the renewable capacity) | • For China, new renewables and storage are already cheaper than most existing coal\(^{27}\)  
• For Indonesia, this tipping point is expected in the next few years\(^{39}\) |
|  | Investment environment and financing costs | • 10-year government/sovereign bond real interest rate (as reference for the country's risk-free rate)  
• Average lending rates and costs of equity for new infrastructure projects  
• Percentage of GDP from private investment | • Indonesia's cost of project financing is expected to be ~9% cost of debt and ~13% cost of equity\(^{40}\)  
• Pakistan's cost of project financing (economy-wide) is estimated to be ~15% cost of debt and ~20% cost of equity\(^{42}\) |
| REGULATORY, POLICY, AND MARKET CONTEXT | Policy support for coal phaseout | • Country's NDC alignment to a 1.5°C emissions pathway  
• Presence of coal phaseout commitment and an accompanying plan to implement transition | • Türkiye has made no coal phaseout commitments. Its current policies and plans are aimed at boosting domestic coal production and generation, even though it has had generous and supportive clean energy policies in the past  
• Vietnam has made commitments to phase down coal by 30% by 2030 and completely by the 2040s |
|  | Market and contractual characteristics of electricity (and upstream) sector | • Type of regulatory environment and mix of market structure (regulated monopolies, IPP-dominated generation, PPAs, wholesale markets, and others) | • The Philippines has a majority publicly owned utility, but its generation in its wholesale market is dominated by IPPs  
• South Africa's utility Eskom is currently a vertically integrated, state-owned monopoly that owns almost all generation in the country |
| TECHNICAL CONTEXT | Grid reliability and resource adequacy | • Recent and projected reserve margins  
• Significant regional transmission constraints (current or projected) | • While Vietnam's national reserve margin is a comfortable 34%,\(^{41}\) there are significant disparities in resource adequacy between the north and south. These disparities will only worsen if major transmission lines are not built |
| SOCIAL CONTEXT | Local and regional macroeconomic factors | • Existence of regions with high economic dependence on coal | • Coal contributes almost 35% to the regional GDP of East Kalimantan in Indonesia—a major coal-producing region—although coal only contributes 1%-2% to Indonesia's national GDP\(^{42}\) |

Section II has identified and expanded on a set of power sector characteristics that will likely drive the shape of a country's near-term coal-to-clean transition. While the list of characteristics is not exhaustive, the authors have attempted to identify the most consequential ones.

Section II has provided critical input to answer the first question in the proposed decision framework introduced in Section I—“Is the coal-to-clean transition likely in the near term?” Section III uses the answer to this question as the starting point for a discussion on the role of auctions in accelerating coal power plant decommissioning.
THREE AUCTIONS FOR COAL POWER PLANT DECOMMISSIONING
Auctions through the Lens of Coal Power Decommissioning

Why should auctions be explored in the context of coal power plant decommissioning?
The transition away from coal requires funds for coal power plant decommissioning, the
development of replacement energy from clean supply alternatives, and the just transition
for affected workers and communities. Multilateral development banks and climate
funds such as Climate Investment Funds (CIF) may provide funding to drive these efforts.
Such organizations aim to maximize the effectiveness of transition funds by allocating
them efficiently to a finite group of players and achieving the highest emissions reductions
at the lowest cost. Auctions could help achieve this goal by allowing bidders to compete for
these funds. Auctions also offer administrative efficiency. Negotiation processes, which are
sometimes prioritized over auctions, can take a very long time, which causes delays in
projects moving forward. Once an auction process is set up, it is a quick, efficient, and
low-cost mechanism for allocating funds.

Auctions are a tool in the multifaceted undertaking of coal transition. Section II of this
scoping report provides an overview of the enabling factors and challenges in a country’s
power sector as they relate to the transition away from coal. Such factors and challenges
help determine whether the transition is likely in a given country. Depending on the nature
of the challenges, the coal-to-clean transition may not be likely in the near term. In such
cases, auctions are unlikely to play a role in coal power plant decommissioning because the
coal-to-clean transition is limited at this stage.

Generally, the factors affecting the likelihood of a near-term coal transition will, in turn,
affect the success of implementing an auction mechanism in this multifaceted exercise. For
example, an auction mechanism may appear to be the right tool to attract participation
from coal power plant owners in a given market structure. However, if recent and pro-
jected reserve margins are unfavorable and renewables uptake is not under way, an
auction process for coal power plant decommissioning may be impractical. This would not
be because auctions were ineffective but because the country at that stage was unlikely to
begin the transition away from coal. Thus, an auction mechanism for coal power plant
decommissioning is unlikely to be successful in a country where the coal transition is
unlikely in the near term.

Issues affecting the broader transition may limit the success of an auction mechanism.
However, in cases where it may be impractical to implement auctions for directly decom-
missioning coal, auctions could play a pivotal role in laying the necessary groundwork for
enabling the future decommissioning of coal power plants. For example, auctions could be
used to encourage rapid uptake of renewables in parallel with building out a robust clean
energy ecosystem, in countries without the latter. Auctions for renewables have been
successful and are gaining popularity as a mechanism to accelerate the adoption of renew-
ables and associated infrastructure globally.43
Introducing a Framework to Assess the Role of Auctions

This section introduces a framework to determine whether auctions can be used to accelerate the decommissioning of coal-fired power plants in a region. The framework introduced in Section I is provided below (see Exhibit 3.1).

Step 1 in the framework uses key information from Section II of this report to assess whether the coal-to-clean transition has sufficient support and would be likely to occur in the near term. Step 2 assesses whether there is sufficient competition for an auction to be conducted. Step 3 assesses the attractiveness and viability of the product at auction. These steps are described in more detail below.

**Step 1: Is the coal-to-clean transition likely in the near term?**

Assessing whether auctions can be used to accelerate the decommissioning of coal power plants in a region is meaningful only if the coal-to-clean transition appears likely in the near term. To analyze this, the enabling factors and challenges laid out in Section II of this report must be addressed adequately. The authors recognize the degree of viability of the near-term transition may vary. The more challenges faced in Step 1 or the more severe the challenge, the less likely the coal-to-clean transition is in the near term.

**EXHIBIT 3.1**
Framework to understand if and how auctions could support coal power plant decommissioning

Auctions unlikely to support coal decommissioning in near-term

Are there enough bidders for an auction?

Is the auction product attractive?

Is a near-term coal-to-clean transition likely

Yes

No

Role of auctions in coal decommissioning

Auctions can be used for coal decommissioning in near term to support coal-to-clean transition

Some considerations

- Coal plant ownership
- Affiliations of owners
- Barriers to exit
  - Long-term PPAs, FSAs
  - Incentives to exit
  - Phase-out mandate
  - Investor pressure

Note: The answer to whether the auction product is attractive rests on a spectrum and is not binary. The more attractive the auction product is to potential bidders, the more likely it is that auctions can be used for coal power plant decommissioning in the near term to support the coal-to-clean transition. In some cases, policy interventions and market reforms may be needed to use auctions for coal power plant decommissioning in the near term.
Step 2: Is there sufficient competition?

For simplicity, Step 2 assumes the enabling factors and challenges laid out in Section II of the report have been addressed and the coal-to-clean transition is likely in the applicable country in the near term.

