ROCKY MOUNTAIN INSTITUTE

MANAGING THE COAL CAPITAL TRANSITION

COLLABORATIVE OPPORTUNITIES FOR ASSET OWNERS, POLICYMAKERS, AND ENVIRONMENTAL ADVOCATES

BY ANNIE BENN, PAUL BODNAR, JAMES MITCHELL, AND JEFF WALLER

AUTHORS & ACKNOWLEDGMENTS

AUTHORS
Annie Benn, Paul Bodnar, James Mitchell, and Jeff Waller

**Authors listed alphabetically. All authors from Rocky Mountain Institute unless otherwise noted.*

CONTACTS
James Mitchell, **jmitchell@rmi.org**
Jeff Waller, **jwaller@rmi.org**

SUGGESTED CITATION
Benn, Annie, Paul Bodnar, James Mitchell, and Jeff Waller. *Managing the Coal Capital Transition: Collaborative Opportunities for Asset Owners, Policymakers, and Environmental Advocates*. Rocky Mountain Institute, 2018., **http://www.rmi.org/insight/managing-coal-capital-transition/**

EDITORIAL/DESIGN
Editorial Director: Cindie Baker
Editor: Laurie Guevara-Stone
Creative Director: Romy Purshouse
Designer: Kaitlin Wutschel

Images courtesy of iStock unless otherwise noted.

Cover image: Battersea Power Station courtesy Loco Steve via Flickr

ACKNOWLEDGMENTS
The authors would like to thank the nearly 50 individuals from the following organizations, among others, who contributed time and expertise to this research through interviews and support: Government of Alberta, Asia Research and Engagement, Bloomberg New Energy Finance, Carbon Tracker, Climate Analytics, State Government of Colorado, Climate Policy Initiative, Center for Strategic and International Studies, E3G, Europe Beyond Coal, European Climate Foundation, Greenpeace, Institute for Energy Economics and Financial Analysis, Moody's, Natural Resources Defense Council, Oxford Smith School, Regulatory Assistance Project, Sandbag, Sierra Club, Solutions for Our Climate (Korea), USAID, Western Resource Advocates, World Wildlife Fund, as well as additional government and utility representatives that requested anonymity.

ABOUT US

ABOUT ROCKY MOUNTAIN INSTITUTE

Rocky Mountain Institute (RMI)—an independent nonprofit founded in 1982—transforms global energy use to create a clean, prosperous, and secure low-carbon future. It engages businesses, communities, institutions, and entrepreneurs to accelerate the adoption of market-based solutions that cost-effectively shift from fossil fuels to efficiency and renewables. RMI has offices in Basalt and Boulder, Colorado; New York City; Washington, D.C.; and Beijing.

ABOUT RMI'S GLOBAL CLIMATE FINANCE PROGRAM

RMI established a Global Climate Finance program in 2017 in recognition that the mobilization and smart allocation of finance is a critical enabler of the low-carbon transition globally. This program builds on RMI's legacy of working closely with disruptors, incumbents, and policy-makers to forge business-led, market-based solutions to clean energy and climate change. We work to boost climate finance flows into developing countries through concrete initiatives, including by enhancing national capacity and deploying innovative financial instruments at the intersection of public and private finance. In advanced economies, our focus is on accelerating the retirement of fossil energy capital stock by managing the capital transition and avoiding stranded assets.

Navajo Generating Station, Page, Arizona

“This is the first global survey of approaches that can help ease capital destruction for asset owners and their shareholders while offering policymakers a clearer path toward accelerating the energy transition.”

—Paul Bodnar, Managing Director at Rocky Mountain Institute.

TABLE OF CONTENTS

01 EXECUTIVE SUMMARY

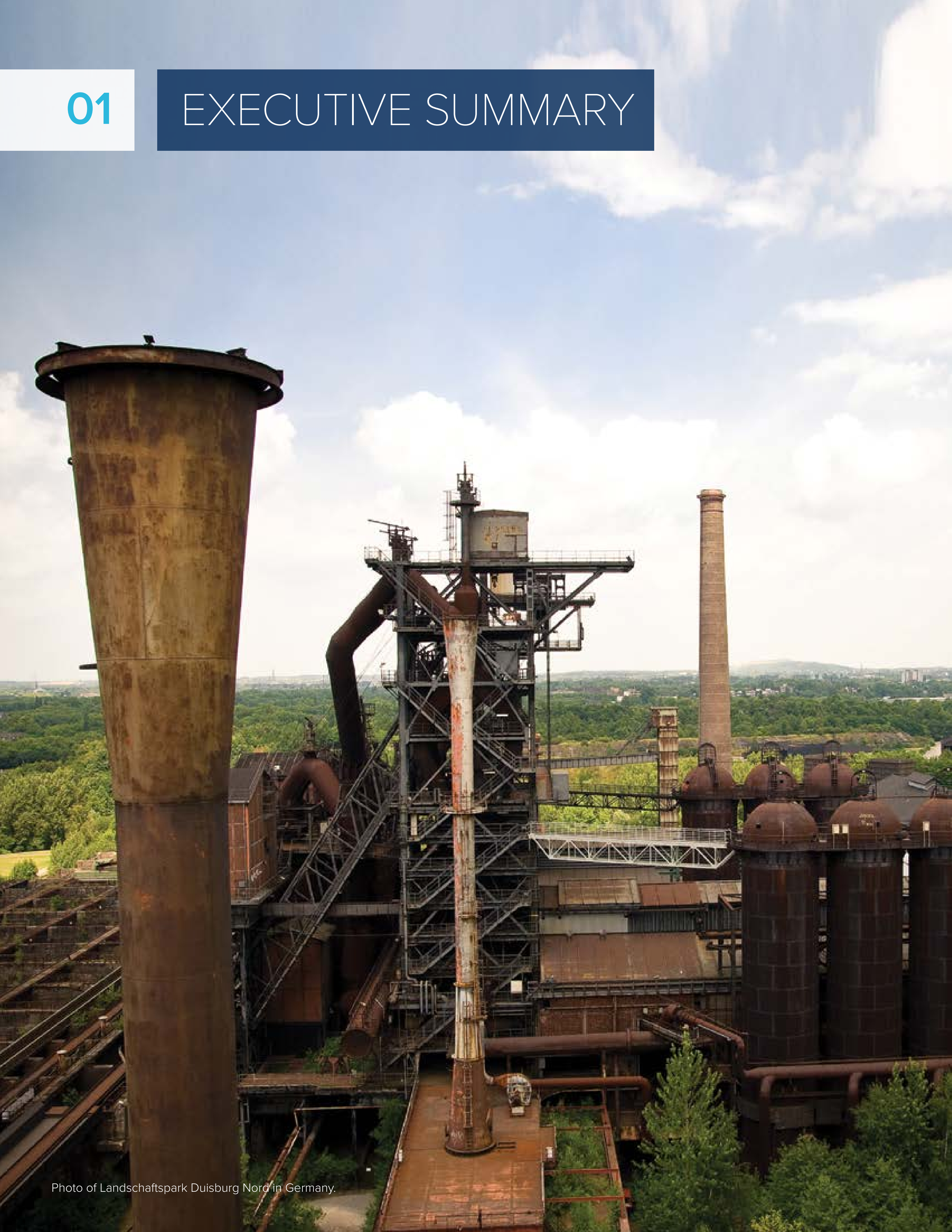


Photo of Landschaftspark Duisburg Nord in Germany.

EXECUTIVE SUMMARY

Coal was the preeminent fuel for grid-based electricity generation around the world for the better part of a century, but its time is coming to an end. With this transition, however, workers and communities are experiencing layoffs and the owners of coal-fired power plants are bracing themselves for hundreds of billions in write-offs. This report intends to start pragmatic conversations on the coal capital transition: the collaborative management of capital exit from coal-fired generating assets in line with their decreasing economic competitiveness compared to clean energy, and in line with the objective of limiting global warming to well below 2C°.[i]

The early retirement of coal plants across the world has enormous financial implications for asset owners, policymakers, and environmental advocates alike. Managing the exit of capital from coal-fired generating assets demands thoughtful and collaborative planning among these stakeholders.

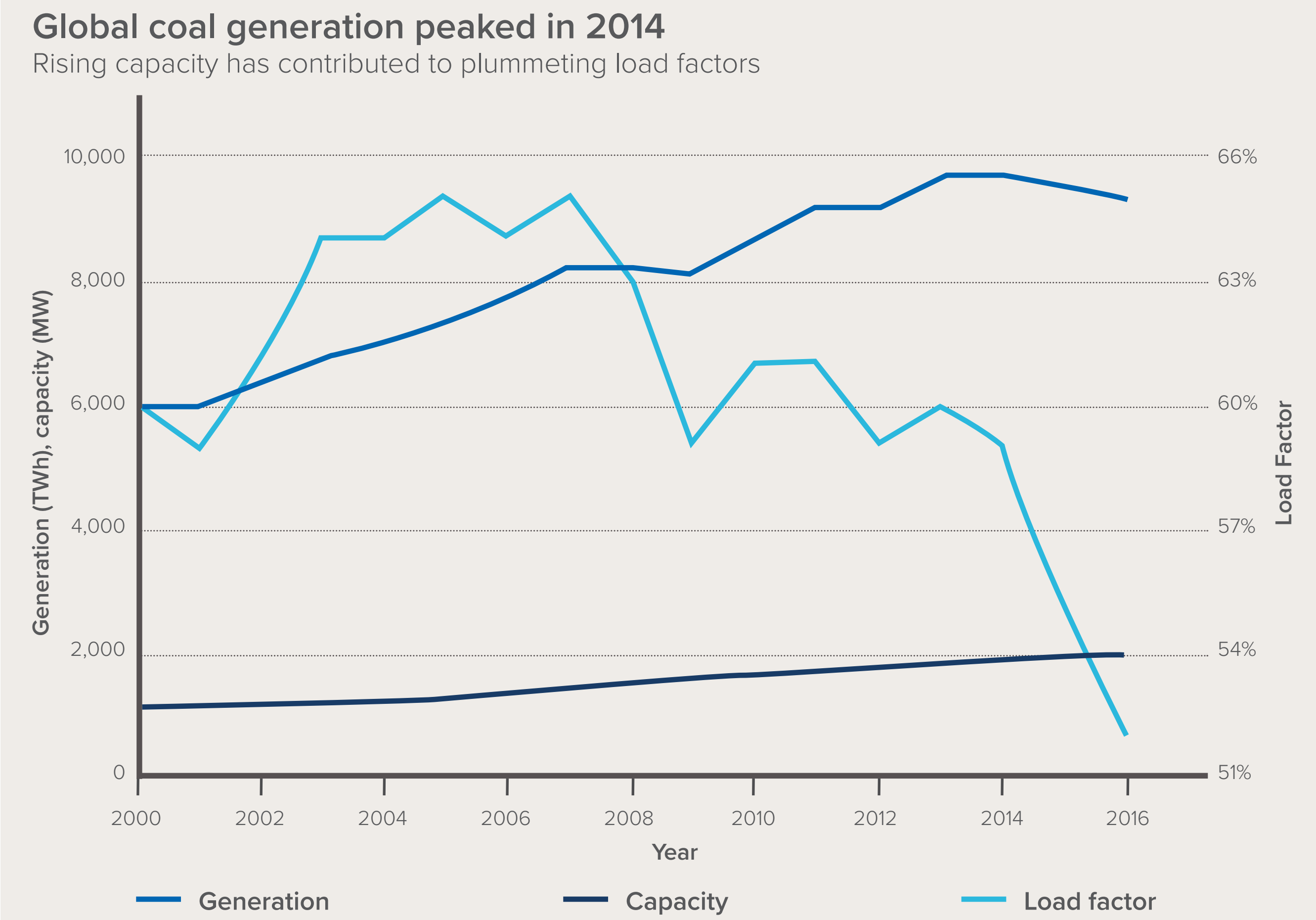
Coal-fired power generation is in structural decline, and its role the global energy mix will continue to diminish due primarily to economics. This erosion is structural, not cyclical, and is driven predominantly by cheap gas, inexpensive renewables, and the costs associated with complying with environmental regulations that seek to reduce air pollution and address climate change.

Photo courtesy Al Braden for the Sierra Club. Sandow Coal Plant in Rockdale, Texas, which closed in 2018.

[i] While most people are familiar with the expression “degrees Celsius” (ºC), that expression signifies an absolute temperature that represents the coolness or warmth of something. The expression “Celsius degrees” (Cº) refers to an interval between two measured temperatures, which in this paper denotes temperature rise above preindustrial levels.

FIGURE ES1

TRENDS IN GLOBAL COAL-FIRED POWER GENERATION



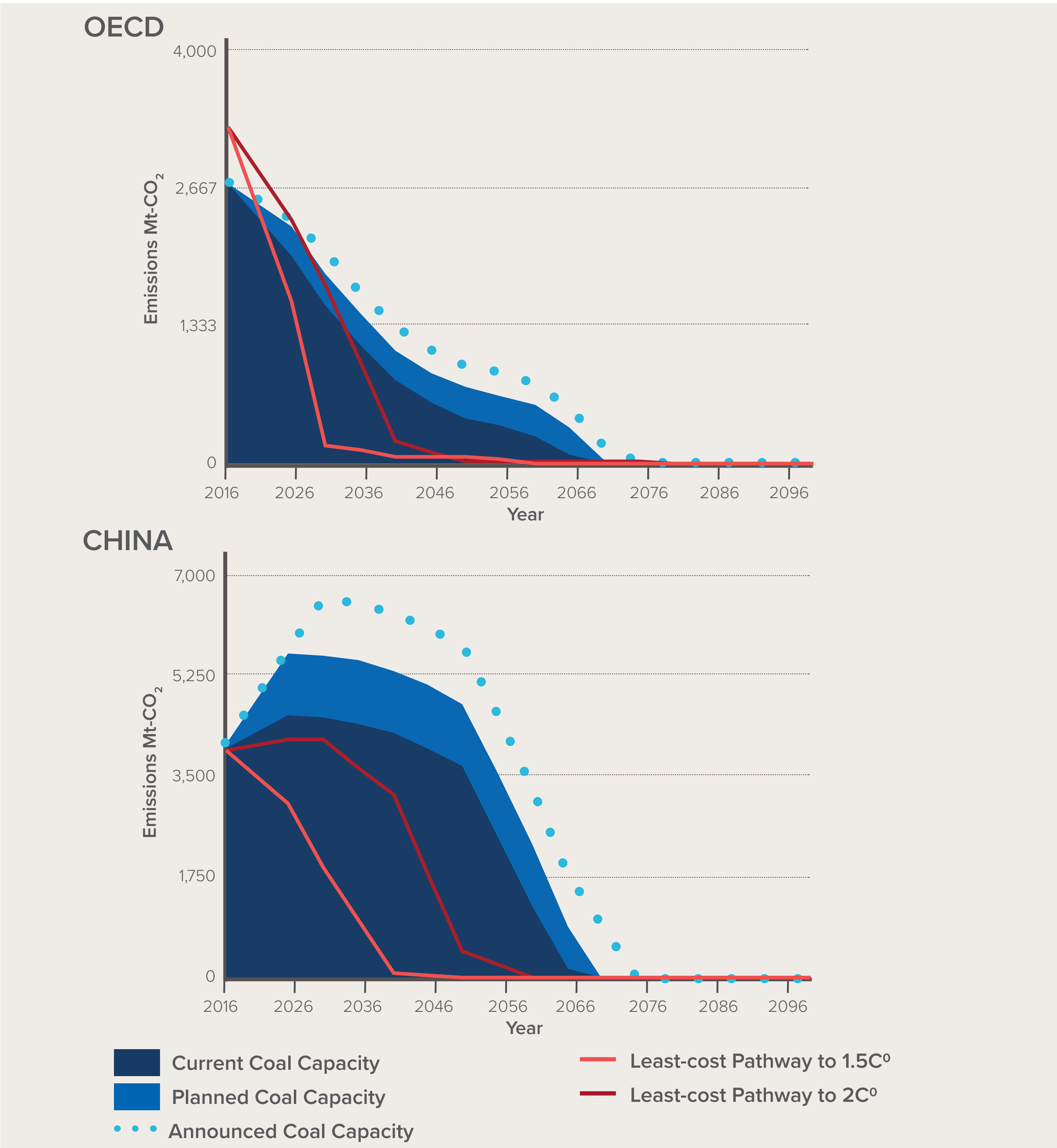
Source: Carbon Brief analysis

The clear downward trend for coal power increases the likelihood of widespread stranded assets and capital destruction. Coal-fired power plants around the world that were designed to operate for decades longer are under pressure to shut, in many cases before associated debt has been paid off. Whether these assets are stranded because of changing economics or regulations (or a combination of the two), coal plants worldwide are at high risk for creating **stranded value** for owners—that is, the assets' actual financial returns will be less than what had been expected at the time of initial investment.

While economic trends are slowing the growth of coal capacity and leading to a significant amount of uncompetitive coal-fired capacity to shutter, **these trends alone will not be sufficient to reduce global greenhouse gas emissions consistent with the Paris Agreement objective of holding warming well below 2 C°.** Leaving aside planned or announced coal plants not yet online, emissions from the existing coal power plant fleet alone exceed levels consistent with globally agreed temperature goals.