Step 2 seeks to understand whether there would be enough potential bidders at the auction. For the purposes of this framework, it is assumed that owners of coal power plants are the potential bidders. An auction requires more than one bidder. For example, if there is a single coal power plant owner in a country, it would be impossible to hold a nationwide auction where coal power plant owners compete for a compensation payment that allows them to decommission early. For competition to exist, there must be losers in the auction. For potential bidders to participate in the auction, there must be a possibility for them to win.

Coal power plant ownership and affiliations. A good understanding of the market structure and stakeholders involved is critical to discover where competition could be introduced in the market. Certain determinations about coal power plant ownership in the applicable country or region must be evaluated to understand the nature of any affiliations that may undermine or influence the decisions of power plant owners. In analyzing the bidder pool for a potential auction, it is essential to determine not only the number of coal power plants present but also the ownership concentration of these power plants. An auction mechanism for the rapid decommissioning of coal must consider the possible entry points for an auction and the bidders targeted in the auction. The ownership concentration of coal power plants is critical to determine whether it is possible for coal power plant owners to compete at an auction. It is also important to know if coal power plant operators are independent or could be influenced by other incentives (e.g., ascertaining whether they are also affiliated with coal mines in the region).

Step 3. Is the product attractive to potential bidders?

Step 3 explores the design of the auction product only after it has been determined that there are sufficient bidders in the auction.

Competition in the auction arises from scarcity. The targeted players may not have the incentive to bid if the product is also available outside of the auction.

It is critical that the auction product be attractive. Participation at an auction is voluntary. Whether the status quo of a coal power plant owner is to continue to operate the coal power plant through the tenor of a long-term contract or continue to provide customers electricity through a utility tariff, the design of the auction product must consider incentives more attractive than that status quo. If the auction product is not more attractive than the status quo, there will be insufficient participation at the auction, even if there are many eligible prospective bidders. The analysis of an attractive package will consider cost drivers and other incentives that may challenge the status quo.
As an example, if a coal power plant owner contracts its plant for the long term, its incentives are driven by profitability, which, in this case, would be the difference between PPA payments and costs to operate and finance the plant. Any auction product would need to consider this incentive structure and be designed and sized accordingly. Furthermore, parties involved in long-term contracts may be open to negotiating an amendment to such contracts if they can share in the benefits of the decommissioning package at auction.

In contrast, if the coal power plant owner is a utility recouping its investments through customer bills, the incentives are different. While the utility's specific business model would shape its decisions around auction participation, unlike an owner in a long-term contract, a utility would be more focused on ensuring continued service to its customers at reasonable rates. This would need to be considered when designing an auction in which such a utility participates.

Finally, if there is a robust wholesale market where coal power plants are exposed to competitive forces, an auction may not be needed. However, this is not the case for the majority of coal power plants and electricity systems across the world.

The auction design must consider the targeted bidders as well as their cost and incentive structures to create an attractive auction product where the barriers and costs to participation do not outweigh the benefits of such participation. The design of the auction product is a complex exercise that must consider facets of the environment in which the auction resides. In Step 3, the following questions should be considered:

• Are there exit barriers such as the prevalence of long-term contracts?
• Are there strong incentives to exit the market such as existing policies supporting the coal-to-clean transition that an auction can be used to help accelerate?

Section III of this report discusses the two questions above at surface level and stresses the importance of developing an auction product that is ultimately attractive to potential bidders. Although this report does not seek to provide the ideal auction product or solution, it discusses key factors to be considered in the creation of such a product or solution. Section IV of this report explores these questions further by looking at them through the lens of three distinct country archetypes.

Barriers to Exit. The economics are increasingly in favor of new clean energy over existing coal power supply in many regions of the world. Thus, an explanation is warranted for why coal power plants are not exiting at the pace that the economics would otherwise indicate and whether exit barriers prevent them from doing so. The prevalence of long-term contracts, such as PPAs and FSAs, is a barrier to exit. These long-term contracts stop coal power plant owners from exiting the market, even if they wish to do so. Aside from the financial liability associated with breaking a long-term contract, a coal power plant owner may be concerned with reputational risk and/or legal repercussions of breaking the contract. These concerns do not necessarily impede decommissioning, but they introduce a complication in that the counterparty to the long-term contract must agree to and support the decommissioning and modifications to a long-term contract.
**Incentives to Exit.** The opposite of exit barriers are incentives to exit or incentives favoring coal power plant decommissioning. The ideal scenario for rapid coal power plant decommissioning would be if policy and auctions worked together as “sticks” and “carrots.” For example, a political mandate that requires coal power plants to shut down by a certain date acts as a “stick.” If coal power plants are forced to decommission, a competitive bidding process that auctions off financial assistance to coal power plant owners for early decommissioning of the plant would act as a “carrot.” Such a process is likely to receive enhanced participation. In the German hard coal auction framework, the strong combination of policy requiring the decommissioning of coal power plants by a deadline (the “stick”) and the opportunity to receive a compensation payment through an auction (the “carrot”) have generally led to good participation in the auction. Although policy is critical to the success of an auction, such success is dependent on whether the auction product is more attractive than the status quo. Even in the absence of a phaseout mandate, if the auction product is more attractive than the continued operation of the coal power plant, it may still successfully achieve coal power plant decommissioning. A softer policy support could be in the form of a moratorium on new coal power plant development, ensuring the compensation used to shut down coal power plants in a region is not used to develop new coal power plants elsewhere.

**Auction Product Design Considerations**

Generally, the most complicated step in the development of an auction process is the creation of an attractive auction product. To attract the right bidders and hold a successful auction process, the issues that the auction process attempts to fix must be well-defined. There could be multiple priorities associated with the auction mechanism and the intended outcome. The following are only some characteristics to consider in developing an auction product:

- **Auction product differentiation.** An auction focusing on the reduction of CO₂ emissions through early coal power plant decommissioning may include auctioning off compensation payments to coal power plant owners submitting the most cost-competitive bids. However, as not all coal power plants emit the same amount of CO₂, the auction design may choose to view old, less efficient coal power plants and new, more efficient plants as different products to prevent value cross-subsidization. Similarly, the auction design should also consider the dispatch characteristics of coal power plants and distinguish coal power plants that are dispatched regularly from those that are not. As a related issue, the outcome that the auction is designed to achieve should be assessed against the larger context of the coal transition and CO₂ reductions. The auction design may, for example, consider whether an outcome in which the auction successfully decommissions efficient plants that are dispatched regularly could lead to a situation in which the remaining less-efficient coal power plants are relied upon to operate more. If these products are not differentiated and outcomes not evaluated appropriately, the auction
will risk being systematically biased toward selecting certain types of plants for closure and overpaying for those retirements or not achieving the CO₂ reductions contemplated. Such auction product differentiation and assessment of the outcome should be included in the development of the auction product design. The decision to differentiate products within an auction may be related to the issue that the auction process is attempting to fix. Given that potential bidders are owners of coal power plants, product differentiation could be viewed as an issue of bidder asymmetry. In this case, product differentiation may play a role in considerations about eligibility and qualification requirements, which are discussed in Section V.xv

Furthermore, CTMs can be financed through debt, equity, or a blended approach. The auction product being designed as part of a CTM may need to be differentiated along the lines of the types of financing.

- **Potential packaging of complementary obligations.** If the region where the auction is placed does not have adequate clean replacement generation, coal power plant decommissioning and replacement by renewables and storage can be considered as complementary goods, and an auction product can be designed to include both elements of coal power plant decommissioning and renewables development. Generally, if there are relatively unattractive elements in the coal-to-clean transition, they could be combined with other more attractive elements to increase the likelihood of robust participation.

- **Specificity and standardization of an auction product is necessary.** In addition to being attractive, the auction product must be standardized to create a level playing field for all bidders. All bidders must compete for the same auction product, which is allocated to the most cost-competitive bids. Additionally, specificity is critical, and the auction product must be defined clearly. For example, an auction providing a compensation payment for coal power plant decommissioning must clearly determine the meaning of decommissioning. Does it entail a complete shutdown by a certain deadline, closure of a unit within a coal power plant, or commitment to a reduction in CO₂ emissions? The shutdown of the entire coal power plant may be more difficult to achieve and less attractive to participating entities than the added flexibility provided through the closure of a single unit or gradual closure of the plant. The auction product must strike the right balance so that its procurement achieves the auction's objectives for the buyer and it is attractive to the seller. Such a balance must also consider any potential perverse incentives for bidders. To the extent appropriate, auctions should be based on price only. If they include non-price criteria, scoring rules must be carefully evaluated to ensure they do not create incentives that distort values, leading to perverse outcomes.

- **Pay-for-performance.** At the heart of the auction product is a series of obligations for the parties to the transaction. To ensure the performance of these obligations is verifiable, and the outcome of the program met, it is common for payment to be structured through pay-for-performance instruments such as renewable energy credits or emissions reductions tracked and issued by a certifying body.xvi This does not mean payment is made only if obligations are met. The transaction could feature an up-front payment with claw-back provisions and penalties if performance is not met in the agreed upon
timescale. This is important given that up-front payment may be necessary to operationalize the early retirement. Additionally, performance metrics should be calibrated appropriately and specified to ascertain when the coal power plant is underperforming or adequately performing its obligations. In most other contexts where a pay-for-performance instrument is used, the obligated party may have to incur costs to replace the energy shortfall, provide replacement emissions reduction credits, or pay liquidated damages. In the context of coal power plant decommissioning, performance needs to be clearly defined to indicate what payments are made for. For example, if a plant regularly experiences technical failure and shuts down due to poor maintenance, an assessment should consider whether the plant should receive a benefit for decommissioning and what the performance of the failing plant implies in this context. Performance metrics should be taken into account alongside other design considerations discussed in the Product Differentiation and Eligibility and Qualification Requirements section.

- **Environmental, social, and governance (ESG) considerations.** Companies are increasingly incentivized to decarbonize their operations and supply chain. ESG considerations are becoming increasingly important and will play a role in shaping what businesses and governments choose to invest in. While it is common for companies to distance themselves from the fossil fuel industry, actions taken to increase the operating costs of existing coal power plants (as opposed to providing services to plants in the development pipeline) could have unintended consequences of prolonging the life of existing coal power plants. For example, an increasing lack of access to working capital for existing coal power plants could have the unintended consequence of making it more challenging for the plants to recover revenue, thereby extending the schedule required for the plants to continue to operate before they can decommission. If the CTM includes certain services at reduced costs in connection with clear accelerated decommissioning targets, this could reduce its overall cost.

- **Financing instruments.** Instruments such as certified emissions reduction credits and renewable energy credits are proven effective in allowing private sector participation in accelerating the uptake of carbon abatement projects and renewable resources, respectively. These instruments recognize private companies for their participation in the financing of the projects and allow the burden of financing to be shared across many participants. Given the gargantuan financial undertaking associated with the coal phase-out, it may be warranted to investigate whether an instrument differentiated from renewable energy credits and emissions reduction credits should be developed to recognize private companies for participating in financing coal power plant decommissioning. Hypothetically, developing a coal reduction credit instrument in the same way renewable energy credits and emissions reduction credits are developed and recognized for use by private corporations as a credit against their carbon footprint could facilitate participation in coal power plant decommissioning by the private sector at scale and help raise funds for coal power plant decommissioning.

Germany has held compensation auctions to incentivize early closure of its coal power plants. A high-level overview of its experience is as follows:
Compensation payments for early decommissioning of coal power plants in Germany

A compensation payment is provided to coal power plant owners to reimburse them for revenue lost when their plants are retired early. The German lignite sector is dominated by two main players, and lignite-fired power stations will be shut down through a negotiated phaseout. There are more hard coal power plant owners in the country, and auctions are the chosen tool to facilitate the early decommissioning of these plants. Seven auction tenders are under implementation for hard coal power plant owners, the first of which took place in September 2020.

**Competition and incentives to participate in the auction:**

- **Competition:** There are sufficient hard coal power plant owners in Germany. In addition, smaller lignite power plants not specified in Annex 2 of the German Coal Exit Act are eligible to participate in the auctions starting in the third round.

- **Incentives to exit:** Germany’s coal phaseout mandate, as laid out in the German Coal Exit Act of July 2020, indicates a hard coal exit by 2035 and a lignite exit by 2038. Such policy requires the plants to shut down eventually. By participating in the auction, coal power plant owners get compensation for revenue lost because of early retirement.

**Other implementation considerations:**

- **Germany’s security of supply:** To protect the overall electricity supply in the country, the German Coal Exit Act requires grid operators and the national grid authority to authorize each plant’s eligibility to be taken off grid.

- **Auction product:** The auction product is a compensation payment. The auctions operate on a pay-as-bid basis, where every successful bidder receives the amount they bid.
• **Auction program structure:** Each of the seven auction tenders has a publicly available maximum price—a bid cannot be above the maximum price for the applicable tender. The maximum prices are indicated in the Germany Coal Exit Act, and they decrease in each tender. The higher maximum prices in earlier tenders could be seen as an incentive to participate in such earlier rounds.

• **Selected winning bids:** Bidders submit a bid amount in EUR per MW of net installed capacity as well as the respective three-year historical CO\(_2\) emissions. This yields a ranking metric of EUR per ton of CO\(_2\), and such bids are evaluated.

• **Auction format:** The auction format is organized as a sealed bid auction with a pay-as-bid settlement structure.
FOUR CASE STUDIES
Thus far, this report has introduced the global coal power landscape, studied the enabling factors of and challenges to the coal-to-clean transition, and introduced a framework that helps assess the role of auctions in coal power plant decommissioning. Section IV translates the theoretical framework introduced in Section I into a discussion on the applicability of auctions for coal power plant decommissioning to specific country archetypes.

This section first establishes the country archetype’s context—including an analysis of the coal fleet, regulatory and policy environment, power generation economics, financing availability, technical constraints, and social impact—and then examines the implications of such context on the role auctions can play in decommissioning coal power plants.