FIGURE ES2

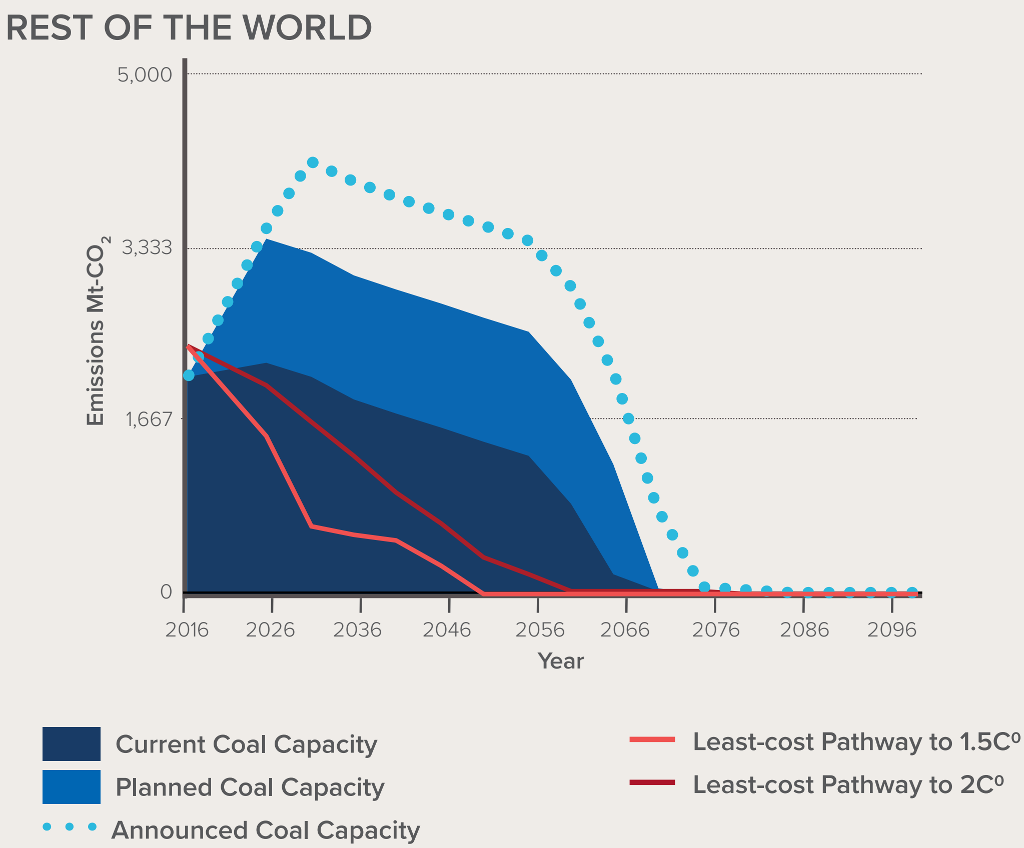
POTENTIAL CO_2 EMISSIONS FROM EXISTING AND PLANNED COAL CAPACITY AGAINST LEAST-COST PATHWAYS



(Figure ES2 continued on next page)

FIGURE ES2

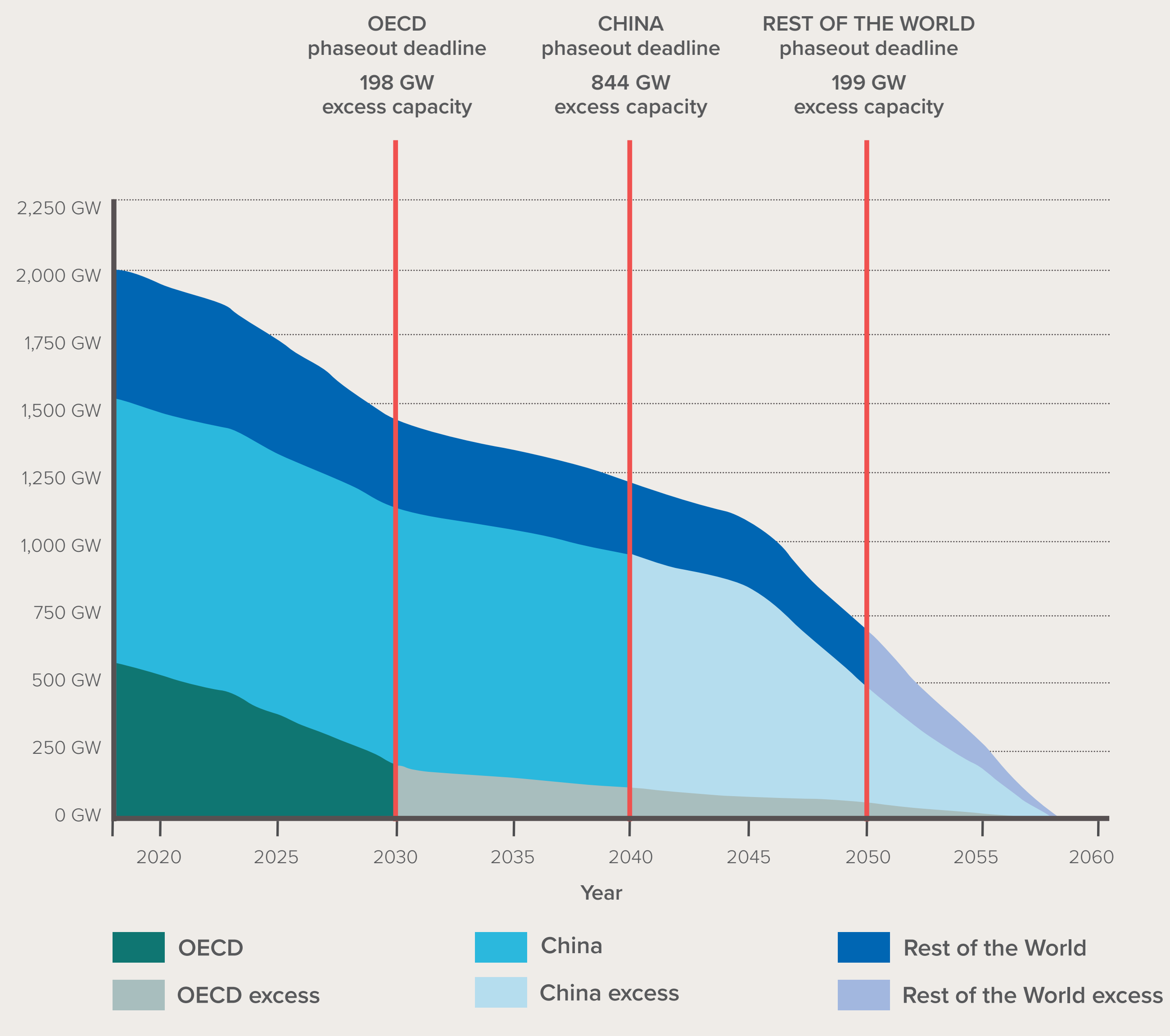
POTENTIAL CO_2 EMISSIONS FROM EXISTING AND PLANNED COAL CAPACITY AGAINST LEAST-COST PATHWAYS



Source: Analysis by Climate Analytics of least-cost pathways for regional coal phaseout

FIGURE ES3

NATURAL RETIREMENT OF CURRENT COAL CAPACITY ON STATED RETIREMENT DATE VS. LEAST-COST PHASE OUT BY REGION SHOWS NECESSARY PREMATURE RETIREMENT



Source: CoalSwarm analysis using the CoalSwarm Global Coal Plant Tracker data

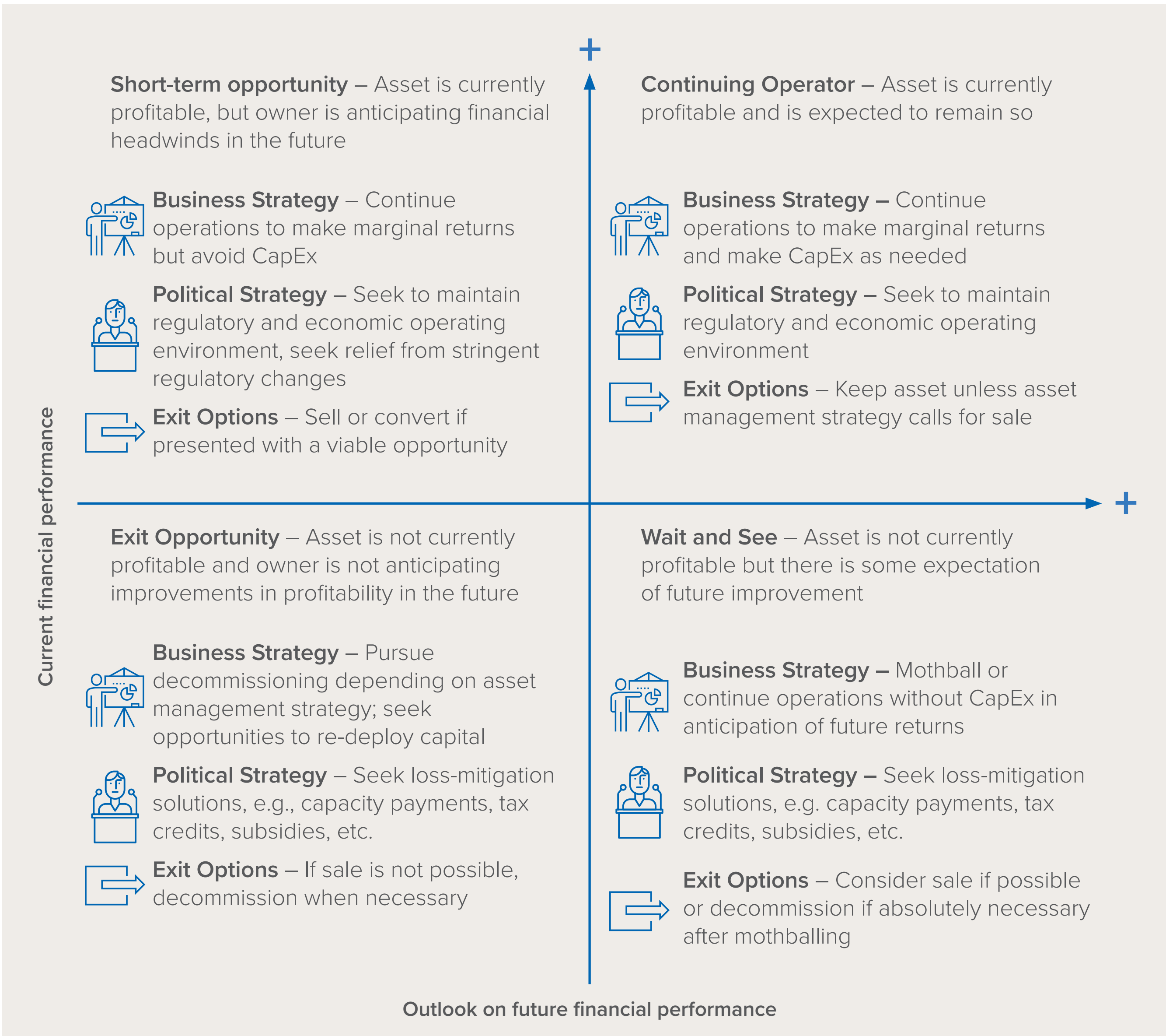
Under least-cost pathways for holding warming **well below 2Cº**, coal closures would need to begin immediately across all regions and be completed by roughly 2030 for Organisation for Economic Co-operation and Development (OECD)/European Union (EU), 2040 for China, and 2050 for the rest of the world. Based on the actual technical lifetimes of the existing coal fleet, **significant early retirement of current capacity would be necessary, including** 198 GW in the OECD, 844 GW in China, and 199 GW in the rest of the world. This holds the potential to strand hundreds of billions of dollars of value globally.

The specter of capital losses fuels opposition to policies aimed at accelerating the energy transition. From the perspective of asset owners, lobbying against climate and clean energy policy is an economically rational response to prospective stranding. As a result, the energy transition is happening in fits and starts. For their part, environmental advocates have focused on the adjustment costs for labor and communities associated with layoffs and the need for a just transition for labor. However, this problem-solving approach has only just begun to be applied to the prospect of write-offs. We recommend it be considered more consistently.

With a better understanding of an asset owner's legitimate day-to-day business perspective, policymakers and advocates can better appreciate how coal plant owners assess their plants' current and future financial performance. More importantly, a nuanced understanding of this financial perspective can help anticipate an owner's likely business strategies, political positions, and amenable exit options, positioning them well to engage directly with owners to proactively manage the coal capital transition. The Asset Position Framework does this by classifying assets into one of four positions based on their current and projected future financial performance: *continuing operator, short-term opportunity, exit opportunity,* and *wait and see.* An asset's position on the framework will determine an owner's likely business strategy with the asset, political strategies, and asset exit options.

FIGURE ES4

ASSET POSITION FRAMEWORK



For asset owners, proactive planning for the end of the coal era can preserve shareholder value and avoid financial shocks to equity and debt holders alike. Policymakers and advocates focused on climate objectives are seeking ways to accelerate the transition of energy sector capital stock from brown to green, including through early retirement of coal assets. But stranding these assets is not—and should not be—the goal; the loss of value associated with stranded assets is an undesirable consequence that, while to some extent inevitable, should be actively mitigated to ensure that all stakeholders are on board with the direction of the energy transition. Instead, policymakers have an opportunity to understand and implement a new toolkit to spur faster energy transition through dialogue rather than adversarial approaches. And environmental advocates can advance their objective of accelerating the clean energy transition and avoid costly and lengthy conflicts with incumbents. Regardless of the region or market circumstance, it is in the interest of owners, policymakers, ratepayers, and other stakeholders to develop a managed plan for capital transition that can reasonably limit losses and allocate them appropriately.

This report is the first global survey of approaches that can help ease capital destruction for asset owners and their shareholders while offering policymakers a clearer path toward transitioning the power sector onto a below-2C° pathway.

The following table describes the 10 policy components for managing the capital losses associated with early retirement of coal-fired generating assets. It also identifies the factors that influence the applicability of components and the potential challenges of including them in policy design.

TABLE ES1

10 POLICY COMPONENTS TO MANAGE THE COAL CAPITAL TRANSITION

POLICY COMPONENT	BEST APPLICABILITY	BEARER OF LOSSES (PROXIMATE)	DESCRIPTION	POTENTIAL CHALLENGES
Mandate Closure	Liberalized and state-managed markets	Asset Owner	Regulators set a date by which some/all coal-fired power must be decommissioned.	Impact investment climate
Full or Partial Disallowance	Regulated markets		Regulators determine that asset should be removed from the rate base and owner is no longer allowed to make a return on the asset.	Impact investment climate
Impose Costs	Liberalized and state-managed markets		Regulators change operating economics by increasing costs via carbon pricing or mandated pollution standards.	• Impact investment climate • Ratepayer pass-through
Remove Alternative Revenue Sources	Liberalized markets		Regulators change coal operating economics by removing ancillary revenues such as subsidies, capacity payments, or reserve payments.	Impact investment climate
Offset Losses	• All markets • Funds available • High policymaker capacity		Regulators allow owners to utilize non-coal-related funds to offset losses created by early closure of a plant, e.g., selling unused emissions allowances or monetizing carried-over tax credits.	Moral hazard
Create Regulatory Asset	• Regulated markets • Funds available • High policymaker capacity		Regulators allow cost recovery from rate base after asset retirement by utilities in regulated markets.	• Ratepayer pass-through • Moral hazard
"Soften the landing"	• All markets • Funds available		In combination with an approach that will force closure by a certain date, offer alternative revenue streams in the interim to maximize cost recovery before early closure.	• Ratepayer pass-through • Moral hazard
Accelerate Depreciation Schedule	All markets		Minimize write-offs at closure by accelerating depreciation before closure. Amount and type of recovery of incremental depreciation expense varies.	• Ratepayer pass-through (regulated markets) • Moral hazard
Take-over and Write-off	• Regulated or state-managed • Funds available		In state-managed markets, the government purchases the asset and writes off the debt. This requires that the government decommission, not mothball, the asset. Otherwise, a risk remains that the asset could be resold to a third party who then continues operation.	Moral hazard
Pay to Close	• All markets • Funds available	Government	Government offers direct compensation payments for closure, negotiated based on valuation of plant and whether full compensation will be paid.	Moral hazard

In considering these options, six factors stand out as especially important in shaping policy choice:

1. **Power market type.** Some policy options apply only to regulated markets.
2. **Policymaker capacity.** Some policies require significant decision-making authority on the part of policymakers, as well as technical and resource capacity for implementation.
3. **Bearer of losses.** Every approach improves the value proposition of asset retirement by either worsening the economics of continued plant operation or increasing the benefits of closure. This requires that capital losses are borne by some combination of government and/or asset owners.
4. **Ratepayer impact.** The application of some approaches may increase costs to ratepayers, which has important implications for policy design and implementation.
5. **Investment climate.** If policy actions are perceived as capricious or unwarranted, they can erode trust between regulators and business.
6. **Moral hazard.** Approaches where the government bears the losses—in the form of compensation to owners—typically carry a degree of risk of moral hazard.

COMBINING POLICY COMPONENTS

The 10 policy components for managing capital losses discussed above are presented individually to highlight the applicability and challenges of each. In practice, however, combining policy components provides flexibility both with the timing of policy implementation, as well as with the ability to allocate—or reallocate—losses across parties. For example, a comprehensive policy could include a future mandated coal phaseout date combined with components designed to alter the coal plants' operating economics. The aim of these components could be to encourage faster retirement (e.g., by including environmental regulations that impose escalating costs) or to provide increased interim compensation to allow coal plant owners to maximize the return on their investment prior to the phaseout date (e.g., by offering alternative revenue streams). Four case studies of coal closures in Alberta, Chile, China, and Colorado demonstrate that there are no one-size-fits-all solutions. Complete policy packages are built from the ground up using policy components fit to their specific context.

RECOMMENDATIONS

Managing the financial implications of stranded coal assets requires a balanced perspective that takes into account the perspectives of three major groups: coal plant asset owners, who stand to bear the burden of capital losses associated with premature closure of coal-fired generating assets; environmental advocates, who seek to accelerate coal phaseout in line with the objectives of the Paris Climate Agreement; and policymakers, who must balance the environmental necessity of accelerated coal plant retirement with thoughtful, managed allocation of the associated capital losses.

POLICYMAKERS

- **Understand the context.** The economics of operating coal plants vary by geography and by plant. Depending on the financial position of individual plants or portfolios, asset owners may be looking for, or be open to, an exit strategy.

- **Shift the conversation.** The challenge is to present an alternative economic equation to asset owners that is sufficiently attractive to encourage acceptance rather than resistance to the notion of early asset closure.

- **Know your options.** The 10 strategies presented in this report are grounded in a global survey of approaches that have been formulated in various jurisdictions to address this issue.

- **Customize.** There is no one-size-fits-all policy solution. Components can be combined to create a package tailored to the needs of all stakeholders involved. Depending on the chosen approaches, the question of policy institutions' technical and human capacity to design and implement the solution can be critical.

- **Build support.** Thoughtful, managed allocation of the associated capital losses through combinations of the strategies surveyed in this report—and others that have not yet been designed—can build support among key political constituencies. Key to productive dialogue is ensuring that outcomes are viewed as equitable among all stakeholders impacted by stranded assets.

- **Balance risk.** In formulating coal capital transition strategies, policymakers should carefully balance maintaining the credibility of the local investment climate with the serious issue of moral hazard.

ASSET OWNERS

- **Acknowledge trends.** It's time to acknowledge that coal-fired power generation is in structural decline worldwide. While there are and will continue to be exceptions, eroding economics and declining load factors globally demonstrate this clearly, regardless of one's view of the merits or durability of climate policy.

- **Recognize that the risk of stranded value is real.** While the decline of coal-fired power generation is at different stages in different geographies, some capital destruction associated with early closure due to both economic and regulatory stranding is inevitable.

- **Leverage the benefits of planning.** Proactive planning for the end of the coal era can preserve shareholder value and avoid financial shocks to equity and debt holders alike.

- **Understand what's feasible.** Asset owners should acknowledge that from a policymaker's perspective, they rarely have claim to compulsory compensation and that moral hazard is a real and legitimate concern. Still, policymakers also have a strong incentive for pragmatic dialogue.

- **Build on existing dialogues.** While they may feel frequently at odds with environmental advocates, coal asset owners should build on the principles for just transition of labor.

ENVIRONMENTAL ADVOCATES

- **Understand the owner's perspective.** To accomplish the early retirement of the coal fleet requires acknowledging that from an asset owner's perspective, opposing policies that would cause such financial hardship is economically rational.

- **Link to a "just transition."** If environmental advocates are serious about neutralizing political opposition to climate action, they need to look seriously at rational decisions motivating this opposition. Therefore, an integrated approach to addressing layoffs and write-offs associated with early coal plant retirement is essential.

- **Manage trade-offs.** Many of the solutions presented here come with difficult trade-offs, using funds that will undoubtedly be limited. Advocates must work alongside policymakers and asset owners to ensure that these trade-offs are being weighed appropriately. Once agreements are reached, advocates must enforce those agreements in the public sphere.

02 INTRODUCTION

INTRODUCTION

The intent of this report is to start pragmatic conversations on the coal capital transition: the collaborative management of capital exit from coal-fired generating assets in line with their decreasing economic competitiveness compared to clean energy, and in line with the objective of limiting global warming to well below 2Cº.[ii]

The early retirement of hundreds of billion dollars of capital stock globally is a structural shift with enormous—and divergent—implications for stakeholders. This report seeks to provide a balanced perspective on how to proceed and takes into account the perspectives of three major groups: *coal plant asset owners,* who stand to bear the burden of capital losses associated with premature closure of coal-fired generating assets; *environmental advocates,* who seek to accelerate coal phaseout in line with the objectives of the Paris Climate Agreement; and *policymakers,* who must balance the environmental necessity of accelerated coal plant retirement with thoughtful, managed allocation of the associated capital losses. We have done our utmost to capture the perspectives of these stakeholders accurately by interviewing 50 individual experts on coal sector economics and coal phaseout.

STARTING ASSUMPTIONS

It is important to acknowledge from the outset that the early retirement of coal plants is a controversial topic with strong views from various stakeholders. Crucial to enabling productive conversations about the coal capital transition, we offer a set of starting assumptions that frames the analysis in the remainder of this report and supports pragmatic discussions of these complex and potentially fraught issues.