The design of an auction has to take into account the specific country context. While three sample country archetypes are provided for discussion, it should be noted that countries do not fit neatly into particular categories. xvii

Introducing Country Archetypes

Country archetypes were created to map auction design considerations to country-specific factors and contexts. These conceptual countries were defined based on the following information:

<table>
<thead>
<tr>
<th>COUNTRY ARCHETYPE</th>
<th>STEP 1: Is the near-term coal-to-clean transition likely? (E.g., strong policy support, robust financing environment, no resource adequacy or grid reliability challenges)</th>
<th>STEP 2: Are there enough bidders for an effective auction? (Number of coal power plant owners in country, percentage of coal power plants owned by largest owner)</th>
<th>STEP 3: Are there significant barriers to exit? (E.g., dominance of long-term PPAs and FSAs)</th>
<th>STEP 3: Are there sufficient incentives to exit? (E.g., political mandate, investor pressure, plants facing losses, auction budget size)</th>
</tr>
</thead>
<tbody>
<tr>
<td>COUNTRY A</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>COUNTRY B</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>COUNTRY C</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
</tr>
</tbody>
</table>

Country A Deep Dive

Context and Country Description: Country A

Country A is a rapidly growing economy with significant challenges and opportunities to lead on the coal-to-clean transition. The country has historically been highly dependent on coal for power but has succeeded in significantly building out renewable energy projects and liberalizing its power market. With the electricity demand projected to increase in the coming decades, Country A needs significant new clean power and a well-managed transition away from coal.

COAL FLEET AND POWER SYSTEM CONTEXT
Coal plays a major role in Country A’s electricity sector—despite recent gains in renewable energy, coal power represents over 60% of the country’s generation. Furthermore, the country’s coal fleet is fairly young, with an average age of 15 years. The fleet has more than 100 owners, around 20 of which own the vast majority of the coal capacity. While there is some consolidation, plant ownership is fairly dispersed, with the largest owner owning around a quarter of all coal capacity.

While the country has had challenges with grid reliability in the past, it now has consistent power supply and faces no significant challenges associated with insufficient capacity (i.e., the country has high reserve margins) or transmission constraints.

**REGULATORY, POLICY, AND MARKET CONTEXT**

Country A has set a national emissions reductions commitment (albeit one not aligned with a 1.5°C pathway). The country has also placed a moratorium on new coal construction.

The country’s electricity sector has gone through a period of liberalization. It now includes a growing wholesale market with grid balancing authorities, although its transmission and distribution remain consolidated under one entity and are regulated at the national and regional levels. While publicly owned generation companies still play a significant role in the sector, private generators also have a strong presence.

While efforts at liberalizing the sector have succeeded, major components of the sector are insulated from competition. PPAs dominate the sector, as do FSAs between coal power plants and the highly consolidated coal mining sector (coal mining is controlled by a few large state-owned enterprises).

Finally, given the historically significant role of coal in Country A’s power sector, the government subsidizes coal production and power generation through below-market (and price-guaranteed) FSAs.

**ECONOMIC AND FINANCIAL CONTEXT**

Due to a robust and growing clean energy ecosystem, new renewable energy in Country A is more competitive than existing coal power. These shifting economics have translated into the development of many renewable energy projects. These projects are supported by improving country-wide costs of financing (~5%–6% risk-free interest rates) but face headwinds from high project financing costs (~6% cost of debt, ~14% cost of equity). Country A also has robust access to domestic and international capital markets and faces few challenges in raising private financing.

**SOCIAL CONTEXT**

While coal production contributes less than 1% to Country A’s national GDP, it is a very important source of employment and tax revenues in coal-producing regions of the country. Its contribution to local or regional GDP can be 25%–40%. Furthermore, coal production at the national level subsidizes other sectors of the economy (like transportation).
COAL-TO-CLEAN TRANSITION

Given the above context and the power sector characteristics conducive to a transition laid out in Section II, a near-term coal-to-clean transition is likely in Country A. While most or all coal power plants may not be decommissioned in the near term, the transition is likely to be under way soon.

One aspect Country A will need to navigate is the managed and rapid decommissioning of coal power even as new coal power plants—which are already in the development pipeline—are brought online. While this is inevitable in a transition to some extent, careful consideration is needed to ensure the financing for coal power plant decommissioning serves a broad coal transition with concrete milestones and timelines.

Implications for Auction Deployment: Country A

The criteria outlined in Section III of this report can help assess how to approach auction design in Country A to advance coal power plant decommissioning.

ASSESSMENT OF POTENTIAL BARRIERS TO USE AUCTIONS

While Country A is relatively well-positioned to deploy auctions for coal power plant decommissioning, challenges remain:

- Long-term contracts
  - Dominance of long-term PPAs—Despite an increasingly liberalized power sector, coal power plant capacity is dominated by long-term contracts. This is the case for many countries across the world—even those that have loosened ownership and market restrictions—and is a legacy of electricity sector structure.
  - Lack of transparency into PPA terms—While the dominance of long-term PPAs is a barrier in and of itself, the lack of transparency into contract terms—contract length, PPA price, early termination clauses—adds to the challenges. An understanding of prevailing contract terms could inform the scope and design of auctions (as well as that of complementary CTMs). It should be noted that transparency of PPA terms is not needed for an auction to be viable. The responsibility to assess the costs of reforming the contracts would lie with coal power plant owners and would include an assessment of whether the benefits of auction product outweigh such costs.
  - Dominance of long-term FSAs—FSAs also represent current and future offtake obligations for plants and are often found in conjunction with long-term PPAs in the same plants. This means many plants are often “locked” into place—they are obliged to provide power until the PPA ends and buy coal until the FSA expires. Furthermore, Country A’s highly consolidated coal mining sector (and the influence that often comes with consolidation) may make an early transition even more difficult.

According to the aforementioned framework, long-term contracts are a barrier to exit and may discourage coal power plants from decommissioning even if they are uneconomic to operate. As such, for coal power plants to participate as bidders at an auction, the auction
product must exhibit benefits greater than the costs of unwinding the long-term contracts (recognizing it may not be possible to unwind these long-term contracts in some cases).

- **No coal phaseout mandate**—Despite having a moratorium on new coal, Country A has no legislative or executive mandate on when coal power must be phased out. While this is not a barrier to participating in auctions, it does represent the lack of a strong incentive for plant owners to participate (see framework in Section III).

- **Coal subsidies**—While the presence of coal subsidies did not prevent new clean energy from becoming cheaper than existing coal in Country A, eliminating them will likely accelerate the speed and expand the scope of the coal-to-clean transition.

### ASSESSMENT OF ENABLING FACTORS TO USE AUCTIONS

- **Ownership and competition**—Country A has over 100 coal power plant owners, and the majority of the capacity is owned by the top 10, with the largest owner owning over a quarter of it (see Exhibit 4.1). There appears to be sufficient diffusion of plant ownership for auctions to be effective despite the recognized consolidation of coal power. A critical next step is to explore the affiliations and associations that such coal power plant owners may be a part of to confirm if these coal power plant owners operate independently or are influenced by other incentives.

**EXHIBIT 4.1**

Distribution of coal power plant ownership, Country A
• **Power generation economics**—New clean energy (with four hours of storage) is already more economic than existing coal generation in Country A. While it might have been possible to deploy auctions for coal power plant decommissioning even if coal was competitive, cheaper replacements strengthen incentives to end investments in or long-term contracts with coal early and pivot to cleaner alternatives.

• **Resource adequacy and grid reliability**—Country A’s strong reserve margin levels and lack of significant transmission constraints would allow for a smooth transition away from coal and facilitate the use of auctions in the decommissioning of coal power plants.

• **Moratorium on new coal power plants.** Country A’s moratorium on new coal power plants is beneficial as it eliminates leakage issues and prevents a situation wherein a coal power plant owner receives money to shut down one plant in a region only to build another elsewhere.

**Other Implementation Considerations: Country A**

**VARIABILITY IN COAL POWER PLANT CHARACTERISTICS**

• Country A has a large coal fleet, with over 200 GW of coal power plants currently operational. At an average age of 15 years, the country’s coal fleet is rather young, with the majority of its coal capacity being less than a decade old.