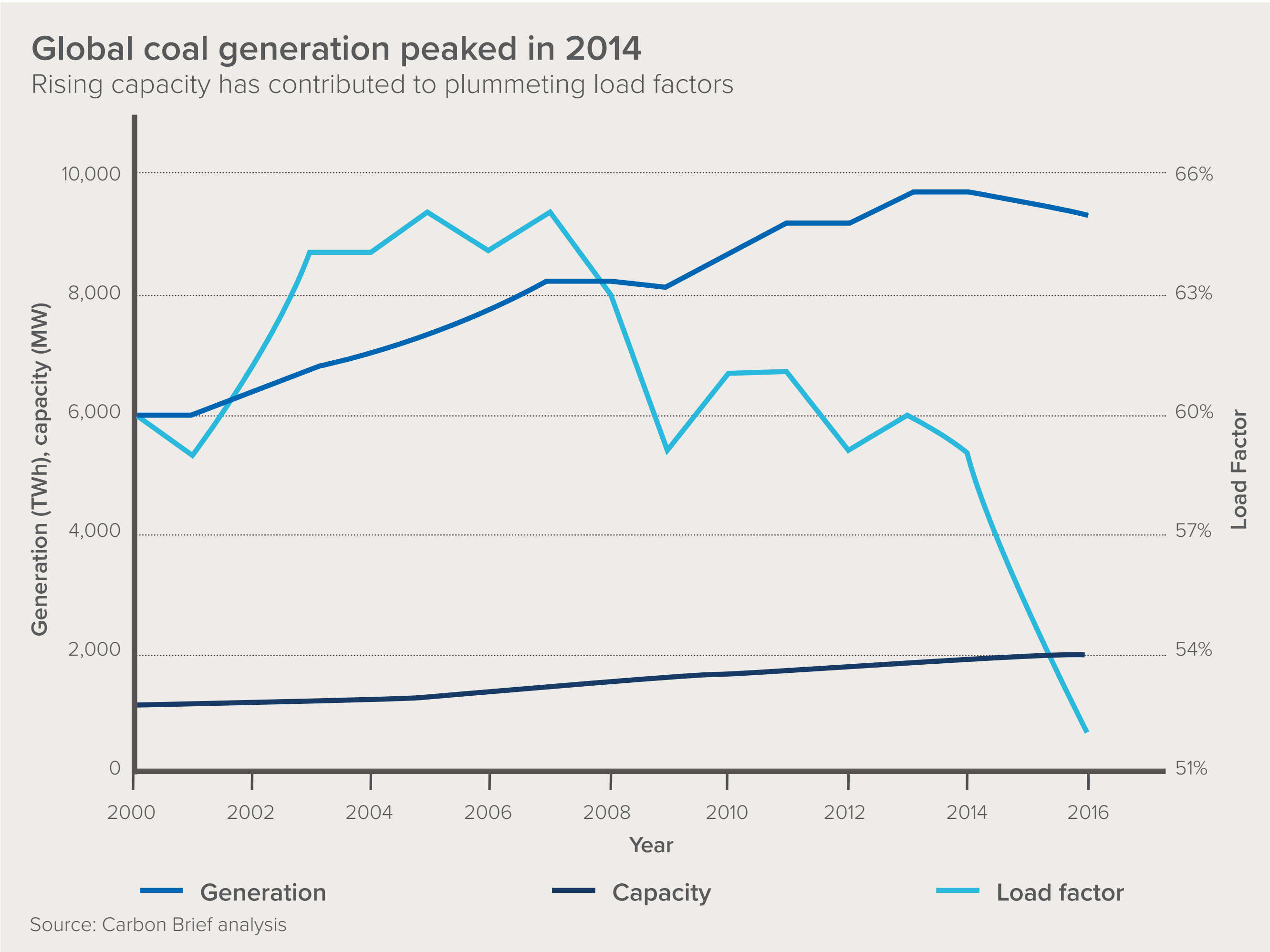
Coal-fired power generation is in structural decline worldwide, and the role that coal will play in the global energy mix will continue to wane. The decline is driven principally by the erosion of the economics of coal generation. This erosion is structural, not cyclical, and is driven predominantly by cheap gas, inexpensive renewables, and evolving regulations on climate and air pollution, which increase the cost of coal-fired generation relative to other energy sources. The declining role of coal in the energy mix is best demonstrated by plummeting load factors for coal-fired generators.[iii] [1]

[ii] While most people are familiar with the expression “degrees Celsius” (ºC), that expression signifies an absolute temperature that represents the coolness or warmth of something. The expression “Celsius degrees” (Cº) refers to an interval between two measured temperatures, which in this paper denotes temperature rise above preindustrial levels.

[iii] The load factor is a ratio of the actual output of a power plant compared with the maximum power it could produce.

FIGURE 1

TRENDS IN GLOBAL COAL-FIRED POWER GENERATION



This trend is expected to persist as installed coal capacity continues to increase (albeit more slowly) and as operating economics continue to worsen. Also notable is that electricity generated by coal-fired plants may have already peaked globally.[2]

This picture becomes clearer at the regional level. In the European Union, the decline of coal economics is most mature. Today, 54% of coal-fired power generation is cash-flow negative after debt service, which is predicted to increase to 97% by 2030. In the world's largest liberalized power market, this trend is driven by economics, with policy contributing to an extent to the decline in competitiveness of coal relative to other sources. Presently, the levelized cost of energy (LCOE) of new coal plants is undercut by the LCOE of new onshore wind,[iv] new utility solar, and new combined-cycle gas turbine (CCGT) generation. Carbon Tracker Initiative, a

[iv] The levelized cost of electricity, also known as levelized energy cost (LEC), is the net present value (NPV) of the unit-cost of electricity over the lifetime of a generating asset.

leading independent financial think tank, estimates that building new wind and solar capacity will be cheaper than continuing to operate existing coal plants in 2024 and 2027, respectively.[3]

The picture in the United States is similar. Currently CCGT generation has the lowest LCOE, with onshore wind and solar marginally higher and coal in fourth place. The LCOE of onshore wind and solar is declining, however, and has reached parity with CCGT in many states.[4] Utilities operating in liberalized markets that own coal assets have lost approximately half of their market capitalization, while in regulated markets higher costs have been borne by ratepayers.[5] Overall, Carbon Tracker estimates that 48% of the US coal fleet by capacity posted negative margins between 2012 and 2017. These financial challenges suggest the need for coal phaseout.

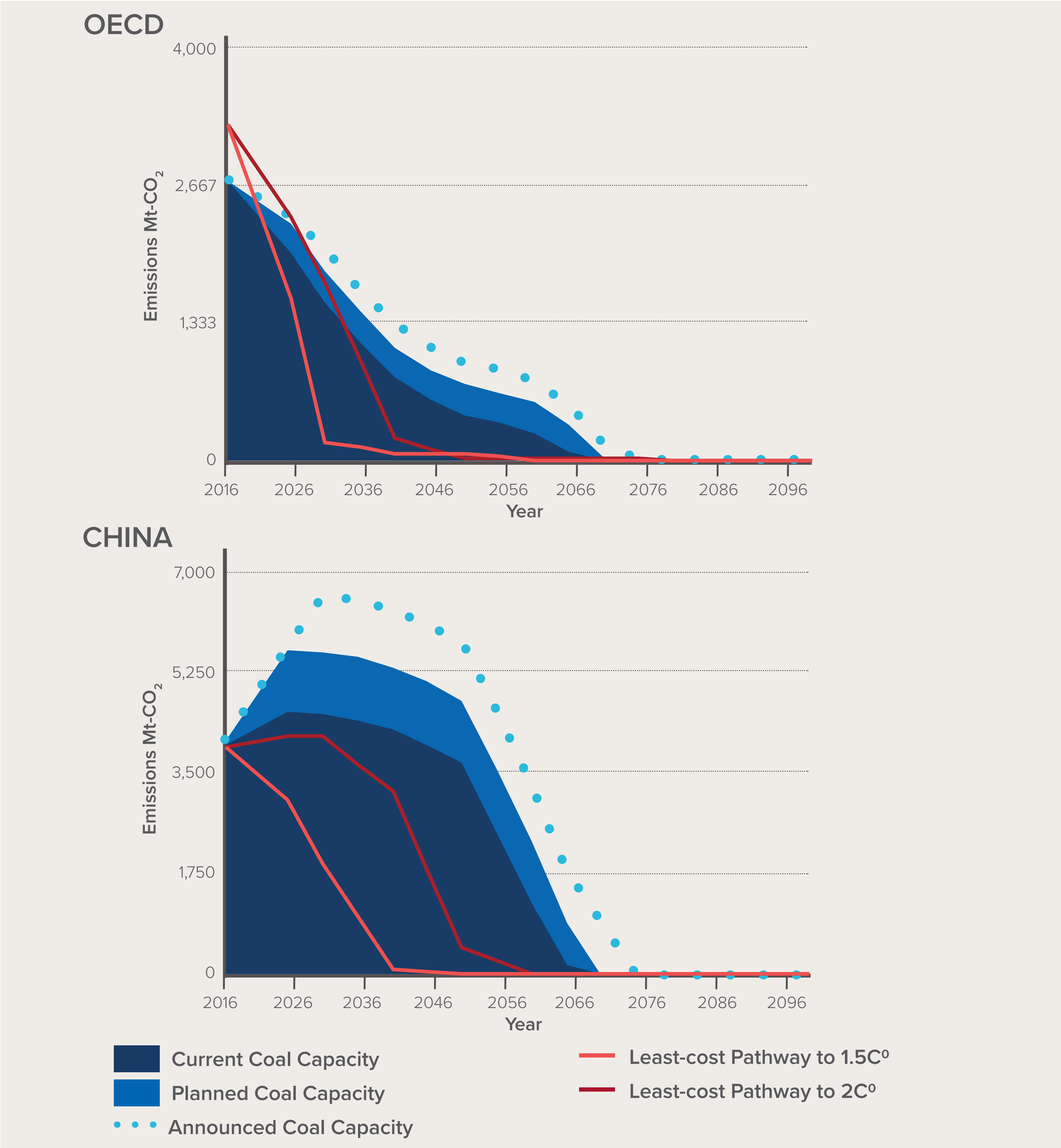
In India, renewables expansion has been significant. Recent wind and solar auctions have undercut the LCOE for new coal and CCGT generation by over 1 and 4 rupees/kWh, respectively.[6] The cost for renewable generation is expected to continue declining rapidly. Coal supply issues, difficulty securing offtake agreements, increasing renewable capacity, and water availability issues have contributed to a decline in the average load factor of coal from 77.5% in 2010 to 59.9% in 2017. Notably, 71 gigawatts (GW) of India's privately owned coal-fired capacity is facing potential financial distress today.[7]

Due to the structure of China's power markets, competition from renewables has yet to directly challenge the financial viability of coal. Despite the incredible buildout of renewable capacity, renewables curtailment is significant. For example, in Gansu province, wind generation is curtailed by up to 33% and solar generation up to 20%.[8] However, due to high overcapacity of coal-fired generation, attractive returns are eroding for many generators. Expected market reforms in which provinces introduce elements of liberalization are expected to undercut current coal benchmark prices and reduce the profitability of coal-fired power generation, particularly in provinces where renewable curtailment is high.[9]

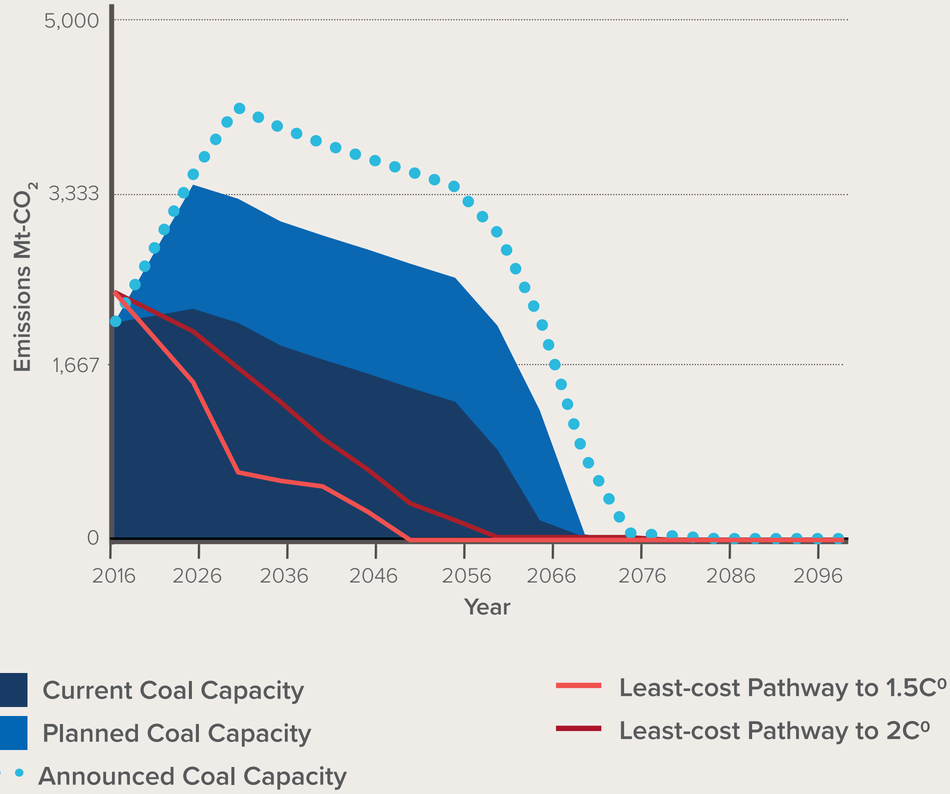
While economic trends are slowing the growth of coal capacity and leading a significant amount of uncompetitive coal-fired capacity to shutter, Figure 2 demonstrates that **this will not be sufficient to meet the Paris Agreement objective of holding warming well below 2C°.** It shows the potential CO_2 emissions from current, planned, and announced coal capacity. It also shows least-cost coal phaseout pathways under 2C° (below) and 1.5C° (well below) scenarios. Note that under a 1.5C° pathway, coal begins winding down immediately across all regions but completes by 2030 for OECD/EU, 2040 for China, and 2050 for the rest of the world (ROTW).

FIGURE 2

POTENTIAL CO_2 EMISSIONS FROM EXISTING AND PLANNED COAL CAPACITY AGAINST LEAST-COST COAL PHASEOUT PATHWAYS



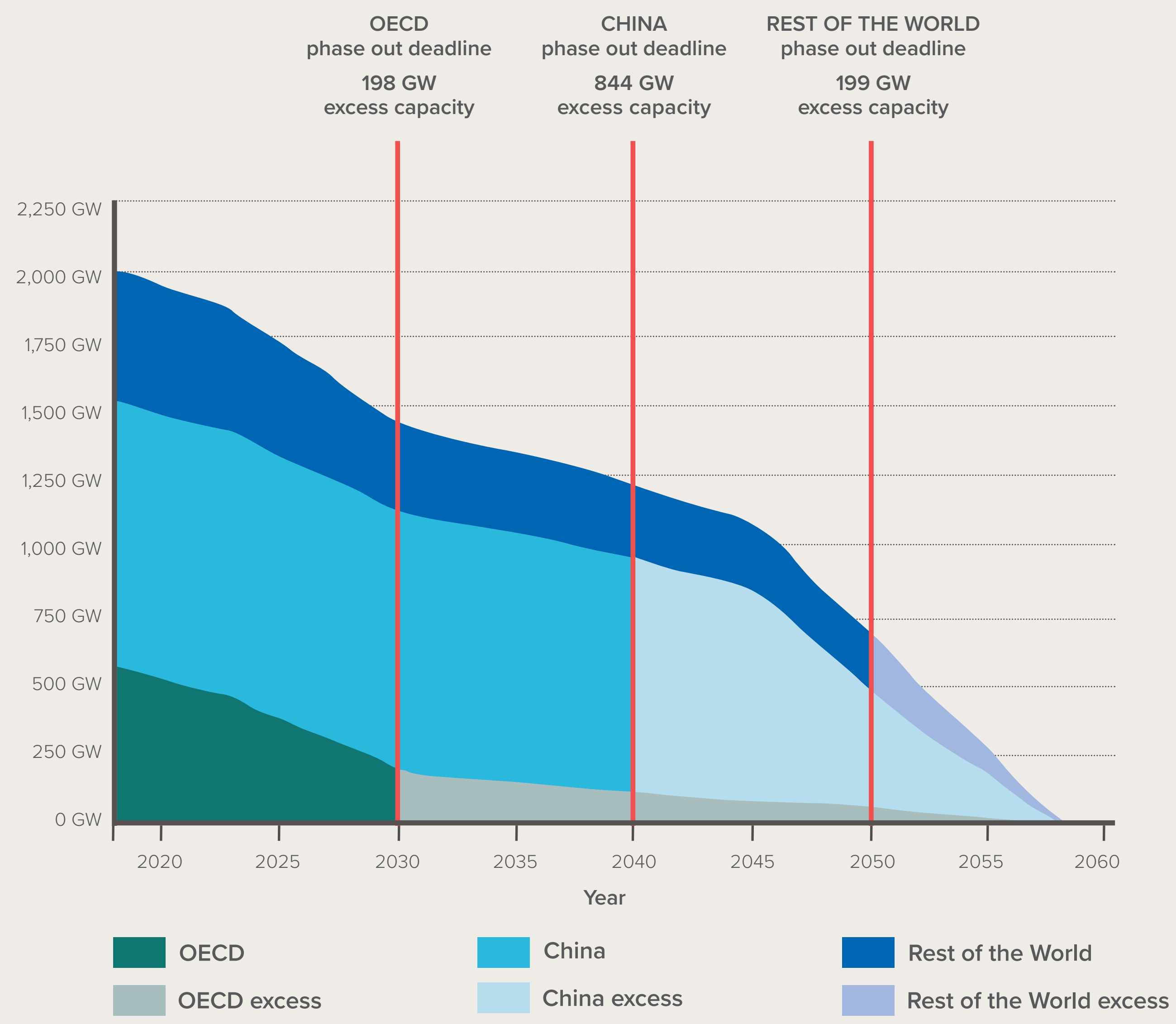
REST OF THE WORLD



Source: Analysis by Climate Analytics of least-cost pathways for regional coal phaseout

FIGURE 3

EXCESS COAL CAPACITY BY REGION



Source: CoalSwarm analysis using the CoalSwarm Global Coal Plant Tracker data

Significant early and additional retirement of existing coal capacity is necessary to keep hold warming well below 2C°. Figure 3 shows the scale of necessary premature retirements needed to hold warming to well below 2C°. In OECD countries, 198 GW of coal capacity will need to be retired prematurely, while the figure stands at a staggering 844 GW for China and 199 GW for the ROTW.[v] Retiring excess coal capacity in line with holding global warming to well below 2C° would cumulatively avoid 142.8 gigatons (Gt) of greenhouse gas emissions.[vi]

Yet these trends—and the push to continue them—are troubling from the point of view of many stakeholders. The stranding of coal assets threatens the destruction of value for workers, communities, companies, and investors. This has been recognized in the context of *layoffs*, where the "just transition for labor" movement has sought to proactively address the adjustment costs for communities and workers. What has not been sufficiently addressed is the issue of *write-offs*—the financial losses that investors might incur when coal plants are shut down. As some coal-fired assets may still be profitable to asset owners, have the technical potential to keep operating, and/or are not fully depreciated, **premature retirement may have significant financial consequences to asset owners. These should be understood and taken seriously.**

According to Carbon Tracker, potential stranded value for the top 20 listed coal asset owners in the United States is estimated at $104 billion.[vii] It should be noted that the great majority of stranded value would occur in regulated markets, assuming that utilities continue to pass the higher costs of coal generation through to ratepayers.[10] The story is markedly different in the European Union's liberalized markets, where uneconomic plants are fully exposed to market forces. Carbon Tracker estimates that phasing out coal in line with a below 2C° scenario may actually lead to the avoidance of losses for 13 of 15 of the top European utilities.[viii] Carbon Tracker estimates that, accounting for capacity that was planned and under construction as of 2016, a total of $490 billion of capital was at risk of being wasted due to existing coal capacity being adequate to meet future power generation needs under a below 2C° scenario.[11]

While some advocates and policymakers have chosen to focus their attention on smoothing the adjustment costs associated with layoffs, there is a strong rationale for also focusing on write-offs where appropriate. From the perspective of asset owners, lobbying against climate and clean energy policy is an economically rational response to prospective stranding. As a result, the energy transition is happening in fits and starts.