• While most of the country’s coal power plants were initially built as subcritical, plants with increasingly modern (and cleaner) combustion technologies have recently been built. During the past decade, for example, more supercritical coal power plants were brought online than subcritical ones.

**EXHIBIT 4.2**

Operating coal capacity by age and technology, Country A
The young age of the coal fleet means these plants are likely far from recouping the initial investments made in them. Hence, a larger budget is required for the transitional package at auction. Furthermore, to the extent that there are clearly differentiated categories of plants, it is essential to investigate whether separate auctions should be conducted for each category. If these coal power plants are not differentiated in an auction, the auction could risk being systematically biased toward selecting certain types of plants for closure and overpaying for those retirements. One of the main objectives of holding an auction to decommission coal power plants is to reduce CO₂ emissions. The results of shutting down a coal power plant that does not operate much is not the same as shutting down a coal power plant that does. The auction mechanism may choose to hold separate auctions based on the characteristics of coal power plants.

Conclusions: Country A

Given Country A’s stage in the coal-to-clean transition, the most significant complication in the transition appears to be the prevalence of the long-term contracts. Specific work on ways to unwind long-term contracts would be appropriate. Additionally, continued development of the country’s renewables sector is key—an auction to decommission coal power plants should not result in the shift of production to other coal power plants but should rather lead to replacement with carbon-free energy. Other than for these considerations, an auction mechanism appears to be well-suited and should be the natural next step to support the coal transition.

Country B Deep Dive

Like Country A, Country B has a rapidly developing economy. It also has been highly dependent on coal for power historically. However, Country B faces a greater set of barriers in the coal-to-clean transition and in deploying auctions to support it. The country’s electricity sector is more consolidated, its financing environment and costs are more challenging, its clean energy ecosystem is more nascent, and the power generation economics are a bigger obstacle.

Context and Country Description: Country B

COAL FLEET AND POWER SYSTEM CONTEXT

Coal powers just over half of Country B’s electricity needs and represents a major export for the country’s coal mining sector; the remaining electricity needs are covered by other power sources, including natural gas. Until recently, the country was adding a significant amount of coal capacity annually, which is reflected in Country B’s young coal fleet (with an average age of 10 years). Coal power plant ownership is more consolidated in Country B—the fleet has around 30 owners and the largest of them (a state-owned entity) owns
over half the coal capacity in the country (see Exhibit 4.3 below for Country B versus Exhibit 4.1 above for Country A). Furthermore, coal power plants not owned by the state-owned entity are in long-term contracts with the state-owned entity, as such entity is the single buyer of electricity in the country.

Country B’s transmission network is robust, and there are no grid reliability issues. Additionally, the country’s grid is oversupplied in many (but not all) of its regions, allowing it to have large overall reserve margins at the national level.

REGULATORY, POLICY, AND MARKET CONTEXT
Country B has set a national emissions reductions commitment, but it is not in line with a 1.5°C pathway. National policymakers have also declared a moratorium on new coal power plant build-out (excluding the plants in the development pipeline). The country’s primary utility has committed to eventually phasing out its coal and set intermediate milestones in the run-up to the final target. Furthermore, there is significant international and diplomatic momentum to support Country B’s coal transition, including financial support in the form of aid packages.

The country’s electricity sector is fairly consolidated—it is dominated by a state-owned, vertically integrated utility that controls all transmission and distribution, and a large portion of generation, and is the single buyer and retailer for all electricity in the country. Private generators contracting with the state-owned utility through long-term PPAs account for the
remaining generation. These PPAs often include fixed capacity and take-or-pay clauses, which necessitate payment any time a coal power plant is available to generate electricity. Because of the structure of this sector, there is no wholesale market in Country B.

The country's coal mining sector is consolidated as well and comprises a mix of large privately owned and state-owned companies. As with PPAs, FSAs that exist between coal mines and coal power plants (whether utility- or IPP-owned) are often long-term and inflexible.

Finally, Country B subsidizes coal production and power generation through below-market FSAs and below-market electricity prices.

ECONOMIC AND FINANCIAL CONTEXT

Country B's state-owned utility is under significant financial strain and needs to be heavily subsidized to remain solvent. The utility has been overextended for years, affecting its ability to swiftly execute projects. The sector's financing environment does not help—typical power generation project financing is very expensive (around 22% in aggregate, with 9% cost of debt) and reflects a high perceived investment risk.

The financial challenges of the utility and the sector, coupled with Country B's limited access to (domestic or international) private capital, has made it highly challenging to build new clean energy projects quickly and affordably. This has contributed to the nascent nature of the country's clean energy ecosystem and the limited pipeline of clean energy projects.

All these factors have led to the current state of power generation economics in Country B. While new renewable energy is expected to become cheaper than existing coal in the next five years, the economics are currently not in its favor.

SOCIAL CONTEXT

Like Country A, Country B is highly dependent on coal in specific regions, with coal mining activities contributing to over 35% of local revenues and serving as a major source of employment.

COAL-TO-CLEAN TRANSITION

Given the above context and the power sector characteristics conducive to a transition laid out in Section II, a near-term coal-to-clean transition is relatively likely in Country B. However, several challenges need to be addressed, as noted below.

First, as stated above, Country B has an oversupply of generation capacity, resulting in high overall reserve margins. Excess generation, with more than half the generation capacity from coal and many coal-generating assets operating at a low capacity factor, compounds the issue and creates a challenge for the coal-to-clean transition. As the grid in many regions of the country is oversupplied, it is challenging to justify building out more renewable energy in the near term. Decommissioning can only lead to a meaningful emissions
reduction in Country B if the generation mix increases in favor of clean alternatives. The oversupply in generating capacity means there is little incentive to add new generating capacity, including renewables.

Although Country B declared a moratorium on new coal power plant build-out, the moratorium excludes plants in the development pipeline. As there are numerous coal power plants in development (adding to the existing coal fleet in the near term), the oversupply issue may be exacerbated. Thus, when considering the use of auctions to decommission coal power in Country B, it is important to carefully consider how such auctions would aid in the coal-to-clean transition rather than correct oversupply issues that may not help reduce emissions.

Implications for Auction Deployment: Country B

In this section, the authors use the criteria outlined in Section III to help assess the approach toward auction design in Country B to advance coal power plant decommissioning.

ASSESSMENT OF POTENTIAL BARRIERS TO USE AUCTIONS

Although Country B is in a relatively good position to transition from coal in the near term, there are some important challenges to deploying auctions for coal power plant decommissioning:

• Long-term contracts
  – Dominance of long-term PPAs—In Country B, a large portion of the electricity is state-owned and the remainder is produced by private generators contracting with the state-owned utility through long-term PPAs.
  – Dominance of long-term FSAs—FSAs between coal mines and coal power plants make the transition challenging, given that the plants are “locked” into buying coal until the FSA expires.

As has previously been explained, long-term contracts are a barrier to exit and may discourage coal power plant decommissioning. If coal power plants are the bidders in an auction, the auction product must present benefits greater than the costs of unwinding long-term contracts (if this is possible). The parties involved in such long-term contracts may be open to negotiating an amendment if the parties can share the benefits of the decommissioning package at auction.