[v] These figures are derived from the analysis of Climate Analytics, which has developed least-cost pathways for energy transitions. In these pathways, the retirement of coal capacity begins immediately in all regions and extends to approximately 2030, 2040, and 2050 for the OECD, China, and ROTW, respectively. These figures exclude planned coal capacity. **https://www.carbonbrief.org/guest-post-peak-coal-is-getting-closer-latest-figures-show**

[vi] Excess emissions calculated from "share of budget" of cumulative emissions until 2050 for current global capacity. See Climate Analytics Source, p. 14, **http://climateanalytics.org/publications/2016/implications-of-the-paris-agreement-for-coal-use-in-the-power-sector.html**

[vii] Stranded value, as used here by Carbon Tracker Initiative, is defined as the difference in the aggregate valuation of assets in a 2C° and business-as-usual scenario.

[viii] These figures assume an EU emissions trading system carbon price escalation to €30 by 2030 and full compliance with the Industrial Emissions Directive best available techniques reference (BREF). **https://www.carbontracker.org/reports/lignite-living-dead/**

It should come as no surprise that of the seven utilities that make Influence Map's list of the top 50 most influential corporations on climate policy,[12] the lobbying position of each aligns with the potential financial implications of climate policy on their portfolios. Several regulated US utilities with exposure to coal and significant stranded asset risk are opponents of climate policy; altogether, US utilities spent $18.4 million lobbying Congress in the 2016 election cycle alone. As recently as March 2018, FirstEnergy requested compensation for upholding energy security for maintaining fuel on-site, which was widely seen as a tactic to save its struggling coal and nuclear assets.[13] Such lobbying activities are not limited to the United States. In Australia, the coal lobby ACA Low Emissions Technologies spent AU$3.6 million lobbying over 2017 for "clean coal" and "coal promotion."[14] Meanwhile, Euracoal, the European coal lobby group, is suing the European Commission for introducing stricter air-quality standards that may force the closure of some power stations and reduce the demand for brown coal. Furthermore, according to German Member of the European Parliament Reinhard Bütikofer, co-chair of the European Greens, disagreement on Germany's coal phaseout halted talks on forming a coalition with German Chancellor Angela Merkel's Christian Democratic Union party.[15]

This report shows that in managing the coal capital transition, pragmatic collaboration among asset owners, environmental advocates, and policymakers can be mutually beneficial. For asset owners, proactive planning for the end of the coal era can preserve shareholder value and avoid financial shocks to equity and debt holders alike. For policymakers, there is an opportunity to understand and implement a new toolkit to spur faster energy transition through dialogue rather than adversarial approaches. And environmental advocates can advance their objective of accelerating the clean energy transition and avoid costly and lengthy conflicts with incumbents.

This report presents the first global survey of approaches that can help ease capital destruction for asset owners and their shareholders while offering policymakers a clearer path toward transitioning the power sector onto a well below 2C° pathway.

JUST TRANSITION FOR LABOR

This report, which focuses on the transition of capital, should be seen as a complement to, rather than a replacement for, the important work being done on creating just transitions for workers and communities. The substantial economic shift associated with phaseout of coal-fired power affects not only the owners of these assets and other entities with direct financial ties (such as banks and private equity), but also workers all along the coal supply chain, from miners to plant operators. There is a rich "just transition" literature, exploring key considerations and implications of transitioning labor from coal to other sectors of the economy. For example, the Coal Transitions: Research and Dialogue on the Future of Coal project released a report entitled *Lessons from Previous 'Coal Transitions,'* which provides several case studies and lessons learned from countries where coal has been phased out. Coal production, coal-based regional identity, labor mobility, and human capital are all important factors that the report's authors identified in understanding the political challenge of coal phaseout.

Ensuring a just transition for affected workers and communities should be an important component of a coal phaseout strategy, regardless of which policy components are employed for allocating capital losses. Many of the policy components that we present here come with difficult trade-offs that use funds that will undoubtedly be limited. Where these trade-offs may be necessary, environmental (and labor) advocates can work alongside policymakers and asset owners to ensure that these trade-offs are being weighed appropriately. Once an agreement is reached, policymakers can work to ensure it is honored contractually, while environmental and labor advocates should work to ensure that it is enforced in the public sphere.

Left: Photo courtesy US Department of Energy. Miner inspecting double ranging drum shearer. Right: Run-down housing in Fairmont, West Virginia.

READING THIS REPORT

This report reflects our findings from structured interviews with nearly 50 individual experts on coal sector economics and coal phaseout. The individuals we interviewed represented organizations from a variety of stakeholder groups, including utilities, governments, environmental advocates, and financial entities. The geographic scope of our interviews included North America, Europe, China, India, and beyond.

In conducting these interviews, we had several objectives. Our first objective was to identify examples of coal phaseout policies around the world and to specifically identify how the issue of stranded capital was addressed. Our second objective was to understand the key factors that led to particular policy choices. Our third objective was to distill the core policy components of coal phaseout.[ix]

The purpose of this research effort is not to propose a one-size-fits-all solution to the challenge of transitioning capital away from coal, nor is it to prescribe particular policy components to particular regions or context. Rather, we have catalogued the policy components available and provide some guidance as to how to select multiple components to construct a complete policy.

This report offers practitioners a clear set of tools to understand the options for managing the coal capital transition as well as the potential political implications of doing so. It does this first by presenting the Asset Decision Framework, which elucidates the legitimate business and political positions of owners with regards to their coal-fired assets.

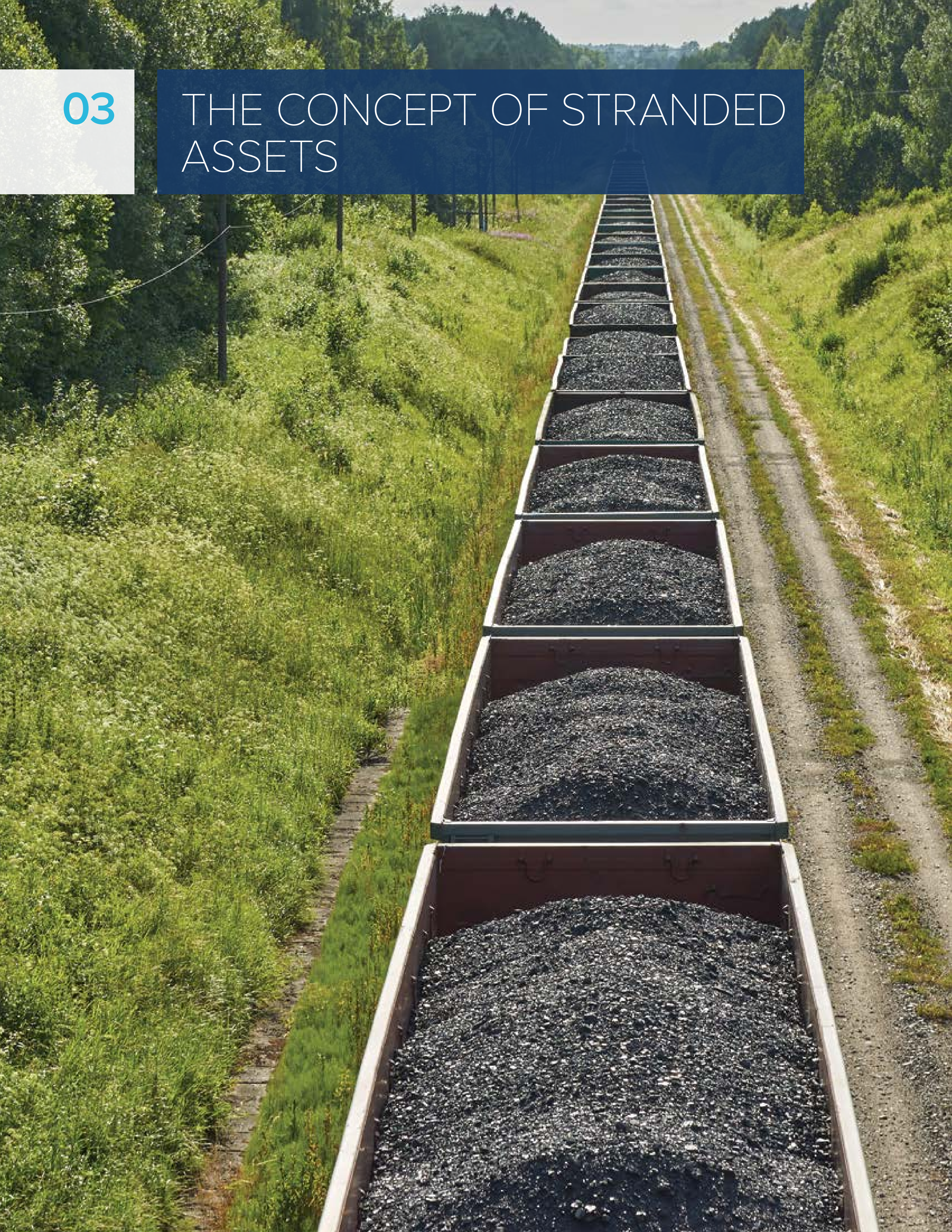
Second, this report presents 10 policy components for managing capital losses from premature retirement. Six key selection criteria will assist practitioners in identifying which components may be applicable as well as the risks they carry.

Finally, the report presents a set of case studies where many of these policy approaches have been applied.

This report focuses on the economics and operating decisions of grid-connected coal-fired power plants. It does not address coal mining or other ancillary assets associated with coal, such as dedicated rail or port facilities for transporting coal. While it does not aim to directly address decisions related to captive power plants in industrial facilities, some of the economic decisions are analogous. For example, solar photovoltaic (PV) and wind generation are beginning to displace captive energy generation in mining, with cumulative capacity approaching 1 GW. The business case is viable in many mining processes and for most regions, especially in the case of remote off-grid sites depending on diesel fuel.

[ix] Many of the arguments and explanations in this report derive from these interviews. We utilized secondary sources to verify statements made in interviews where possible. Specific findings are not attributed by name to specific interviewees. However, a list of organizations whose input is represented can be found in the acknowledgments section.

03 THE CONCEPT OF STRANDED ASSETS



THE CONCEPT OF STRANDED ASSETS

A key factor underlying the purpose of this report is the concept of **stranded assets.** We use this term generally to refer to coal-fired assets that, "at some time prior to the end of their economic life (as assumed at the investment decision point), are no longer able to earn an economic return (i.e., meet the company's internal rate of return), as a result of changes associated with the transition to a low-carbon economy."[16] There are two primary drivers for stranding, which will be particularly useful for stakeholders to understand when crafting a coal capital transition plan for their specific context.

- **Regulatory stranding** occurs when policymakers create laws or regulations that impede the coal asset from being utilized for its full useful life, so owners may not make the return anticipated when they made their initial investment.

- Even without direct regulation from policymakers that prevents the asset's continued use, **economic stranding** can occur when operating economics are such that it is no longer worth it for the plant owners to continue operations.

Regulatory and economic stranding are not mutually exclusive. Indeed, there is often an interplay between the two: some regulations, such as environmental controls or carbon taxes, can negatively impact the operating economics of coal plants, which, in combination with certain adverse economic factors, could render an asset stranded.

A related and important figure to consider in the context of coal phaseout is **stranded value,** which, when defined broadly, is the difference in expected and actual financial outcomes. Determining stranded value during a coal phaseout is complicated. All sides are best served by recognizing the potential for divergent valuations and depoliticizing them where possible by making valuation a technical exercise.[x]

Below, we overview three types of valuation: NPV, NBV, and market value.

NPV is the sum of a plant's forecasted cash flows—taking into account long-term revenue contracts (power purchase agreements) and expense contracts (fuel supply agreements, operating and maintenance agreements)—and discounted to the present day. While this measure is useful for capturing the cash flow potential of an asset, it is a highly subjective approach, requiring assumptions on future demand, operating costs, environmental compliance, and—in the absence of fixed revenue or fuel supply contracts—future wholesale electricity prices and coal supply costs. Calculating stranded value using two NPV calculations by finding the delta between a business-as-usual scenario and a closure scenario is extremely difficult because of subjectivity described above. See the **Dollars and Sense—Lessons on Valuation** callout box for an example of this.

Another valuation approach that doesn't involve forecasting future revenues or expenses is **net book value (NBV),** which is the outstanding accounting balance of the asset's value net of **depreciation.** Depreciation is the accounting practice that allows a company to parcel out the cost of an asset over a period of time commensurate with its useful life. NBV is a measure of the amount of the asset's value that has not yet been recovered. In practical terms, the full value of the original asset is added to the owner's balance sheet when the plant is built, and then a portion of the remaining value is deducted as a depreciation expense each year until the remaining value is zero (i.e., the asset is considered fully depreciated). Further investment into a coal plant (for example, installing new equipment that extends its useful life) can be added to the outstanding balance and itself depreciated according to the appropriate depreciation schedule. If an asset owner

[x] For a longer discussion on making the political technical, see Caldecott and Mitchell (2014), *Premature Retirement of Sub-Critical Coal Assets: The Potential Role of Compensation and the Implications for International Climate Policy.*

decommissions an asset that has an outstanding depreciation balance (i.e., the net book value is greater than zero), the owner must **write off** that outstanding balance. This could represent a significant financial loss, so owners will seek to avoid doing so. The Alberta case study found at the end of this report provides a good example of using future NBV to inform negotiations and construct policy solutions.

A final measure of value is **market value,** or what an asset owner could sell an asset for to willing buyers. This is an important measure to understand because while the NBV of an asset could indeed be positive and therefore the owner would be required to take a write-off if the plant were retired early, the asset's market value could already be zero if it is economically stranded.

DOLLARS AND SENSE—LESSONS ON VALUATION

As part of Australia's 2011 Clean Energy Future package, AU$2 billion was set aside for the Contract for Closure program, which was meant to negotiate the closure of 2 GW of coal-fired power generation. The main component of this policy was *pay to close.* After the selection of five coal-fired subcritical power generators for Contract for Closure in late 2011, negotiations for compensation payments began. However, no agreement was reached by June 2012 and negotiations were cancelled in September 2012.

The collapse of Contract for Closure was due to a large disparity in what compensation asset owners requested to close plants and what the Australian government was willing to offer. This is best demonstrated by the valuations of Hazelwood power station. Asset owners gave a self valuation of AU$3 billion while the government's total budget for the program meant to close five plants was AU$2 billion. Both sides held different views on what the future held for coal power stations in the region and valued them accordingly using NPV-based valuations.[xi]

Photo courtesy Mriya for WikiCommons. Hazelwood Power Station as seen from a light aircraft flying overhead.

[xi] Ibid

WHY STRANDED DOESN'T ALWAYS MEAN CLOSED: UNDERSTANDING THE CONTEXT OF COAL-PLANT OPERATIONS

The question of whether a coal plant is stranded often lacks a clear answer. It may be more constructive to consider the *potential* for stranding on a forward-moving continuum, taking into account clear economic and regulatory trends that are likely to increase a coal asset's risk of stranding. While one would expect decommissioning to be the rational outcome to an uneconomic coal plant with poor prospects for improvement, this is not always the case. Instead, there may be factors that insulate an asset from the financial ramifications of being stranded and shift associated capital losses away from the asset owner to other stakeholders.

There are two noteworthy examples of this. The operating economics for much of the US coal fleet are poor due to pressure from lower-cost generation (natural gas plants, wind, and solar). However, the way in which this economic stranding manifests itself depends largely on the region in which a plant is located. In deregulated markets, the inability of coal plants to effectively compete with lower-cost generation in the market has led to the shuttering (or conversion to gas) of many coal plants. But in regulated states, coal plants are insulated from these market forces as they are permitted to recover the cost of their uneconomic plants from ratepayers. The plants are economically stranded in both jurisdictions but, in regulated markets, the impact of economic stranding is absorbed by ratepayers (in the form of higher electricity rates) rather than by the utilities that own the assets.

In India, a different dynamic prevents stranded coal plants from closing. As much as 71 GW of coal-fired capacity owned by independent power producers is uneconomic because of an inability to secure long-term power purchase agreements (PPAs). The country's distribution companies are balking at signing PPAs in part because they do not want to lock in prices for coal power at a time when renewable generation is an increasingly cheaper alternative. Without these contracts, the plants are not being dispatched and are falling far short of meeting their revenue projections. The impact of this economic stranding has been muted by banks' disinclination to declare loans made to these plants in default in order to avoid significant write-offs.

Similarly in China, where both labor concerns as well as local gross domestic product (GDP) and employment figures are of great importance, overcapacity may be best addressed not by shutting down coal plants but via idling or mothballing. For example, a plant could cease regular power generation operations while keeping the business open, workers employed, and creditor banks rolling over bad debt.

Regardless of the region or market circumstance, it is in the interest of owners, policymakers, ratepayers, and other stakeholders to develop a managed plan for capital transition that can reasonably limit losses and allocate them appropriately. In the following tables we highlight the factors that are most relevant for identifying stranding risks and are therefore important for policymakers and other stakeholders to consider when contemplating the financial implications of a coal phaseout plan. Table 1 summarizes variations in the general operating context of plants, and Table 2 focuses on plant-specific characteristics.

The identified variables are referenced throughout the following sections, which describe the key factors influencing current and future financial performance of coal-fired assets, provide an overview of policy components for managing the coal capital transition, and give a set of case studies where such policies have been implemented.

TABLE 1

VARIABLES (GENERAL OPERATING CONTEXT)

GENERAL CONTEXT	
CONCEPT	**DEFINITION**
Type of power market	The type of market in which an asset operates has a significant impact on its exposure to market forces and its ability to pass regulatory costs through to ratepayers. Liberalized markets are fully competitive, meaning that coal asset owners are exposed to market forces, are not guaranteed a return on their investments, and have less ability to pass through costs to ratepayers. Both the EU and some US markets, such as Texas and the northeast, are examples of liberalized markets. Regulated markets feature vertically integrated utilities that earn a regulated rate of return for providing power services, a system that enables them to pass regulatory costs to ratepayers. US markets throughout the Midwest and mid-Atlantic are examples of regulated markets. In China's state-managed market, coal-fired generators sell power to one of two grid companies. They earn a government-set coal benchmark price for a set number of operating hours each year.
Cost-competitiveness of coal power	The cost-competitiveness of coal relative to alternative sources, such as combined-cycle gas turbine, wind, and solar generation, is a very significant factor in determining if and when a coal asset may become stranded. In liberalized markets with lowest-cost dispatch, coal utilization will reflect the relative price of coal generation compared with that of other fuel sources. When cheaper forms of generation come on line in a market, they negatively impact dispatch rates for coal plants. In regulated markets, the higher relative costs of coal generation are relevant to regulated or publicly owned utilities for which customer costs and concerns are explicitly factored into their governance or oversight structures.
Type and rigor of environmental regulations	Environmental regulations can have a range of impacts, from incremental costs to significant capital expenditures. For example, the introduction of a carbon-pricing mechanism will increase costs for coal generators relative to costs for other generation sources, whereas the introduction of new air-pollution standards may require considerable capital expenditure, which may be difficult to justify for some assets and force their closure.
Economic subsidies for coal	Subsidies can range from virtually zero to significant. They typically come in the form of direct subsidies, capacity market payments, or other supplemental revenue streams that bolster the operating economics of coal plants.

This photo shows Yuanbaoshan Power Plant, which is a coal-fired power plant in Yuanbaoshan, Chifeng, China.