• Dominance of state-owned entity—The participation of a state-owned entity in an auction usually requires additional governmental authorization absent in most private transactions. This does not mean an auction cannot be conducted with state-owned entities as bidders. However, Country B presents two complexities: (1) Country B’s state-owned entity is the largest coal power plant owner, holding over half of the coal power generating capacity, and (2) the state-owned entity is also the single buyer having long-term contracts with the remaining generating assets. An auction involving the state-owned
entity as a bidder clearly presents several issues that need to be addressed, including the state-owned entity’s market dominance and its influence over the decisions of IPP plants participating in the auction, given these other bidders need to renegotiate the terms of the PPA with the state-owned entity before they can determine their participation at the auction. In summary, the state-owned entity should not be expected to compete in the auction with other bidders unless these complexities are addressed.

- **No coal phaseout mandate**—Similar to Country A, Country B has no legislative or executive mandate on when coal power must be phased out. Country B has set a national emissions reductions commitment, but the commitment is not in line with a 1.5°C pathway. While this is not a barrier for participating in auctions, it does represent the lack of a strong incentive for plant owners to participate in the auction (see framework).

- **Coal subsidies**—Country B subsidizes coal production and coal power generation through below-market FSAs and below-market electricity prices. Such subsidies may help decelerate the coal-to-clean transition. As stated above, while new renewable energy is expected to become cheaper than existing coal in the next five years, eliminating these subsidies will likely accelerate the speed and expand the scope of the coal-to-clean transition.

- **Nascent clean energy ecosystem**—The financial challenges and limited access to private investment that Country B’s state-owned entity and sector face have made it highly challenging to build new clean energy projects. Moreover, the development of large-scale renewables is a capital-intensive exercise and the limited access to private investments in Country B does not aid the development of renewables in the country. This has contributed to the nascent nature of Country B’s clean energy ecosystem and the limited pipeline of clean energy projects. It is the authors’ understanding that renewables will be more economic than coal in the near future, and the economics and business case for renewables in Country B will be strong. However, the lack of a robust clean energy ecosystem and required infrastructure will complicate a smooth transition to clean alternatives.

**ASSESSMENT OF ENABLING FACTORS TO USE AUCTIONS**

- **Political support**—There is generally good international and diplomatic momentum to support Country B’s coal transition, and this may come with financial support in the form of aid packages.

- **Financial health of state-owned entity**—The dominance of the state-owned entity in Country B is different from that in Country A. Country B’s sector is dominated by a state-owned, vertically integrated utility that controls all transmission and distribution, all retail sales to end customers, and a large portion of generation. Private generators contracting with the state-owned utility through long-term PPAs account for the remaining generation. Such a power sector structure creates a challenge for an auction. While involving the coal power plants owned by the state-owned entity in an auction can be complicated, there may be a potential opportunity to have private owners of coal power plants participate in an auction for early decommissioning. Given that Country B’s state-owned entity is under significant financial strain and needs to be heavily subsidized to remain solvent, PPAs may be uneconomic to maintain. It may be in the interest
of both counterparties to the PPA to unwind the PPA if both parties share the benefits of the decommissioning package.

- Robust transmission network and no grid reliability issues—Country B’s transmission network is robust, and there are no grid reliability issues. Minimal grid upgrades are required to facilitate the adoption of clean supply alternatives.

- Power generation economics—New clean energy (with four hours of storage) is expected to be more economic than existing coal generation in Country B in the near term. Currently, the state-owned utility is financially strained and likely losing money in operating its coal power plants. If the economics are in favor of clean energy, the state-owned utility will have an incentive to unwind its long-term contracts with coal early and pivot to clean alternatives. An attractive package will be needed for the owners of IPP coal power plants to agree with the revised terms of the long-term contract.

Conclusions: Country B

Country B faces a greater set of barriers in its coal-to-clean transition and in deploying auctions to support it. On the transition, the country has high costs of project financing, a heavily indebted and dominant state-owned utility, a nascent clean energy ecosystem, and a generation oversupply. Decommissioning can only lead to a meaningful emissions reductions in Country B if the generation mix increases in favor of clean alternatives. In Country B’s case, it may be challenging to accelerate the uptake of renewables in an environment where there is oversupply of generating capacity.

In using auctions to support the transition, Country B faces challenges due to the lack of a coal phaseout mandate and the existence of PPAs and FSAs, which is compounded by the fact that such PPAs and FSAs are with the state-owned entity that owns a large portion of the generation. As explained above, involving the state-owned entity as a bidder may be complicated, but privately held coal power plant owners can participate in an auction for early decommissioning. When considering the use of auctions to decommission coal power in Country B, it is important to carefully consider how such auctions would aid the coal-to-clean transition rather than correct oversupply issues that may not help reduce emissions.

Country C Deep Dive

Like Countries A and B, Country C’s economy has also grown rapidly over the past decade—growth that has been partly supported by a significant expansion of electricity supply. In some ways, Country C would seem better positioned for a near-term coal-to-clean transition than Country B. Coal power plays a much smaller role in its electricity sector, its fleet is young but older than that in Country A or B, and it has a robust clean energy ecosystem. As a result, it has power generation economics that are favorable for a clean energy transition.
However, the countervailing forces in Country C are strong and have driven down the likelihood of a near-term transition. This is because government policy heavily favors increases in coal production and generation, and the country’s investment and financing environment is quite challenging due to broader macroeconomic issues.

**Coal fleet and power system context**

Coal powers over a third of Country C’s electricity sector—a share that was slowly declining but grew in the past five years. Country C has fewer coal power plant owners (~25) than either Country A or B, but this is likely a function of its electricity sector being smaller by an order of magnitude. Furthermore, Country C’s coal power plant ownership is the most diffused of all three countries—the largest owner owns only 15% of all coal power plants (see Exhibit 4.4 below compared with Exhibits 4.1 and 4.3 above). The country’s coal fleet, while young, is the oldest of the three countries with an average age of 20 years.

While Country C’s share of coal generation increased in recent years, so has its build-out of renewable energy. The country recorded a surge in new wind and solar farms coming online, which supported rapid growth in the country’s electricity demand.

Finally, Country C’s reserve margins—which were dangerously low a decade ago—have risen rapidly since then and are now comfortably above the levels needed to ensure resource adequacy. The country is not challenged by significant transmission constraints or grid reliability issues.

**EXHIBIT 4.4**
Distribution of coal power plant ownership, Country C
REGULATORY, POLICY, AND MARKET CONTEXT

Like Countries A and B, Country C also set a national commitment to reduce emissions, although it falls woefully short of a 1.5°C-aligned pathway.

In fact, not only is the commitment lacking in ambition, but also the current government policies would increase emissions, coal production, and coal generation. The government adopted this policy direction to boost energy security—Country C spends billions of dollars importing coal, which has significantly increased in the past year with the increase in electricity demand.

This support for more coal mining and coal power is reflected not only in its plans to expand the coal fleet and domestic coal mining sector but also in subsidies. Country C provides fiscal support for coal mining, and its state-owned entities offer support in procuring primary materials and supplies for coal generation.

The government also established highly supportive policies for renewable energy in the past (including feed-in tariffs and renewables auctions), which have been instrumental in the significant build-out of wind and solar energy in Country C. These policies, however, are likely to expire soon.

Unlike Country B, Country C has a wholesale market, and its generation is dominated by private companies (despite the existence of state-owned enterprises). However, Country C bears resemblances to Countries A and B in another aspect—its coal mining sector is quite consolidated and tightly controlled by a small set of state-owned enterprises.