TABLE 2

VARIABLES (PLANT-LEVEL CHARACTERISTICS)

PLANT-LEVEL CHARACTERISTICS	
CONCEPT	DEFINITION
Asset efficiency	Plant-specific operating costs (fixed and variable, as well as ongoing maintenance and required capital expenditure) can vary significantly from one unit to another. More efficient plants are cheaper to operate and have reduced exposure to environmental regulatory risk, and will therefore be more favorably positioned on the dispatch curve than less efficient coal plants.
Outstanding debt and depreciation	Since outstanding loan and depreciation balances need to be addressed in the context of plant closure, they are a barrier to early retirement. Creditors will seek full repayment of their loans, and asset owners will seek to minimize write-offs of any remaining depreciation. Managing these outstanding balances is a key element for successful coal phaseout strategies. Outstanding debt and depreciation and asset efficiency are correlated—albeit imperfectly—with the age of an asset. While one would expect long-operating coal plants to have only a small portion of an original loan or depreciation balance remaining, any subsequent investments in the plant (e.g., new equipment) will involve new depreciation schedules and likely new debt as well.
Age of asset and planned retirement date	The average age of the fleet in a given jurisdiction and its expected operating life can be important factors to consider in coal phaseout policies. For example, owners of newer plants might demand more favorable treatment because older plants have had more time to recover their costs than plants with shorter operating lives. However, some might argue that owners of newer assets should have more appropriately internalized the risk of stranding before coming on line.
Local political feasibility	The local political landscape can play a role in an asset's stranding or recovery. Whereas local environmental issues may direct the local political landscape toward closure, issues relating to local employment and tax basis may do the opposite.
Asset owner's portfolio management strategy	Some utilities and independent power producers (IPPs) own and operate multiple assets with varying fuel sources and across multiple geographies. The company's global asset management strategy might deemphasize a certain region or a particular generation type. In such cases, decisions about individual plants may be made irrespective of other plant fundamentals. An additional consideration is the size and diversity of the company's holdings (i.e., the proportion of its revenues coming from coal), which will inform what options are available to owners to diversify their revenue base.
Operating income risk exposure	Plants can be exposed to operating income risk through revenue and/or expense variability. Two key determinants of this risk are exposure to coal price variability, and whether the owner has a firm revenue source for the plant's output. Coal price risk is generally higher in coal-importing markets and lower when mines are on-site or nearby. Availability of long-term supply contracts—including sweetheart deals—can also affect price risk exposure. Similarly, the availability of long-term, fixed-price PPAs or the ability to fully pass through to ratepayers the cost of generation mitigates downside revenue risk.

INDIA CAPITAL LOSSES

India presents an interesting case study, illustrating the importance of managing the capital transition to avoid steep capital losses.

Until very recently, it was generally assumed that India would need to continue building coal-fired power plants to meet its growing electricity demand in a cost-effective way. But this conventional wisdom has been turned on its head—both because electricity demand is growing more slowly than analysts and policymakers had expected and because the levelized cost of renewable technologies has plummeted. Moreover, the challenge of meeting demand is not one purely of capacity, but also of matching that capacity to the areas of growing demand. Now it is increasingly evident that coal may not provide the flexibility and price point that India's growing economy requires, and in some regions it is already less economically appealing than solar and wind.[18]

With a combination of coal supply and land acquisition challenges and difficulty securing off-take contracts with the country's utilities, as much as 71 GW of privately owned coal-fired capacity is facing potential financial distress. One reason utilities are reluctant to sign long-term power contracts is that the price of renewable energy has come down sharply. Utilities do not want to be locked into contracts for coal-fired electricity that are likely to become increasingly expensive as compared to deflationary renewable alternatives. In addition, much of the growing demand is coming from the rural poor, who cannot afford the rates utilities would need to charge if this demand were met by new coal-fired generation.[19]

As a result of these forces, revenues for a large swath of the country's privately owned coal power plants are sharply below what was forecasted when the loans were extended. Lenders to these projects—including many state-owned banks—have historically not pressed the issue, choosing instead to restructure bad loans rather than take write-offs, a situation worsened by the inability to enforce promoters' equity obligations. According to a recent Bank of America Merrill Lynch analysis, Indian banks are exposed to up to $38 billion in potential loan write-offs to the power sector. According to the report, this amount represents roughly 75% of the face amount of the non-performing loans to this sector (primarily generation assets).[20]

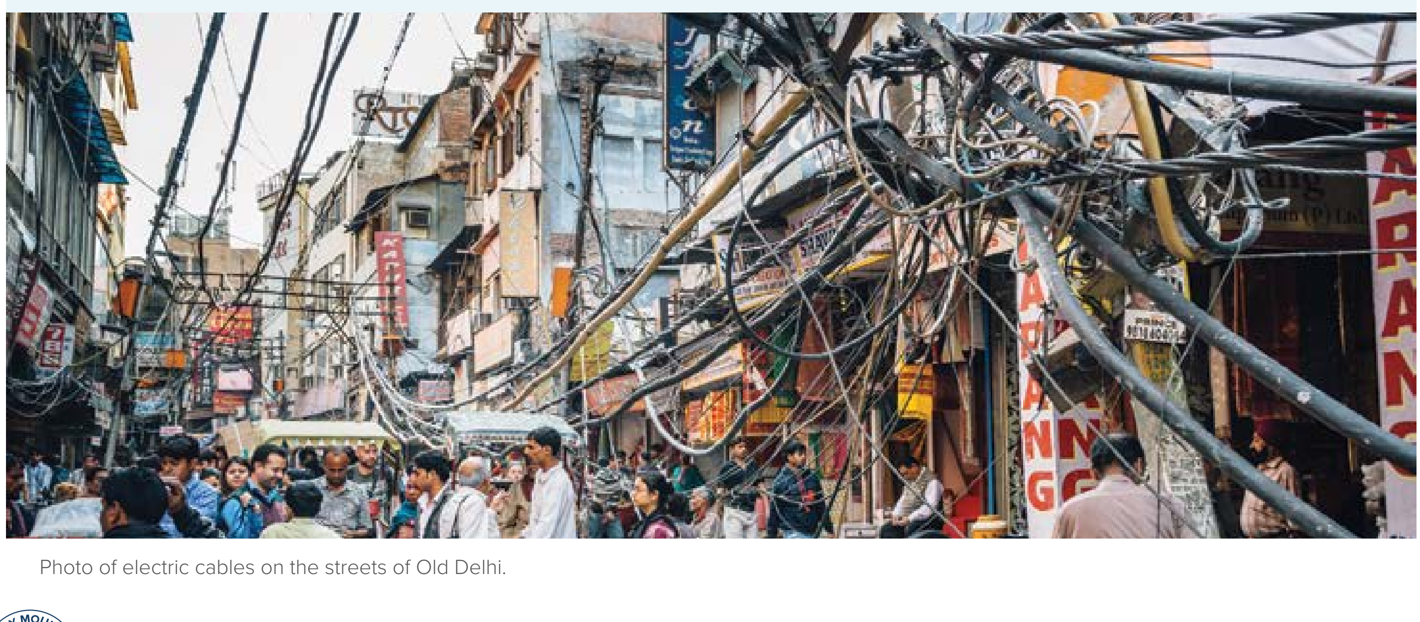


Photo of electric cables on the streets of Old Delhi.

INDIA CAPITAL LOSSES CTD.

Earlier this year, the Reserve Bank of India implemented new guidelines intended to empower banks to detect nonperforming loans relatively quickly and develop plans to manage potential defaults (including swifter recognition of losses). The implications for loans made to the power sector are significant, particularly for public-sector banks, given the extent of the potential write-offs involved.[21]

Moreover, given the current state of the Indian power market, it's not clear that these assets have sufficient value to be sold to new owners in order to repay the bank loans, particularly with issues of quality and technology obsolescence, compounded by new regulations introducing emissions standards. Nonetheless, in an effort to recoup as much of their loans as possible (thus avoiding having to record high write-offs), banks have turned down purchase offers, reportedly holding out for higher valuations than the market is currently prepared to provide.[22]

The crisis facing privately-owned coal-fired generation in India is a concrete case of economic stranding: with distribution companies balking at buying power from increasingly high-cost plants, owners of this asset class face a bleak profitability outlook in the near term. Some owners may take the view that it is worth waiting out this period with the expectation that some government intervention will help spur a market for the plants' output.

Waiting for a government fix to stimulate the market is also in the interest of many banks that might prefer to keep nonperforming loans on their books with the hopes of an eventual recovery. However, these creditors may not have the luxury of waiting given the regulatory pressure to more effectively manage nonperforming loans, which, in many cases, would involve creditors selling their collateral (i.e., the plants) to repay the outstanding obligations and clean up their books. Yet with these assets economically stranded, the market is likely to value these assets at distressed levels that would still require banks to absorb significant losses, including the accumulation of interest expenses (which are considerable given commercial interest rates exceeding 10% per annum). With renewable energy tariffs falling some 10% annually, and most long term PPAs having zero indexation clauses, time is likely the enemy of these distressed thermal power assets.

The interplay of the dynamics shaping the value of privately owned coal-fired plants in India are instructive to those contemplating collaborative capital transition solutions for coal owners—in India and beyond. The current state of affairs in India illustrates the importance of actively engaging with the difficult issues presented by a stranded asset class. Indeed, Indian coal plant owners and lenders are already contemplating steep losses, so a forward-looking plan to manage these losses more efficiently might help mitigate a worse outcome. While many of the solutions described in this report require some consensus around a plant's value—whether to support compensation calculations or, more generally, to better understand owners' short- and long-term economic outlooks for their plants—they present an opportunity to mitigate financial challenges by transitioning capital to more economically attractive clean-energy options.

04 UNDERSTANDING THE ASSET OWNER'S PERSPECTIVE

UNDERSTANDING THE ASSET OWNER'S PERSPECTIVE

Understanding the legitimate day-to-day business perspective of asset owners is fundamental to collaboratively managing capital losses associated with the early retirement of the coal fleet. We first provide an overview of the factors that influence current and projected financial performance of coal-fired generating assets. The Asset Position Framework then considers an asset's current and future financial performance to classify an owner's likely business positions, political positions, and amenable exit options. Asset owners and policymakers can use this framework to help identify which policies might make asset owners indifferent to, or even supportive of, policies that encourage premature retirement. This is further developed in the next section, where we identify the components of such policies.

It is important to note that we refer to a single "owner perspective" in this report as a shorthand to differentiate the perspective of those with a direct financial stake in the enterprise as distinct from other stakeholders such as policymakers, ratepayers, and environmental and public health advocates. In reality, "ownership" can take a variety of forms. In regulated jurisdictions, plants are likely to be directly owned by a utility, which could be an investor-owned or a state-owned enterprise. In deregulated markets, owners of coal-fired generation are more likely to be independent power producers or pure financial players (e.g., private equity investors). Lenders to coal-fired plants are not owners, but do have a collateral claim to the plant and its ownership. In addition, the entity managing the day-to-day plant operations may not have any ownership stake in the asset.

CURRENT AND FUTURE FINANCIAL PERFORMANCE OF ASSETS

A coal-fired asset's current financial performance is determined by revenues less operating expenses, including debt service. An owner's financial outlook on his or her asset will include projected revenues and operating expenses as well as potential future capital expenditures associated with impending or potential regulations. In the case of liberalized markets, financial performance is measured by an asset's contribution to shareholder returns. In regulated markets, the benchmark is value for ratepayers—especially in relation to other potential forms of power generation.

The financial performance of a single asset may also be evaluated in the context of an owner's broader portfolio of power-generation assets, which can be concentrated in certain technologies and/or geographies or diversified. For simplicity's sake, the Asset Position Framework on page 40 excludes such considerations.

FIGURE 4

FACTORS INFLUENCING FINANCIAL PERFORMANCE

Current Financial Performance
is determined by:

Revenues

- Utilization (i.e., expected vs. actual)
- Competitiveness relative to other sources
- Demand
- Long-term PPAs
- Revenue adjustments (e.g., subsidies, bail-outs, reg. pass-through, capacity market payments)

Operating Expenses

- Coal price (i.e., spot market or long-term contract)
- Operating environmental compliance costs
- Depreciation expense
- Debt service
- Other operating costs

Future Financial Outlook
is determined by:

Projected Revenues

- Future utilization and dispatch
- Capacity market trends
- Future competitiveness relative to other sources
- Demand trajectories
- PPA duration

Future CapEx

- Future compliance costs
- Regulatory risk
- Asset efficiency
- Political environment

Projected Operating Expense

- Coal price exposure
- Outstanding debt
- Outstanding depreciation

ASSET POSITION FRAMEWORK

Based on current and projected future financial performance, the Asset Position Framework presented in Figure 5 classifies assets into one of four positions: *continuing operator, short-term opportunity, exit opportunity,* and *wait and see.* An asset's position on the framework will determine an owner's likely business strategy with the asset, political strategies, and asset exit options. For example, if the current regulatory framework is conducive to current and future profitability of an asset, an owner will likely view it as economically rational to maintain the asset and make marginal returns while also seeking to maintain the existing regulatory environment.

Asset owners' operating and investment decisions for existing coal assets can be categorized into six options:

- **Continue Operations with Capital Expenditures.** Continue operation of plant and make capital expenditures as they are necessary; asset stays on balance sheet, profit and expenses per normal operation

- **Continue Operations without Capital Expenditures.** Continue operation of plant but avoid large capital requirements; asset stays on balance sheet, profit and expenses per normal operation

- **Sell.** Make minimal changes to plant and equipment; remove asset from balance sheet; inflows from sale

- **Convert.** Redeploy existing equipment as feasible and convert facility to natural gas- or biomass-fired generation; write off equipment that cannot be reused and change asset on balance sheet

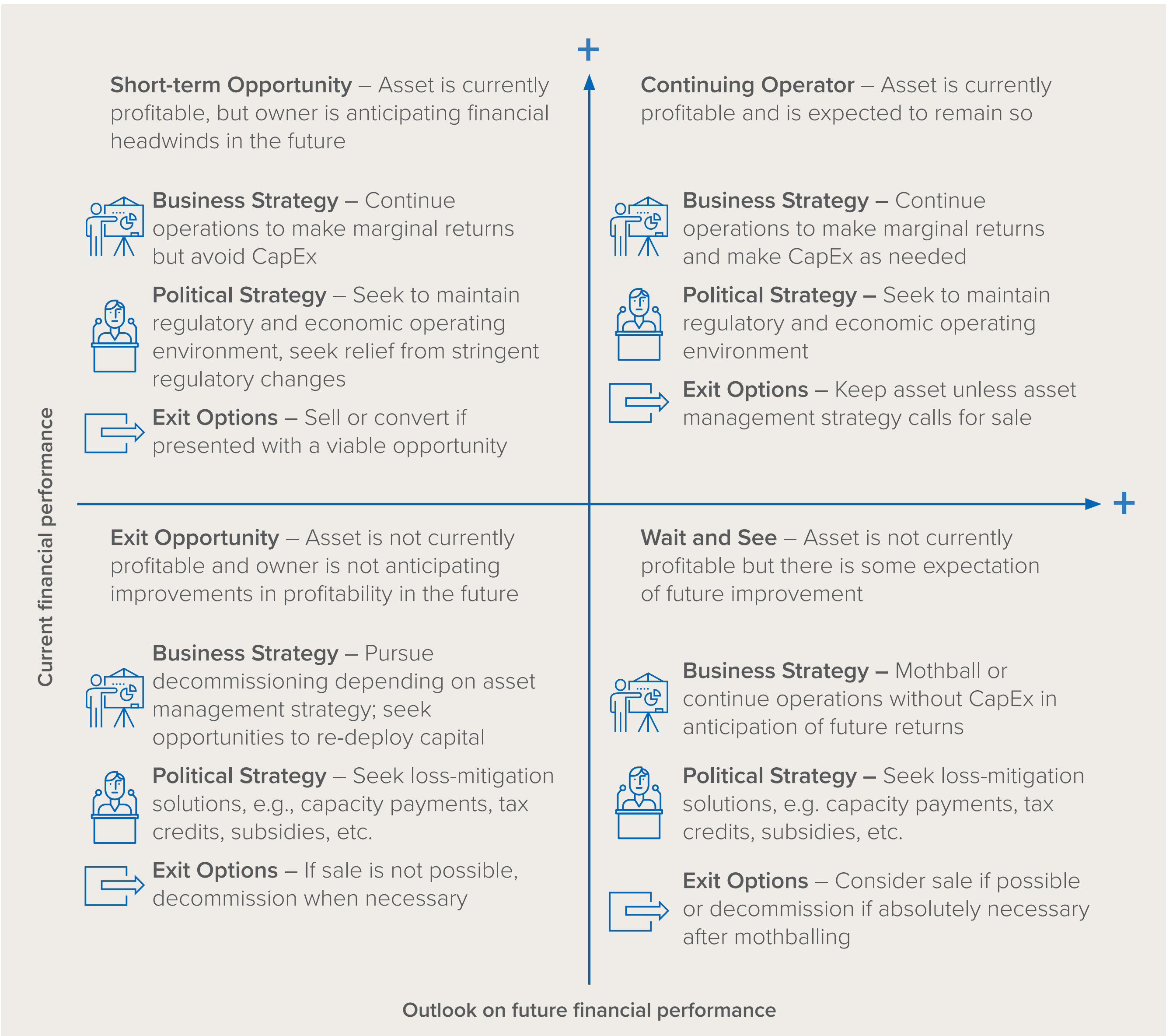
- **Idle/Mothball.** Cease plant operations but maintain equipment to potentially restore service in the future; keep asset on balance sheet but forego operating revenues

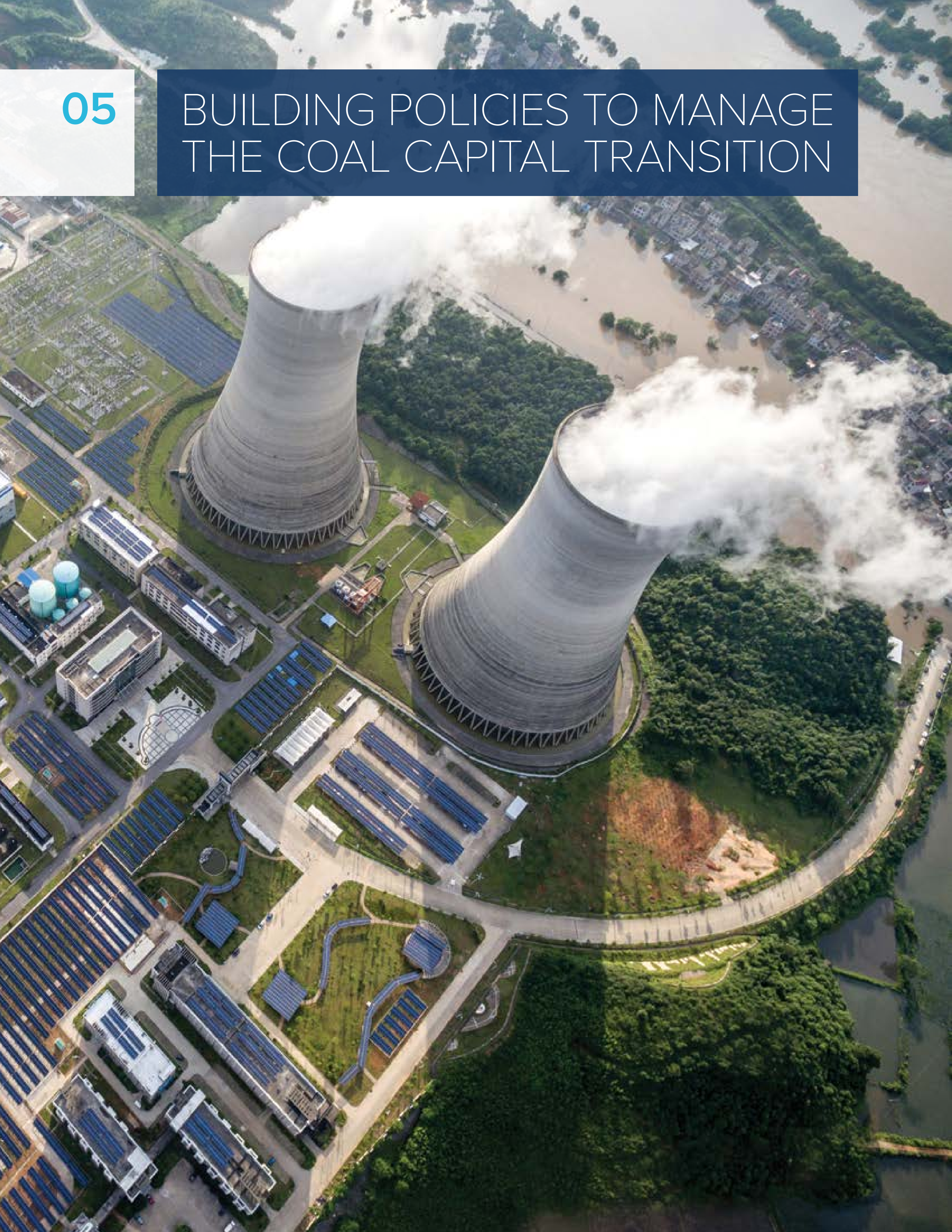
- **Decommission.** Fully cease plant operations and tear down to brownfield; write off any outstanding balance or negotiate with regulators for some level of continued recovery

The Asset Position Framework indicates the situations in which each of these six might be a dominant strategy.