Finally, while the presence of long-term PPAs and FSAs is likely in the country’s power sector, it is difficult to understand their extent, because Country C is more opaque than Countries A and B (at least as it relates to electricity sector dynamics).

ECONOMIC AND FINANCIAL CONTEXT

Partly due to the government’s supportive renewable energy policies, Country C has a strong track record in renewable energy development and a robust ecosystem to support it. As a result, new clean energy in Country C is already more competitive than existing coal power, which should spur further project development.

However, Country C faces significant challenges in its economy. Due to substantial currency devaluation, the country is grappling with extremely high inflation and high interest rates (for example, Country C’s 10-year government bonds are seeing yields of over 22%). Experts believe the country’s historical renewable energy growth could have been significantly greater had it not been for these headwinds. Thus, the broad macroeconomic context paired with the likely expiration of renewable energy subsidies will surely pose major challenges in sourcing and securing the low-cost financing needed for the country’s transition.

SOCIAL CONTEXT

As with Countries A and B, coal-related activities are minor contributors to national economic output. Information about the dependence of specific regions on coal for tax
revenues and employment is difficult to find for Country C. However, given the often remote locations of coal mines, coal-heavy localities in the country likely rely to a significant extent on the revenues and job opportunities in the coal mining sector.

COAL-TO-CLEAN TRANSITION

Given the above context and the power sector characteristics conducive to a transition laid out in Section II, the authors believe a near-term coal-to-clean transition is unlikely in Country C. The government’s current policy direction and the country’s dire financing environment make a transition challenging in the near term. However, changes and/or improvements to both factors could tip the future of the transition in Country C.

Implications for Auction Deployment: Country C

In this section, the authors use the criteria outlined in Section III to help assess the approach toward auction design in Country C to advance coal power plant decommissioning.

Although a near-term coal-to-clean transition has been determined to be unlikely, the authors study the barriers and enabling drivers, as was done for Countries A and B. These barriers and enabling drivers would play a role if the factors that currently disfavor a near-term transition were to shift.

ASSESSMENT OF POTENTIAL BARRIERS TO USE AUCTIONS

Country C faces the following key challenges in the near-term transition from coal:

• Lack of government support to transition away from coal—As noted above, Country C has a national commitment to reduce emissions that falls woefully short of a 1.5°C-aligned pathway, and its government policy heavily favors increase in coal production and generation. This is one of the two primary factors that impede a transition to phase out coal generation in Country C. Any coal-to-clean transition will likely not involve meaningful government support. The authors note, however, that a change in political priorities could quickly pivot the direction of the transition.

• Financing and macroeconomic issues—Country C suffers from currency devaluation, extremely high inflation, and elevated interest rates. These macroeconomic factors contribute to difficulties in sourcing and securing the low-cost financing needed for the country’s transition. Although the renewables ecosystem is robust due to government subsidies and feed-in-tariffs, such policies are set to expire soon. Improvements in the financing conditions and macroeconomic factors would help accelerate the adoption of renewables required for the transition.

ASSESSMENT OF ENABLING FACTORS TO USE AUCTIONS, COUNTRY C

• Ownership and competition—For Country C, there appears to be sufficient diffusion of plant ownership for auctions to be effective. A critical next step is to explore the affiliations and associations that coal power plant owners may be a part of to confirm if these owners operate independently or are influenced by other incentives.
• No grid reliability issues—Country C’s strong reserve margins and lack of significant transmission constraints allow for a smooth transition away from coal and would facilitate the use of auctions in coal power plant decommissioning.

• Power sector economics—Unlike Country B, the power sector is not dominated by a state-owned utility. Country C has a wholesale market, and its generation is dominated by private companies. As noted above, new clean energy in Country C is already more competitive than existing coal power, which should incentivize early coal power plant transition. An auction focused on accelerated decommissioning should ascertain if there are other barriers to exit in Country C, such as the prevalence of long-term contracts.

Conclusions: Country C

Country C’s efforts to diversify its power sector through the continued support for renewables and coal power (and the mining sector) is clear. Although there is strong political support for coal, notably, such policies are dependent on the current administration and may change in the future. Country C presents highly favorable conditions, including the diffused ownership structure and a developed renewables ecosystem, which would enable the coal-to-clean transition once the two main barriers, as described above, are dealt with.

Reflections on Case Studies

As a country explores whether the coal transition is likely in the short term and the role that auctions could play in accelerating such transition, the country must understand the differences between first-order questions (i.e., questions that speak to the coal-to-clean transition) and second-order questions (i.e., questions that speak to the enabling factors and barriers to using auctions). As the above case studies show, it is difficult to place countries into discrete categories. Rather, most countries will sit in a spectrum—some factors enable the use of auctions to help decommission plants, while other factors will be considered barriers to the use of auctions. The country may need to address issues related to the coal-to-clean transition (i.e., lack of policy support for coal power plant decommissioning) before it attempts to hold an auction.

These case studies reference auctions held in a country-specific context for simplicity and to illustrate certain key concepts. A multi-country regional auction may attract more participation and be more effective.

The following section highlights additional items to consider if auctions are to be used in the coal-to-clean transition.
FIVE NEXT STEPS AND HIGH-LEVEL RECOMMENDATIONS
In designing the auction process, it is of utmost importance that stakeholders clearly identify the issue (or issues) to be addressed to ensure an appropriate set of incentives are created and the auction parameters and program requirements are calibrated to achieve those outcomes.

This section introduces items related to auction design and auction process implementation as the next steps for further evaluation. While the list of items discussed in this section is not exhaustive, the authors attempt to identify the most critical factors to inform national governments and other organizations as they explore auctions to achieve rapid decarbonization.

Additional Auction Design and Implementation Considerations

Once the auction is determined to be viable and the auction product is designed, other determinations must be made regarding the auction. The following list is non-exhaustive but includes key characteristics of the auction that must be addressed.

• **Auction format.** There exist various auction formats, including requests for proposals (RFPs), sealed-bid auctions, multiple-round auctions, and combinatorial auctions. In a forward auction, bidders compete with each other to buy the product, often driving up the price of purchase. In a reverse auction, the buyer either pays the lowest possible amount for a given quantity of product or obtains the highest quantity of product using a fixed expenditure. The larger regulatory environment and market rules, maturity of the market, and expected bidder pool should be considered when deciding on the auction format. These design decisions also consider whether settlement with winning bidders should feature a uniform price or be on a pay-as-bid basis.

• **Auction parameters.** Parameters that suit the bid product and auction format must be set in the development of an auction process. For example, in a clock auction, the following parameters must be set:
  – Starting prices of the auction
  – Price decrements or increments
  – Length of rounds
  – Auction volume or target quantities
  – Reservation prices, ceilings, or floors

The setting of auction parameters requires an understanding of the market conditions and economics surrounding the bid product. In this context, an understanding of the market players, anticipated demand, and expected value for the auction product would inform the
auctioneer about the appropriate price to start the auction and the target quantity for the auction. If these parameters are not set appropriately, the outcome can be adverse and the results may not be competitive.

- **Auction protocols and procedures.** Auction processes in various regions of the world and for a wide range of auction products are monitored by government regulatory staff to ensure the process is in accord with approved plans and compliant with government regulations. Thus, sensitive and extreme precautions should be taken to develop and implement protocols and procedures to ensure the conduct of the competitive bidding process is fair and transparent and complies with legislation and regulations. Auction-related documents, manuals, and protocols should be in place.