FIGURE 5

ASSET POSITION FRAMEWORK





05 BUILDING POLICIES TO MANAGE THE COAL CAPITAL TRANSITION

BUILDING POLICIES TO MANAGE THE COAL CAPITAL TRANSITION

This section identifies 10 policy components for managing the capital losses associated with early retirement of coal-fired generating assets. The list was compiled by reviewing examples of managing capital losses as well as interviewing 50 expert practitioners representing asset owners, policymakers, and environmental advocates. In the first half of this section, we identify six factors that determine the applicability of policy interventions as well as the challenges they may represent. Then we identify and discuss 10 policy components for managing the capital losses associated with early retirement of coal-fired generating assets.

In the second half of this section, we identify how these components are used and combined in reality. Policy components are considered individually for sake of clarity and comparability. In practice, however, there is no one-size-fits-all approach. Coal phaseouts comprise multiple components assembled to create bespoke policy packages that fit the specific context of technical, economic, and political demands. We then directly address the selection of policy components within a political context.

KEY POLICY OPTIONS

Based on the interviews conducted, six factors stood out as especially important in shaping policy choice in a jurisdiction-specific context:

- **Power market type.** Some policy options apply only to regulated markets. Market type can also shape the ability of asset owners to pass through costs to ratepayers.
- **Policymaker capacity.** Some policies require significant decision-making authority on the part of policymakers, as well as technical and resource capacity for implementation. Policy creation also generally requires structured and well-informed bilateral dialogue with asset owners.
- **Bearer of losses.**[xii] Every approach improves the value proposition of asset retirement by either worsening the economics of continued operation or increasing the benefits of closure. This requires that capital losses are borne by some combination of government and/or asset owners. The political feasibility of this dimension must be considered in relation to policies implemented individually or in combination.
- **Ratepayer impact.** Some approaches impose costs on asset owners, but with variations in the degree to which costs can be passed through to ratepayers as higher rates. This has important implications for policy design and implementation, which are discussed more in depth below.
- **Investment climate.** If policy actions are perceived as capricious or unwarranted, they can erode trust between regulators and business, thus negatively impacting a jurisdiction's overall investment climate and hence cost of capital.

[xii] For the purposes of clarity, we consider only the proximate payer with regards to availability of funds. For example, if the loss is borne by the government through funds generated by an industrial carbon tax, the public sector is considered to have paid, even if industry originally generated the funds.

- **Moral hazard.**[xiii] Approaches where the government bears the losses—in the form of compensation to owners—typically carry a degree of risk of moral hazard. This is a risk that should be mitigated with careful timing and scoping, particularly because asset owners are rarely entitled to even partial compulsory compensation.[xiv]

Table 3 on the following page identifies and describes the 10 policy components for managing the capital losses associated with early retirement of coal-fired generating assets. It also identifies the factors that influence the applicability of components and the potential challenges of including them in policy design. Below the table, we discuss each policy component in depth, including where it may or may not be applicable and any potential challenges to its inclusion in a policy package.

Navajo Generating Station outside Page Arizona, planned to be decommissioned at the end of 2019 but may have found a new buyer.

[xiii] Providing compensation to some asset owners may encourage others to wait to retire assets—in hope of receiving future compensation—even though it is economically reasonable to close the asset.

[xiv] For more a more in-depth discussion of compensation, see Caldecott and Mitchell (2014), *Premature Retirement of Sub-Critical Coal Assets: The Potential Role of Compensation and the Implications for International Climate Policy.*

TABLE 3

10 POLICY COMPONENTS TO MANAGE THE COAL CAPITAL TRANSITION

POLICY COMPONENT	BEST APPLICABILITY	BEARER OF LOSSES (PROXIMATE)	DESCRIPTION	POTENTIAL CHALLENGES
Mandate Closure	Liberalized and state-managed markets	Asset Owner	Regulators set a date by which some/all coal-fired power must be decommissioned.	Impact investment climate
Full or Partial Disallowance	Regulated markets		Regulators determine that asset should be removed from the rate base and owner is no longer allowed to make a return on the asset.	Impact investment climate
Impose Costs	Liberalized and state-managed markets		Regulators change operating economics by increasing costs via carbon pricing or mandated pollution standards.	• Impact investment climate • Ratepayer pass-through
Remove Alternative Revenue Sources	Liberalized markets		Regulators change coal operating economics by removing ancillary revenues such as subsidies, capacity payments, or reserve payments.	Impact investment climate
Offset Losses	• All markets • Funds available • High policymaker capacity		Regulators allow owners to utilize non-coal-related funds to offset losses created by early closure of a plant, e.g., selling unused emissions allowances or monetizing carried-over tax credits.	Moral hazard
Create Regulatory Asset	• Regulated markets • Funds available • High policymaker capacity		Regulators allow cost recovery from rate base after asset retirement by utilities in regulated markets.	• Ratepayer pass-through • Moral hazard
"Soften the landing"	• All markets • Funds available		In combination with an approach that will force closure by a certain date, offer alternative revenue streams in the interim to maximize cost recovery before early closure.	• Ratepayer pass-through • Moral hazard
Accelerate Depreciation Schedule	All markets		Minimize write-offs at closure by accelerating depreciation before closure. Amount and type of recovery of incremental depreciation expense varies.	• Ratepayer pass-through (regulated markets) • Moral hazard
Take-over and Write-off	• Regulated or state-managed • Funds available		In state-managed markets, the government purchases the asset and writes off the debt. This requires that the government decommission, not mothball, the asset. Otherwise, a risk remains that the asset could be resold to a third party who then continues operation.	Moral hazard
Pay to Close	• All markets • Funds available	Government	Government offers direct compensation payments for closure, negotiated based on valuation of plant and whether full compensation will be paid.	Moral hazard

Mandate closure—In isolation from other components, mandating closure of coal assets situates all costs, both in terms of foregone revenues and in terms of asset value write-offs, on asset owners. The political feasibility of this approach could be challenging in some regions depending on the nature of the affected power market. However, it may be possible to limit stranded value through selective targeting of assets, and through supplementing the mandate with additional policy components.

In both regulated and liberalized markets, any losses are unlikely to be passed through to ratepayers. However, mandating closure in regulated markets can be challenging because owners are entitled to a specific rate of return. The regulatory feasibility of mandating closure should be determined case by case.

This component carries a potential risk of impacting the investment climate in the region if the mandate is viewed as sudden or unjustified. Such risks can be mitigated through adjustments to the time scale of implementation, and through direct engagement with the affected parties. Adjacent policies that support a healthy investment climate—for example, incentives for investment in the clean energy sector and a clear and trusted energy policy agenda—can also mitigate this risk.

Given the above-mentioned challenges associated with mandated closure, it is more common to see mandated closure (often in the form of a date setting for coal shutdown) combined with another policy component, which effectively limits the steep capital losses which a pure mandated closure would imply.

Full or partial disallowance—Applicable only in regulated power markets, the regulatory authority effectively prohibits the utility from continuing to recover all or part of the coal plant's cost from its ratepayers. In the same way as mandating closure, the owners effectively bear the full cost of early closure under this approach. The political and regulatory feasibility of this component will vary by region, depending on the nature of the regulatory power of the market. This policy can positively impact ratepayers because the plant's cost can no longer be passed through to them, particularly if other lower-cost energy options are available. However, there is a risk that disallowance can negatively impact the investment climate in the region if it is viewed as sudden or unjustified. As with mandating closure, these risks can be mitigated in the timeline of implementation, and through pairing the approach with additional policy components.

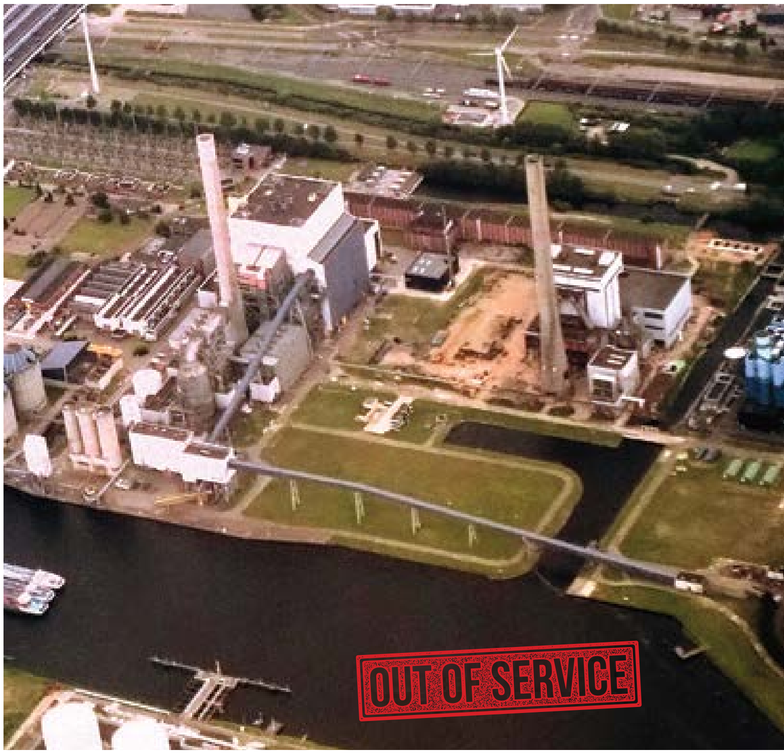


Photo courtesy Milliped for Wikimedia Commons. De Centrale Hemweg in Amsterdam. The right plant was closed in 2013; deconstruction began in 2014.

Impose costs—Policies that impose costs include such actions as introducing or increasing carbon pricing, or requiring compliance with new or stricter pollution standards. Such policies impact the operating economics of coal plants by increasing operating costs (e.g., per-unit carbon price) and/or forcing a large capital expenditure decision (e.g., installation of special equipment). Initially, highly efficient plants will be less impacted than older, less efficient coal plants for which the cost of compliance may be significant.

This component is most applicable in liberalized power markets where plants compete on cost for dispatch. (In regulated markets, plant owners would seek to recover these additional costs from their ratepayers.) Given the direct costs imposed on coal plants, political feasibility may be challenging in some regions.

Ratepayer impacts deriving from any imposed costs will depend on the degree to which costs are passed through to ratepayers. In regulated markets, ratepayers are likely to absorb these increased costs given the utilities' ability to pass through generation costs. In a liberalized power market, asset owners will also seek to pass along these costs, but the impact will depend on the overall generation mix in a particular region. For example, if coal plants are a small portion of overall generation, increased costs may make these plants more expensive than other generators; if they're dispatched less as a result, the additional costs won't be passed through. But in regions where coal is a significant share of generation and coal is often on the margin, these costs are likely to pass through to the wholesale cost of electricity, which will eventually have a rate impact.

As with other approaches that negatively impact the operating environment of the assets, there is some risk of impacting the investment climate in the region by creating the perception of "changing the rules of the game." This risk can be mitigated as discussed above.

Remove alternative revenue—Removing alternative revenue is the logical inverse of imposing costs. Rather than creating additional operational or capital expenses to alter the operating economics of the plants, this component would decrease alternative sources of revenue that plants might be receiving, such as subsidies, capacity payments, and reserve payments. Such action affects the plants' bottom line by reducing revenues rather than by increasing costs, but otherwise has similar economic, political, and ratepayer impacts. Removing alternative revenue is most applicable in liberalized power markets where actors are fully exposed to market forces and therefore absorb the losses associated with uneconomic coal plants. Political feasibility may be challenging in some regions where coal generators have significant political capital, though potentially less so than imposing new costs or taxes.

As with imposed costs, the impact on ratepayers of the removal of alternative revenue depends on the degree to which costs are passed through to ratepayers, if possible, a utility may try to make up the foregone revenues by increasing rates. The feasibility of this tactic will depend on how dispatch is determined, on wholesale rates, and on other factors. In general, one would expect more ratepayer impact in a regulated market and less in a liberalized one.

The potential negative impact on the investment climate (and the mechanisms for mitigating this risk) is similar to that of imposing additional costs, inasmuch as the policy would alter the baseline scenario according to which investors made their initial investment decision.

Offset losses—Regulators or legislators may allow owners to access funds or tax credits for which they might not otherwise be eligible in order to offset write-offs created by early closure of the plant. While this component may not be widely applicable as funds must be available to offset, it is an appealing option to mitigate the losses from the owner's perspective without relying on direct compensation from government or ratepayers. Funds for this component could come from redirecting government sources, or from the affected party's own balance sheet, for example from tax credits. While the component requires a high degree of tailoring to specific affected plants, it also provides a high degree of flexibility for owners and policymakers to tailor an approach to their particular financial context.

There is some risk of moral hazard, depending on the source of the funds for the offset. If other plants in the jurisdiction could reasonably expect similar offsets from the same source, moral hazard will be a greater risk. The risk can be mitigated by using funds particular to the affected plant, or by using legislative mechanisms to narrow the scope of the offset. In some cases, the use of offsetting losses might actually incentivize other plants in the jurisdiction to identify sources of funds on their own balance sheets, thus turning a risk of moral hazard into an opportunity for scalability.

The impact on ratepayers depends on market type. In a liberalized power market, the impact is likely to be neutral, because the revenue stream for the offset is not related to rates charged for electricity generation. In a regulated context, it could be positive if the costs of operating the uneconomic plant will no longer be passed through to ratepayers, and neither will the costs of decommissioning.

Create regulatory asset—Using this component, the utility is permitted to continue recovering the cost of the retired plant after operations cease. This component applies only in regulated power markets, as it depends on the ability of the utility to make a return on a paper asset.

This component shifts capital losses to ratepayers to some extent. Ratepayers continue to pay for the shuttered plant and, potentially, new generation asset to replace the retired capacity. However, the extent of this shift depends on the particular case—regulators may allow only partial continued return. The full burden may be addressed in combination with other components. Additionally, the net impact to ratepayers may be positive if the end result is a lower-cost generating asset.

There is some risk of moral hazard with this approach, particularly if owners are allowed to continue making a full return. This risk can be mitigated with narrow scoping of any regulatory actions, or by limiting the return that can be earned.

Soften the landing—This policy component is somewhat paradoxical, as it can at first glance appear to be supporting rather than phasing out coal operation. By "soften the landing," we refer to policies whereby, after setting a date for coal phaseout, a government may make available new revenue streams for coal plants, or continue to offer alternative revenue sources that allow the plants to continue to operate until the deadline. When paired with a firm closure plan, the increase in short-term revenues acts as a cost-allocation strategy by allowing owners to maximize plant cost recovery before the mandated early retirement date. The feasibility of this approach, which can be used in any power market, will depend to a large extent on the source of these alternative revenue streams: direct government support from taxpayer dollars will involve a different set of considerations than if the financial burden falls on ratepayers (i.e., new capacity payments). Similarly, new revenue streams will face different challenges than continued or extended existing supports. Policymakers should also be mindful that this approach carries a moderate risk of moral hazard depending on implementation specifications.

The extent to which costs are passed through to ratepayers will depend on the source of the funds (i.e., whether government or ratepayer), as well as the magnitude of funding (i.e., amount of alternative revenues). The magnitude of funding will also affect the risk of moral hazard, with smaller funding streams mitigating the risk. Policymakers should also take care that the phaseout deadline is firm. This component can only properly be understood as a cost-allocation mechanism if it is for a predetermined, finite period of time, and ends with closure of the plant.

Accelerate depreciation schedule—Allowing an owner to accelerate the depreciation of a coal plant mitigates the total write-off that the owner must take at closure. This component is likely to be tailored to specific plants rather than applied as a general policy, taking into consideration the plant's outstanding value and retirement timeline. In some cases, the accelerated depreciation strategy may originate with the owner rather than policymakers, thus reducing some of the regulatory capacity burden.

Accelerating the depreciation timeline comes with an associated additional incremental depreciation expense. The extent to which plant owners are allowed/able to recover that incremental expense informs both the likelihood of ratepayer pass-through, as well as the extent of moral hazard risk. A regulated utility may be allowed to recover the costs associated with the incremental depreciation expense from its ratepayers.

In liberalized power markets, utilities will not necessarily have that recourse, although they may be able to identify other sources of revenue to offset the incremental expense (see "Offset losses"). There is a moderate risk of moral hazard depending on these implementation specifications.

An additional consideration for regulated utilities is ensuring that the accelerated depreciation expense does not cause rate shocks to its customers. In the United States, securitization has been proposed to counter the impact of accelerated depreciation on ratepayers. Under this approach, regulators allow the utility to create a regulated asset that holds the outstanding depreciation expense, which the utility continues to recover from its customers over time through a special charge; the utility, in turn, can create a security backed by this new, dedicated revenue stream. When the security is sold to the public, it is often at a lower interest rate than the utility's typical rate of return, which means that ratepayers pay less for cost recovery than if the depreciation expense were still on the utility's books. The utility can use the proceeds from the issuance of the security to invest in cleaner and more cost-effective generation assets.

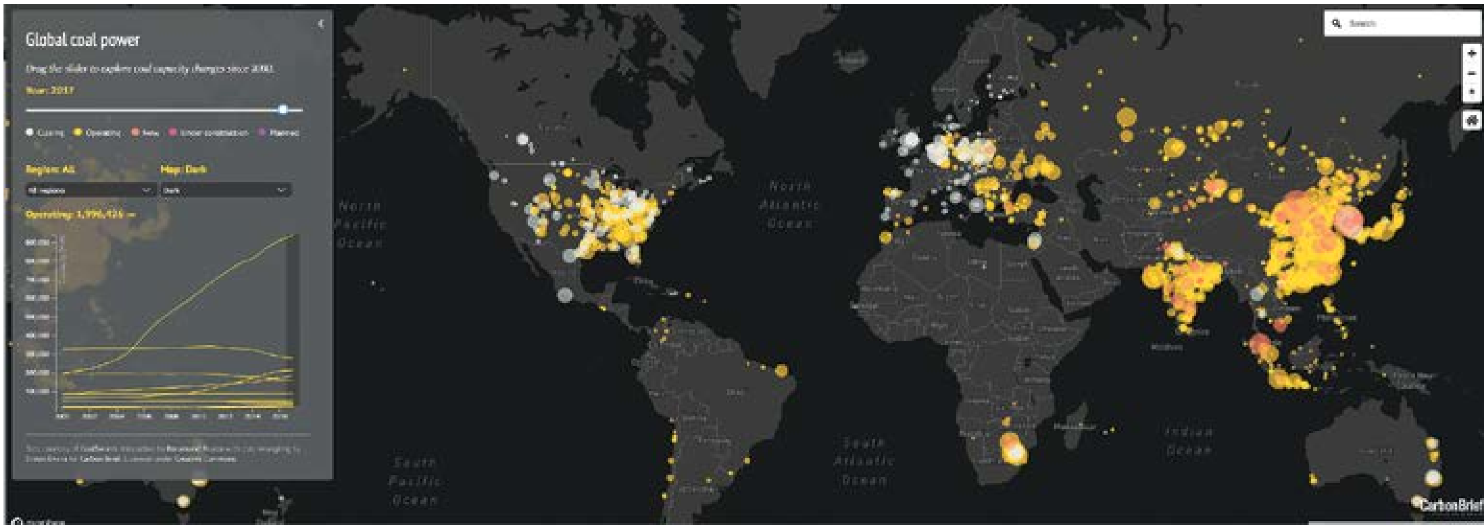
Take over and write off—This component describes an entity—for example, the state or a parent company—taking ownership of the asset and writing off its outstanding balance. This approach effectively transfers any write-off value from the original owner to the entity taking over.

In markets with state-owned enterprises, the government write-off must be financially and politically feasible. There is a high risk of moral hazard in this situation, as other firms may avoid taking the write-off by waiting for a similar opportunity. This risk can be mitigated by carefully tailoring the policy, and sending strong market signals that narrowly define when such measures will be employed. In this situation the costs of the write-off may be born by taxpayers, but not necessarily by ratepayers.

Pay to close—In using this component, the government offers owners direct compensation in exchange for the plant's closure by a certain date. The full value of the plant need not be the only possible amount for compensation; as with the other components discussed, partial remuneration can be paired with other policy components to complete a policy. Nonetheless, negotiations over the amount of compensation could be fraught if the parties use different methods to calculate the plant's value (See Dollars and Sense—Lessons on Valuation, on page 31).

Political feasibility plays a significant role in determining whether this approach is appropriate, and is particularly driven by the source of funding (e.g., taxpayer funds or ratepayer pass-through) and by the other elements of the phaseout plan (particularly provisions for labor and environmental concerns). Feasibility may increase, however, if funds are already available (e.g., carbon tax revenues). This approach involves a high risk of moral hazard as other coal plants (and even other industries) may come to expect similar payments.

Photo courtesy Sierra Club. Big Brown Coal Plant in Texas which closed in 2018.



Global coal power mapped. Data courtesy of CoalSwarm. Interactive by Rosamund Pearce with data wrangling by Simon Evans for Carbon Brief.

BUILDING COMPOSITE POLICY PACKAGES

The 10 policy components for managing capital losses discussed above were considered individually to identify the applicability and challenges of each. In practice, combining policy components provides flexibility both with the timing of policy implementation as well as with the ability to allocate—or reallocate—losses across parties. For example, a policy could include a future mandated coal phaseout date while employing other components to alter the operating economics over time, including environmental regulations that impose escalating costs while also offering alternative revenue streams in the meantime. This use of seemingly contradictory policy components, described in the United Kingdom callout box, serves as an example of how instruments can proactively manage the losses associated with early retirement of coal over time. The Case Studies section of this report provides more in-depth examples of policy components being used together to create comprehensive coal phaseout strategies.

UNITED KINGDOM

In 2015, the UK government announced that coal would be phased out by 2025, with restrictions taking effect in 2023. This utilization of the *mandate closure* approach was supported by *impose costs* mechanisms: the UK carbon price floor was increased from £9.54 to £18.08 in 2015,[24] thus negatively impacting the operating economics of the coal fleet. The government is also planning a new emissions intensity limit of 450 g CO_2 per kWh of electricity generation, which is the lever used to *mandate closure* by ensuring the closure of unabated coal by the phaseout deadline.[25]

It was expected that some of the coal fleet would retire in advance of the 2025 deadline due to increased costs. Indeed, three plants closed in 2016, and the level of coal generation in the United Kingdom has fallen in the past several years. It is down from 22% of all generation in 2015 to a record low of 2% in the second quarter of 2017.[26]

However, the government has also offered an *alternative revenue stream* by continuing to provide capacity payments to coal-fired power plants. This has proven controversial. The government argues that the capacity market allows for security of the energy supply as well as maintains the investment climate and encourages new investment in generating assets.[27] However, many argue that these capacity payments are unnecessary subsidies that the coal sector should not be receiving, with *The Guardian* characterizing payments as “an unnecessary lifeline.”[28]

The capacity payments allow the asset owners to make marginally higher returns prior to plant closure, effectively reallocating some of the closure costs away from the asset owners and toward the government or, depending on the capacity payment structure, the ratepayers. Taken together, this combination of policy components formed a comprehensive cost-allocation strategy that fits well within *soften the landing*.

Battlesea power station in the background in London.

FACTORING IN THE POLITICAL

In writing this report, we have assumed that as the magnitude of financial losses for a particular stakeholder group rises (e.g., asset owners and shareholders, government and taxpayers, ratepayers, coal interests), so too does the generation of political headwinds from that group. Thus, the selection of policy components is an expression of political confidence to stay that course.

The most apparent axis along which losses may be allocated is that which runs between asset owners and government. However, as we discuss in the Key Policy Options section of this report, the proximate payer is not necessarily the party bearing all losses today or in the future. For example, losses allocated to asset owners by various policy options can sometimes be passed on to ratepayers. This effect is demonstrated today within the context of some coal-owning US-regulated utilities. While the coal assets are more expensive than other forms of power generation, they remain in operation and the higher costs are passed through to ratepayers. India provides another example: with 71 GW of India's privately owned coal fleet facing financial distress, Indian banks effectively bear the losses by choosing to restructure bad loans instead of taking write-offs.

We do not advocate any position or set of policy components because political feasibility is best left to regional experts. All parties should note, however, that there are rarely cases where even partial compensation of asset owners and shareholders is compulsory.

Photo courtesy Dennis Schroeder for NREL. Congressional staff tour the Siemens 2.3-101, 3.2 MW wind turbine.

06 CASE STUDIES


CHINA
retire 20 GW of coal
by 2020

CASE STUDY: ALBERTA

A COMPENSATORY APPROACH

Photo courtesy David Dodge, Green Energy Futures. Sundance is the largest coal-fired power plant in Alberta with 1,566 MW of capacity.

In 2015, the Province of Alberta (Canada) announced a Climate Leadership Plan, which called for all coal-fired electricity to be phased out by 2030. Historically, coal has accounted for roughly half of the province's energy generation, and Alberta also produces more coal pollution than all other Canadian provinces combined.

At the time of the announcement, Alberta had 18 coal-fired generating units, 12 of which were already slated for retirement or conversion to natural gas within the designated time frame. Therefore, the province's focus was on the remaining six plants, owned by three companies: Capital Energy, TransAlta, and ATCO. These remaining plants had planned retirement dates ranging from 2036 to 2061.

NEGOTIATED AGREEMENT FOR COAL PLANT PHASEOUT

In early 2016, an agreement was finalized between the province and the affected companies in which Alberta would pay the three owners of the remaining plants annual "transition payments," from 2017 through 2030, equal to CAN$97 million in the aggregate. In exchange, the companies agreed to close their plants by 2030. The agreement allows coal plants to convert to natural gas rather than decommission.[29]

The starting point of calculating the annual compensation was the expected net book value of the coal-generating plants in 2030. The NBV was then prorated by the number of years the plants would have been stranded due to existing federal regulations requiring coal-fired plants to close after 50 years of operations, and then further discounted for the probability that some of the components could be reused. The NBV approach was considered more straightforward than other valuation methods since it didn't rely on the parties having to forecast future cash flows or make other forward-looking assumptions.[30]

POLITICAL AND ECONOMIC CONTEXT

Alberta has a deregulated electricity market in which roughly half of all electricity generation is coal-fired.

Beginning in 2015, Canadian regulations required coal-fired plants to meet greenhouse gas (GHG) emission standards or retire when they reach 50 years of operation, which meant that the long-term value proposition of Alberta's coal-generating assets were not infinite.[31] Also, because the province's power market is fully deregulated, coal plants would be exposed to increasing levels of competition from lower-cost generation. In addition to the declining cost of wind energy, significant natural gas reserves within Alberta means that gas-fired generation is an increasingly cost-effective alternative.[32]

At the same time, there are not many market players in Alberta, and the government wanted to ensure a healthy investment climate to encourage energy companies to continue investing in new generation (both gas-fired and renewables) in the province. In fact, the agreements require that, in exchange for the transition payments, the asset owners will:

1. invest a minimum dollar amount per year in the Alberta electricity industry;
2. maintain their operations in the province; and
3. make annual payments in support of the towns surrounding the coal plants.

SOLUTIONS SELECTED TO FORM POLICY

The primary lever of the solution to phase out coal in Alberta is direct compensation. There are also two secondary levers that play a role in this effort: Alberta's "date-setting" of 2030 to phase out coal, and the Canadian government's regulations requiring coal plants in the country to close after 50 years of operations which provide a ceiling to the level of compensation that the asset owners can realistically expect. Still, sizing the compensation amount was a complex process. The negotiations focused on three key questions:

1. Should compensation be provided?
2. What should the compensation cover (foregone future revenues or write-off of existing book value)?
3. How is compensation delivered (timeline and type)?

In the end, the parties signed a contract to close by a certain date in return for scheduled payments. This approach allows the province to meet its primary energy policy goal (coal phaseout by 2030) and the owners to recover the full cost of their plants. There were a number of factors that informed the final agreement between provincial government and asset owners. These include:

- **Investor confidence.** From a practical standpoint, Alberta is a small energy market, so incumbent players will need to be part of the future generation mix in any transition scenario. At the same time, the provincial government needed to attract new market entrants—including developers of gas-fired power plants—to invest in the generation sources that will replace the phased-out coal power. Indeed, the province has a “30 by ’30” renewable energy target, in which 30% of the electricity mix in 2030 will come from solar, wind, and hydro generation.

For both these reasons, maintaining investor confidence was a key consideration for the government. Reaching an agreement that allowed full recovery of the coal plants’ costs was a way to neutralize any potential investor concerns that the province was seeking policy goals at the expense of the investment community.

- **Existing funds.** One reason compensation was politically feasible is that the compensation payments are not funded by ratepayer surcharges or directly from taxpayers. Rather, Alberta has an existing stream of provincial carbon tax revenues that will be used to make the annual transition payments.[33]

- **Durability.** Crafting a multiyear agreement that satisfies the plant owners’ desire for recovering their initial investment provides sufficient incentives for asset owners to preserve the deal regardless of any future election outcome.

- **Power market.** Given that Alberta’s power market was deregulated in 2000, the last remaining PPAs in the province were due to sunset by 2020. Without long-term contracts for their power, owners of coal-fired generation plants would be exposed to a more competitive landscape in which the cost of other generation (gas, wind) is on a declining trajectory.[34]

- **Fuel-source alternatives.** With its abundant indigenous natural gas resources, it is feasible for coal-generation owners subject to this agreement to convert their plants to gas-fired generating assets rather than to close permanently. From a supply security perspective, coal-to-gas conversion had to be part of the mix since roughly half of the province’s power generation is coal.

- **Environmental regulations.** Along with federal regulations that mandate closure of coal plants after 50 years of operations and encourage coal-to-gas conversion, many market participants in the province expected higher carbon pricing, so asset owners have an incentive to convert their coal-fired plants in the near term.

KEY TAKEAWAYS

The agreement resulted from a series of bilateral discussions between the government and the individual companies whose plants were subject to the policy. This high-touch approach may not be feasible everywhere, depending on the government's resource capacity and the number of affected parties.

The agreement's success was due in large part to two primary factors. For the asset owners, the cost competitiveness of coal power in a fully deregulated electricity market was less compelling that it once was; cheaper sources of energy were expected to negatively impact coal generation in the long term. With natural gas infrastructure readily available in the province, the government's coal phaseout initiative helped speed up a decision to close or convert coal plants that was likely to be taken at some point anyway.

For Alberta, having a source of funds from a provincial carbon tax available to fund the transition payments made this approach more politically palatable than if the province had to tap general taxpayer revenues or levy ratepayers. It also helped that labor was not a significant issue: the existing coal is imported from outside the province, so there were no Alberta miners impacted. Also, the coal plant workers are expected to be redeployed to other plants, or remain at the existing plants that convert to gas.

Photo courtesy David Dodge, The Pembina Institute. Genesee coal-fired power plant in Alberta.

CASE STUDY: CHILE

PHASE OUT ANNOUNCED

Photo courtesy Gobierno de Chile. President Bachelet at the inauguration ceremony of the 141 MW Luz del Norte solar farm in 2014.

Over the past decade, coal has become the largest fuel source of Chile's electricity sector, mainly due to sharp decreases in Argentine gas exports, which had previously been the primary source of the country's power generation. There are 28 coal plants in the country, some of which are fairly new (35% are less than five years old), while half of the plants (37% by installed capacity) will be at least 30 years old by 2020.[35]

In 2015, the Chilean government released "Energía 2050," an energy policy plan that calls for renewables to represent 60% of the country's energy mix by 2035 and at least 70% by 2050, coupled with a 30% target reduction of GHG emissions.[36] Since coal represents the largest source of electricity generation (40%), it is clear that coal phaseout would have to be part of any strategy to meet the country's 2050 energy goals.

BEGINNINGS OF A COAL PLANT PHASEOUT PLAN

In early 2018, the Chilean government announced an agreement with Asociación de Generadoras, the trade group representing the country's major utilities, that no new coal-fired power plants would be built without carbon capture and storage. Moreover, the parties agreed to form a working group to develop a plan to replace existing coal capacity with renewables, in line with the Energía 2050 plan.

While no details have surfaced regarding the timeline of—or potential compensation for—closing the country's coal power plants, it is nonetheless remarkable that the main power generators in a country would make an in-principle commitment to phase out coal.

On the heels of this announcement, Engie SA, the French power company and a member of Asociación de Generadoras, announced that it was going to close its coal plants in Chile and replace them with renewables. No further details or timeline have been announced. Engie has three coal-fired power plants in Chile, which produce an aggregate 7.5 GWh of electricity each year. Philip De Cnudde, CEO of Engie Latin America, explained the rationale for shuttering the plants rather than trying to sell them. As he told Bloomberg, "Selling coal plants in the current circumstances is not good. We can't get a good value."[37]

Notably, Engie is not exiting the Chilean market entirely; rather, it will invest in cost-competitive renewable energy, like wind and solar, to meet its generation needs.

POLITICAL AND ECONOMIC CONTEXT

While the Chilean government and the major utilities have not finalized a plan for phasing out coal, there are clear factors that brought the utilities to the table to reach this in-principle agreement.

- **Political factors.** The Chilean government signaled its intention to transition away from coal-fired generation through its Energía 2050 plan, which calls for heavy deployment of renewables in the coming decades. While there is no specific call to phase out coal, the plan's goals to sharply increase renewables and decrease GHG emissions are not consistent with continued reliance on coal-fired generation.

- **Impose costs.** In 2014, Chile passed legislation that imposed a tax of $5 per ton of carbon dioxide released from thermal power plants with capacities greater than 50 MW. Although the tax is lower than what has been imposed in other countries and no increases are built into the enabling legislation, the tax does serve to increase the cost of coal-fired generation at a time when it has become less cost-competitive relative to renewables. The carbon tax took effect on January 1, 2018—the same month the Chilean government and the country's utilities announced the coal phaseout initiative.

- **Increased cost competitiveness of alternative energy sources.** Solar energy has become increasingly competitive in the Chilean market, where electricity derived from the sun is often half the cost of coal-generated electricity—and that's without any subsidies for solar power. A number of factors contribute to low-cost solar, including a strong solar resource, the declining cost of photovoltaic panels, and a regulatory change that divides the electricity day into three blocks—one of which is all daylight—which benefits solar parks that can bid energy in the middle third.

  Further favoring Chile's turn to solar power is that, unlike other geographies, gas is not a cost-effective alternative to coal power. Chile has minimal gas reserves, Argentina has exported much less gas in the past decade to its neighbor, and importing of liquefied natural gas is expensive.

- **Low levels of indigenous coal.** Chile imports 80% of the coal used for its thermal plants so there are few entrenched interests in promoting a coal-based economy.

KEY TAKEAWAYS

The January 2018 announcement of a working group to figure out the phaseout of coal in Chile is the start of a complex process. It's not yet clear what the final coal phaseout process will entail nor what sort of capital transition assistance—if any—will be part of the plan. Still, the forces that brought the utilities to the table in the first place are likely to be the ones that will shape the final agreement.

Photo courtesy Antonio Garcia on Unsplash. Solar farm in Chile's Atacama Desert.

CASE STUDY: CHINA

RETIREMENT MANDATE, SOMETIMES WITH A CATCH

Photo courtesy Wikimedia Commons. Jungliangcheng Power Plant, China

Beginning in 2016, China's National Development and Reform Commission (NDRC) and National Energy Administration (NEA), along with other national government agencies, released a series of policies designed to retire coal generating units and postpone new-build coal capacity. These policies include the "Notice on Further Implementing Coal Generation Retirement" and "Guidance on Supply-Side Reform to Prevent and Address the Coal Overcapacity Issue".[42] These policies address the 13th Five-Year Plan's (FYP) goal of retiring 20 GW of coal generation as part of limiting total coal-generating capacity to 1,100 GW from 2016 to 2020. The country retired 5 GW in 2016, 4 GW in 2017, and is targeting the retirement of a further 4 GW in 2018.[43]

Under national-level guidance, provincial authorities are responsible for implementing policies. Provinces are required to inspect and audit all generators under 300 MW in their jurisdiction to ensure they meet the efficiency and pollution criteria and then submit a list of planned plants for retirement to NDRC and NEA. Provincial agencies are required to review plant owners' applications for compensation and decide on a compensation mechanism. Several potential compensation mechanisms are recommended and offer ways to offset losses from closure, for example, by allowing the construction of larger, more efficient, and environmentally compliant generators elsewhere.

POLITICAL AND ECONOMIC CONTEXT

During the 2000s, the Chinese government supported the construction of new coal plants to address the historic issues of electricity shortages. This led to significant overbuild, the impacts of which have become particularly acute over the 12th FYP, as the average load factor of coal generators has declined from 61% in 2011 to 47.5% in 2016.[44] This has led to economic losses for many generators, which these policies attempt to address by implementing the coal capacity cap.[xv]

Air quality concerns are another significant driver of policies intended to retire coal capacity. To address these concerns, retirement policies are targeted at older, less efficient plants, particularly those that do not comply with existing regulations. Replacement capacity must be environmentally compliant as well as more efficient. Similar local and provincial policies had been in place prior to the 13th FYP, yet it was deemed that a national policy was needed because those efforts were undercut by plants in neighboring provinces that continued to contribute heavily to poor air quality in cities.

While the 20 GW closure target looks to be achievable, China currently has 1,050 GW of operational coal capacity with a further 200 GW of capacity planned. The impact of offering asset owners a chance to replace capacity may contribute to this significant pipeline of planned projects, which seems likely to take China beyond its 1,100 GW coal cap.

[xv] It is worth noting that planned projects are not always approved for construction. Even projects that are started are not always completed.

POLICY APPROACHES

- Mandate closure. Policies require closure of any coal-fired plant that fails to meet minimum thresholds for size (e.g., single condensing coal unit <50 MW), as well as efficiency and pollution standards. Approximately 80% of retired capacity was owned by large state-owned enterprises (SOEs). For example, Datang, a large SOE, took a proactive role in retiring its coal fleet and plans to shut down 14 units under 20 MW (2.6 GW in total) over the course of the 13th FYP.[46] Smaller local generators have participated far less because, relative to large SOEs, they lack the access to capital and capabilities to develop new projects. They also receive less regulatory oversight than large SOEs.

- Offset losses. While mandatory closure for noncompliance was the enforcement mechanism, the policies also offer potential alternative revenue sources. First, policies allow owners to replace the retired units with new, more efficient, and environmentally compliant plants of equal aggregate capacity. Second, policies grant up to five years of tradable generation rights for owners unable to replace their retired capacity. Third, policies allow land to be transferred or used for another five years for other non-heavy industry business encouraged by the government. In China, land is owned by the state, and companies can only buy and be granted rights to use the land.