- **Communication with bidders.** An auction may not be successful if bidders are not informed of the opportunity or do not understand the auction rules and requirements. Thus, it is important to promote the opportunity, communicate the relevant information clearly, and allow sufficient lead time for potential bidders to understand the opportunity, seek the necessary approvals, and prepare for participation in the auction.

- **Auction rules and documents.** Various documents, including auction rules, the standard contract to be signed by winning bidders, and explanatory documents on participation requirements for the auction, must be developed. The auction process may include opportunities for interested stakeholders to provide comments on draft documents and proposed requirements such that the final auction documents may incorporate suggestions from a wider range of market players. These stakeholder workshops and comment processes will allow the auctioneer to uncover potential barriers to participation in advance of the auction process.

- **Eligibility and qualification requirements.** The auction requires participation by qualified bidders. It is critical that the eligibility and qualification requirements are calibrated appropriately to ensure it focuses on requirements that can be met by the bidders and indicate their ability to perform and deliver on the obligations should they win. Such eligibility and qualification requirements should be precise enough to limit participation to targeted players. The eligibility and qualification requirements work together with product differentiation considerations discussed above to ensure alignment of the auction product with the targeted players.

- **Cost to participate and auction budget size.** In general, there is a cost to preparing a bid and participating in an auction. It is essential to ensure the costs of participation do not outweigh the potential benefits of winning. In addition, the auction budget size must be calibrated carefully and be large enough to be attractive.

- **Other statutory or legal requirements.** The auctioneer must consider any statutory or legal requirements applicable in the host country. For example, tender and procurement laws are quite common in some regions of the world. While developing the auction, it is important to ascertain if the auction framework is subject to these legal or statutory requirements. If so, the auction rules will need to be developed consistent with such requirements.
• **Existing monitoring and verification systems.** If a country considers holding an auction featuring a pay-for-performance product, it would be important for the country to monitor and verify the systems’ performance. In this regard, it would be beneficial to leverage an existing infrastructure or framework such as the Gold Standard or Verified Carbon Standard (VCS) for carbon offsets or a REC registry for renewable energy credits.

Concluding Remarks and Next Steps

Coal power plant decommissioning is part of a multifaceted exercise in which an auction can play a pivotal supporting role. The auction process, including the development of the requirements and material obligations, requires a high degree of standardization. If it is designed well, it could allow for the coal transition mechanism to be allocated efficiently and transparently on a least-cost basis.

This report introduces the topic of auctions for accelerating a global coal-to-clean transition and provides a framework for stakeholders to assess the role auctions could play in stepping up coal power plant decommissioning. However, significant follow-up research, analysis, engagement, and implementation efforts are needed to better understand auction applicability and efficacy in specific contexts.

In particular, deeper research into specific countries or regions is warranted. It is important to understand if and how auctions could support the transition, how they could be designed and financed, and what trade-offs are associated with the various options. Such research should then be shared with relevant in-country decision makers, and the possibility of a pilot should be examined.
Endnotes

31. “About the PAF”, Pilot Auction Facility, https://www.pilotauctionfacility.org/content/about-paf
i. The SDGs are a collection of 17 interlinked global goals set up by the United Nations General Assembly as a blueprint to achieve a better and more sustainable future for all by 2030.

ii. CTMs are financial mechanisms that highlight the role of finance in accelerating a global coal-to-clean transition. They encompass a wide spectrum of instruments – debt, equity, blended – and can be designed and deployed by private and public stakeholders.

iii. Transition finance in this report is defined as financial support that enables the transition of companies and assets from high-carbon to low- or zero-carbon.

iv. This analysis is from RMI’s How to Retire Early report in 2020. The analysis was marginal in nature, i.e., it represents the percentage of coal power plants that could be individually replaced on the margin by renewables and four hours of storage. It does not represent the costs of simultaneously replacing that percentage of coal power as a collective. Furthermore, since the referenced report was published in 2020, lithium-ion costs have seen significant increases due to supply chain constraints, which are likely to last for the next few years. While the broader trends signify that there are substantial savings to be gained from the coal-to-clean transition, the likelihood or degree of savings in the very near future may be a challenge.

v. This estimate of net benefits from RMI’s How to Retire Early report accounts for implemented carbon pricing schemes but does not factor in the unpriced health or environmental costs of coal.

vi. The PPCA Finance Principles represent a clear and comprehensive statement of how to fully align coal power-related financial services and investments with the goals of the Paris Agreement.

vii. Climate finance refers to financing from a variety of sources (public, private, local, transnational) supporting climate mitigation and adaptation efforts. While this report focuses on the importance and scarcity of public financing as one reason to consider auctions, auctions may bear relevance for a broader set of climate finance efforts (including those that involve the private sector).


ix. In some cases, the electricity and RECs are bundled.

x. Reserve margins are calculated as a ratio of the difference between installed capacity and peak demand to peak demand. They measure the amount of generation capacity available to meet the expected peak demand in a particular period.

xi. Onshore wind or solar PV with four-hour battery storage sized to 50% of the renewable generation capacity replaces coal in most instances and is thus used as a cost proxy. Although this assumption is simplistic – and a mix of resources, including long-duration storage, are likely required to replace all coal, particularly as renewables shares increase – four-hour storage is a reasonable replacement for most existing coal power plants. Separately, the long-run marginal cost of coal generation includes short-term marginal costs, fixed O&M costs, and environmental remediation. This number does not include the costs of coal power plant decommissioning.

xii. Coal power plant owners may not be the only potential bidders in an auction for coal power plant closures, and other entities could be potential bidders depending on the design elements of the auction. In this report, the authors assume coal power plant owners are the bidders for illustrative purposes and discussion of the concepts.
xiii. The example in this paragraph references an auction held in a country-specific context. It may be possible to hold a multicity regional auction or one that is specific to a region within a country.

xiv. For example, according to the US Energy Information Administration (EIA), coal is expected to account for 85% of US electric generation capacity retirements in 2022 due to increasing competition from renewable energy and natural gas.

xv. For example, the auctions for coal power plant closures in Germany differentiate between large lignite power plants and hard coal power plants, and the large lignite power plants are ineligible to participate in the auctions. See below for more information on the auctions for hard coal power plants in Germany.

xvi. Existing monitoring and verification systems will also influence the auction product and how performance is measured.

xvii. This section studies the attractiveness of the auction product through the lens of coal power plant owners as the potential bidders. For purposes of illustration and discussion of the concepts in this report, the authors assume the auction product features a compensation payment to such plant owners for early coal power plant decommissioning. The report acknowledges a compensation payment is not the only way to structure an auction product. The compensation payment mechanism has been successfully employed in the German context and provides a starting point to talk about the potential role of auctions.

xviii. This report does not determine the minimum number of coal power plant owners that would be acceptable to hold an auction; such determination may depend on several factors, including the affiliation and ownership concentration of the bidder pool.

xix. As discussed in Section III, the possibility of using auctions for coal power plant decommissioning is predicated on the likelihood of near-term coal-to-clean transition. In Country C, the near-term coal-to-clean transition is currently unlikely. Thus, while Country C's power sector presents favorable conditions to utilize auctions, such auctions may not be viable at this time. Country C's case study will explore this in further detail.