KEY TAKEAWAYS

China is using administrative authority to mandate the retirement of coal generators while providing some support for firms that stand to bear the losses of closure. China seems to be on track to meet the 20 GW closure target of the 13th FYP, though much of the capacity that has been closed will be replaced with more efficient units. This will lower contributions to air pollution, but will lessen the contributions of closures to the coal cap. On-the-ground implementation at the provincial level offers some important considerations for policymakers looking to close coal-fired power stations within a realistic context of economic necessities and multiple policy objectives.

Market conditions

One intention of these policies is to encourage larger, more efficient, and environmentally compliant generators. Asset owners are allowed to build replacement capacity outside of the province where generators were closed, presumably to allow generation to move where overcapacity concerns are less acute in order to balance the market overall. Furthermore, by granting generation rights to asset owners that retire capacity without replacing it, policies provide economic support to the remaining generators, which are likely more efficient and environmentally compliant. This also softens the landing for firms that only close plants.

Environmental regulations

The contributions of coal-fired power stations to air pollution have drawn significant public attention in recent years. These concerns are a strong driver behind the use of mandatory closures as well as the selection criteria (i.e., generator size, efficiency, and environmental compliance). It seems that policies are designed to deliver theoretical, if not actual, air-pollution reduction; however, the net capacity reduction is much less clear due to both mandating retirement and allowing some replacement. Thus, the contribution of policies to the coal cap of 1,100 GW is questionable.

Implementation capacity

Perhaps most notable are the takeaways on implementation capacity. Policies were mandated at the national level yet they are being implemented at the provincial level, including the negotiation of compensation between firms and provincial governments. Without transparent and standardized terms for this process, policy implementation has proven challenging in terms of the thoroughness of plant inspections and the potential overcompensation of firms.

CASE STUDY: COLORADO

SOMETHING FOR EVERYONE

Colorado Springs city skyscrapers and coal power plant steam.

Colorado's electricity system is regulated; utilities are vertically integrated and own both generation and distribution systems. Over half of Colorado's electricity generation comes from coal (55%), a quarter is derived from natural gas, and the remainder comes from a combination of wind, solar, and hydro. In 2004, Colorado became the first state in which voters passed an amendment to institute a renewable portfolio standard; since the vote, renewable energy resources have increased in the state from 2% to 22% of generation.[47]

Xcel Energy, the biggest regulated electric utility in Colorado, owns 72 power plants in the state, with an aggregate capacity of 17 GW—40% of which is coal fired.[48]

In 2017, Xcel Energy sought approval from the state's regulatory body to retire, by 2025, two coal-fired plants and replace them with new wind, solar, and natural gas generation. The plan was filed with the support of a diverse group of stakeholders in the state, including environmental and ratepayer advocacy groups, construction and labor associations, and renewable energy developers. According to Xcel, its "Colorado Energy Plan" would reduce the share of the state's energy mix generated by coal plants from 46% to 23% within a decade.

The Comanche Generating station, located in Pueblo, CO, consists of three units. The two slated for retirement, with an aggregate capacity of 660 MW, came on line in the early 1970s; the third unit—which will continue to operate—has a capacity of 750 MW and was commissioned in 2010.[50]

COMPREHENSIVE COAL PHASE-OUT PLAN

Xcel and its stakeholder partners put forth a plan comprised of a number of elements that, taken together, are designed to holistically address the operational and financial implications of shuttering the two Comanche units. The Colorado Energy Plan states that Xcel will:[51]

- Retire the two oldest units of the Comanche Generating Station by 2025
- Seek to accelerate depreciation of the units to align with their new retirement dates
- Issue a competitive bidding process to source new generation to replace the retired units (coal generation would not be eligible.)
- Own a portion of the new generation, with the balanced to be owned by independent power producers
- Seek to reduce a state-mandated renewable energy rider currently levied on ratepayers

BUILDING BLOCKS OF THE SOLUTION

Given the comprehensive approach to crafting the Colorado Energy Plan, it is little surprise that it contains a number of approaches discussed in this report. Notably, this plan was not initiated by Colorado regulators; rather it was developed by the utility in consultation with numerous stakeholder groups.[xvi] Still, the analysis below provides a framework for understanding the factors that enabled so many disparate groups to support a plan to close the Comanche power plants.

- **Accelerated depreciation.** At the time of the filing, Xcel estimated that the cost of closing the plants early, including accelerated depreciation and decommissioning, would be around $200 million. The Colorado Energy Plan would allow Xcel to accelerate the depreciation remaining on the plants at the time of closure and, as a regulated utility, pass those costs on to its ratepayers.

- **Regulatory asset.** Xcel proposes to delay the recovery of the accelerated depreciation from its ratepayers by setting up a regulatory asset that will collect the incremental expense associated with early retirement of the Comanche units (accelerated depreciation and other costs).

- **Offset capital loss**. While the Colorado Energy Plan would allow Xcel to fully recover the costs of the units being retired, that alone would not address the long-term financial implications of Xcel losing two regulated assets. Xcel therefore sought the ability to own a substantial portion of the generating assets expected to replace the Comanche units. Indeed, the plan calls for Xcel to own a target of 50% of new renewable energy generation and 75% of gas-fired plants.

- **Impacts on ratepayers.** Concerns that rate shocks would result from allowing Xcel to recover from ratepayers the accelerated depreciation associated with the Comanche plant closures were moderated by: (1) the proposal to redirect half of the Renewable Energy Standard Adjustment (RESA) funds ratepayers are already paying to recover the accelerated depreciation and; (2) the cost of new renewable energy generation being significantly lower than the cost of the coal-fired generating it would replace. Thus, while ratepayers would be paying more per unit of electricity than the market rate for solar, they would be paying less per unit of electricity than they are currently paying for power from the Comanche plants.

[xvi] In March 2018, Colorado regulators allowed Xcel to move forward and develop the details of the plan; further regulatory approvals are necessary for full implementation, and the plan may undergo changes as a result.

It is instructive to revisit the key criteria discussed in the 10 Policy Components section in the context of the approaches that the Colorado Energy Plan draws together. Indeed, it is a good example of how heavily the local context weighed on the formulation of the plan and how many disparate elements had to be weaved together to create a solution that addressed stakeholder concerns.

- **Availability of funds.** Colorado ratepayers are already subject to the RESA, a state-mandated renewable energy rider on utility bills. RESA revenues are designed to fund the incremental costs the state's utilities incur in integrating renewables on to the grid and help utilities meet the renewable portfolio standard adopted by popular vote in 2004. Ratepayers in Xcel's service territory pay a 2% rider each month to fund the RESA. As the cost of renewables has decreased dramatically in recent years, Xcel argues that a 1% RESA rider is sufficient for that purpose and proposes to redirect proceeds from the other 1% to recover the accelerated depreciation expense associated with the newly created regulatory asset (described above).

Arapahoe Station Coal fired power plant Denver Colorado

- **Alternative energy sources.** A key factor supporting Xcel's plan is the prevailing reduction in renewable energy costs. Indeed, Xcel issued a solicitation for new energy resources in 2017 and received over 230 project bids, with the median cost of wind ($18.10/MWh) and solar ($29.50/MWh) falling below the cost of running the Comanche units ($31/MWh).[53]

- **Policy considerations.** Given that the federal tax credits supporting wind and solar projects are due to expire in the early 2020s, there was a strong incentive for parties to lock in historically low renewable energy prices.

- **Muted political opposition.** Given that the coal supply for the Comanche units comes from Wyoming, there was little anticipation of pushback from Colorado coal mining interests.[54]

SOMETHING FOR EVERYONE

The scope of the Colorado Energy Plan speaks to the range of stakeholders consulted in its formation. Indeed, the number of elements brought together to support the Comanche retirement plan is evidence of the complex balancing act required to address the needs and concerns of the plants' owner, ratepayers, project developers, and environmental advocacy groups. In fact, Xcel wrote in its filing that elements of the Colorado Energy Plan "are not severable and work in concert with one another."

Under the terms of the proposed plan, Xcel would fully recover the costs of two plants being retired through accelerated depreciation. It would also have the opportunity to own a significant portion of generation set to replace the 45-year-old plants, creating new assets whose cost Xcel will be able to recover from ratepayers in the coming decades.

The plan appeals to environmental advocates because it would secure the early shuttering of two aging coal plants, as well as a significant increase in renewable energy generation in Colorado. That increase in new generation was designed to draw the support of independent power producers, along with labor groups anticipating construction jobs. The concerns of ratepayers are addressed in the plan through a combination of redirecting existing fees toward Xcel's recovery of the accelerated depreciation balances and the low cost of new generation that will replace the retired coal plants.

Although the plan Xcel has put forward has drawn support from various stakeholder groups, final approval from Colorado regulators is still required. It will be interesting to see what proposed adjustments, if any, they will seek to this carefully crafted plan.

Photo courtesy Dennis Schroeder for NREL. Anna Craig stands on the top of the GE/Alstom wind turbine at the National Wind Technology Center..

07 CONCLUSION

Photo courtesy Dennis Schroeder for NREL of Ivanpah Solar Power Facility in the California Desert.

CONCLUSION

This report presents the first global survey of approaches that can help mitigate capital destruction for asset owners and their shareholders while offering policymakers a clearer path toward transitioning the power generation's capital stock away from coal toward green investments, in line with keeping warming below 2C°. In doing do, it has sought to strike a balance of perspectives among coal asset owners, policymakers, and environmental advocates. Indeed, stranding coal assets is not—and should not be—part of an energy transition strategy; the loss of value associated with stranded assets is an undesirable consequence that, while to some extent inevitable, should be actively mitigated to ensure that all stakeholders are on board with the direction of the energy transition. Above all, the conclusion is that managing the coal capital transition through pragmatic collaboration among asset owners, environmental advocates, and policymakers can allow each stakeholder group to achieve its core objectives more effectively. The takeaways for each group are as follows.

POLICYMAKERS

- Policymakers can balance the environmental necessity of accelerated coal plant retirement with thoughtful, managed allocation of the associated capital losses that builds support among key political constituencies for the energy transition. This report offers a toolkit of policy approaches capable of spurring faster energy transition through dialogue rather than adversarial approaches.

- It is important to understand how the economics of coal impact the operation of coal plants in a given geography. Depending on the financial position of assets, asset owners may be looking for or open to exploring an exit strategy. The Asset Position Framework provides guidelines for structuring policymakers' understanding of the legitimate business perspective of asset owners as well as which approaches they may find acceptable.

- From an asset owners' perspective, pursuing policy change to delay the clean energy transition can be rational and not a function of ideology or political preferences.

- The challenge is to present an alternative economic equation to incumbents that is sufficiently attractive to encourage acceptance of, rather than resistance to, the notion of early asset closure. We have laid out the steps for identifying which solutions may be applicable given context-specific considerations, as well as the risks that should be considered.

- As discussed throughout this report, losses from coal are already accruing across many geographies, though they may be currently borne by parties other than the asset owner (as in the case of ratepayers in US-regulated markets and banks in the context of Indian IPPs). As policymakers address accruing losses or consider introducing new losses, they should carefully balance maintaining the credibility of the local investment climate with addressing the serious issue of moral hazard. It should be noted clearly that asset owners very rarely have a claim to even partial compulsory compensation.

- There is no one-size-fits-all policy solution. Components can be combined to create a package tailored to the needs of all stakeholders involved. Depending upon the chosen approaches, the question of policy institutions' technical and human capacity to design and implement the solution can be critical.

- Key to productive dialogue is ensuring that outcomes are viewed as equitable among all stakeholders affected by stranded assets. We recommend that environmental advocates and advocates of labor and local communities be included in dialogue to ensure that outcomes are as broadly equitable as possible.

ASSET OWNERS

- Regardless of political debates and the prospect of painful adjustment costs, it is time to acknowledge that coal-fired power generation is in structural decline worldwide. We recognize that there are and will continue to be exceptions to this structural decline and that asset owners are best placed to understand these exceptions. But eroding economics and declining load factors globally tell the story clearly regardless of one's view of the merits or durability of climate policy.

- While the decline of coal-fired power generation is at different stages across geographies, some capital destruction associated with early closure due to both economic and regulatory stranding is inevitable.

- Proactive planning for the end of the coal era can preserve shareholder value and avoid financial shocks to equity and debt holders alike. We do not advocate fighting economic realities through winning short-term concessions, such as capacity payment extensions. Even though in one sense this approach is a rational response to declining economics, it also presents a significant opportunity cost compared to making material strategy shifts and redeploying capital to assets with long-term growth potential, like solar and wind.

- The Asset Position Framework offers a simple guidepost for developing a strategy, and a starting point for engaging pragmatically with regulators. Asset owners can consider the policy options presented in this paper and ask themselves what it would take in strict economic terms to make them indifferent to plant closure. By taking the initiative and thinking creatively about balance sheets and asset management strategies, owners might craft an appealing exit strategy that is superior to losing an adversarial regulatory battle.

- Asset owners should acknowledge that from a policymaker's perspective, they rarely have claim to compulsory compensation and that moral hazard is a real and legitimate concern. However, policymakers also have a strong incentive for pragmatic dialogue, understanding that political confrontation is costly, and that long-term benefits to the energy sector, communities, and general investment climate can be significant if policy actions are perceived as pragmatic, predictable, and equitable.

- While they may feel frequently at odds with environmental advocates, coal asset owners should build on the principles for a just transition of labor. Advocates are seeking a faster transition in the energy economy, and have acknowledged the legitimate need to address the adjustment costs of communities and workers. To the extent that asset owners are willing to explore analogous solutions that facilitate early retirement, seeking alignment with advocacy groups and joint approaches to policymakers can be particularly powerful.

ENVIRONMENTAL ADVOCATES

- To accomplish the early retirement of the coal fleet requires acknowledging that from an asset owner's perspective, opposing policies that would cause such financial hardship is economically rational. Their opposition to climate and clean energy policies is evident and powerful and it will continue to have a material effect on the pace of the global energy transition unless better alternatives are developed that affect their preferences. It is our view that a tone of pragmatism is the most effective way forward given the quickly changing economic environment for coal generation.

- The stranding of coal assets threatens the destruction of value for asset-owning companies and investors just as it does for workers and communities. The just transition for labor is motivated not only by equity and moral considerations, but also by the practical need to align labor and environmental votes. Similarly, it will be helpful for environmental advocates to understand the economic rationale behind climate opposition if they hope to neutralize it. Therefore, an integrated approach to addressing layoffs and write-offs associated with early coal plant retirement is essential.

- Many of the solutions that we present here come with difficult trade-offs, using funds that will undoubtedly be limited. Environmental and labor advocates must work alongside policymakers and asset owners to ensure that these trade-offs are being weighed appropriately.

- Once agreed on, approaches that provide some financial support in the present in exchange for closure in the long term (e.g., in Alberta as shown in the Alberta case study) should be enforced contractually by policymakers as well as in the public sphere by advocates.

Photo courtesy Dennis Schreeder for NREL. Contracted workers clean Heliostats at the Ivanpah Solar Project.

08 ENDNOTES

ENDNOTES

[1]Simon Evans and Rosamund Pearce, "Mapped: The world's coal power plants," *Carbon Brief,* May 6, 2018, **https://www.carbonbrief.org/mapped-worlds-coal-power-plants**

[2]Ibid.

[3]"Lignite of the living dead," *Carbon Tracker,* December 8, 2017, **https://www.carbontracker.org/reports/lignite-living-dead/**

[4]Tom Randall, "Solar and Wind Just Passed Another Big Turning Point," *Bloomberg News,* October 6, 2015, **https://www.bloomberg.com/news/articles/2015-10-06/solar-wind-reach-a-big-renewables-turning-point-bnef**

[5]"No country for coal gen – Below 2°C and regulatory risk for US coal power owners," *Carbon Tracker,* September 13, 2017, **https://www.carbontracker.org/reports/no-country-for-coal-gen-below-2c-and-regulatory-risk-for-us-coal-power-owners/**

[6]"Accelerating India's Clean Energy Transition," *Bloomberg New Energy Finance,* November 28, 2017, **https://data.bloomberglp.com/bnef/sites/14/2017/11/BNEF_Accelerating-Indias-Clean-Energy-Transition_Nov-2017.pdf**

[7]Tim Buckley and Kashish Shah, "India's Electricity Sector Transformation," *IEEFA,* November 21, 2017, **http://ieefa.org/wp-content/uploads/2017/11/India-Electricity-Sector-Transformation_Nov-2017-3.pdf**; and **https://www.bloomberg.com/news/articles/2018-06-24/abandoned-power-plant-a-38-billion-warning-sign-for-india-banks;** and **http://www.cfo-india.in/article/2018/04/06/banks-stare-38-bn-pile-bad-loans-power-sector-report**

[8]"In 2017, the newly installed photovoltaic power generation has a total installed capacity of 53.06 million kilowatts [Translated]," *National Energy Administration,* January 24, 2018, **http://www.nea.gov.cn/2018-01/24/c_136920159.htm;** and "2017 wind power grid operation [Translated]," *National Energy Administration,* February 2, 2018, **http://www.nea.gov.cn/2018-02/01/c_136942234.htm**

[9]Yiyi Zhou and Sophie Lu, "China's Renewables Curtailment and Coal Assets Risk Map," *Bloomberg New Energy Finance,* October 25, 2017, **https://data.bloomberglp.com/bnef/sites/14/2017/10/Chinas-Renewable-Curtailment-and-Coal-Assets-Risk-Map-FINAL_2.pdf**

[10]"No country for coal gen – Below 2°C and regulatory risk for US coal power owners," *Carbon Tracker,* September 13, 2017, **https://www.carbontracker.org/reports/no-country-for-coal-gen-below-2c-and-regulatory-risk-for-us-coal-power-owners/**

[11]"Chasing the Dragon? China's coal overcapacity crisis and what it means for investors," *Carbon Tracker,* November 27, 2016, **https://www.carbontracker.org/reports/chasing-the-dragon-china-coal-power-plants-stranded-assets-five-year-plan/**

[12]"Corporate Carbon Policy Footprint - the 50 Most Influential," *InfluenceMap,* September, 2017, **https://influencemap.org/report/Corporate-Carbon-Policy-Footprint-4274a464677481802bd502ffff008d74**

[13] Robert Walton and Gavin Bade, "FirstEnergy asks DOE for emergency action to save PJM coal, nuke plants," *UtilityDive,* March 29, 2018, **https://www.utilitydive.com/news/firstenergy-asks-doe-for-emergency-action-to-save-pjm-coal-nuke-plants/520280/**

[14]Adam Gartrell, "Coal industry campaign dwarfs political spending by green groups," *Sydney Morning Herald,* February 2, 2018, **https://www.smh.com.au/politics/federal/coal-industry-campaign-dwarfs-political-spending-by-green-groups-20180201-p4yz6i.html**

[15]Sara Stefanini, "Big coal no more," *Politico,* March 20, 2018, **https://www.politico.eu/article/coal-lobby-electricity-energy-union-big-coal-no-more/**

[16]Carbon Tracker, **https://www.carbontracker.org/refs-and-resources/terms-list/#stranded-assets**

[17]Atin Jain, *India Slashes Power Demand Forecast: Assessment of Latest Electricity Demand Forecasts by Central Electricity Authority,* BNEF (April 5, 2018).

[18]Tim Buckley and Kashish Shah, *India's Electricity Sector Transformation: Momentum Is Building; Peak Coal In Sight,* Institute for Energy Economics and Financial Analysis, November 12, 2017, **http://ieefa.org/wp-content/uploads/2017/11/India-Electricity-Sector-Transformation_Nov-2017-3.pdf,** and *Uncompetitive: Coal's Cost Disadvantage Grows as Renewable Tariffs Plummet,* Greenpeace India Society, December 2017, **https://aaf1a18515da0e792f78-c27fdabe952dfc357fe25ebf5c8897ee.ssl.cf5.rackcdn.com/1862/Uncompetitive+-+CoalTariffBriefingDec2017.pdf?v=1513842142000**

[19]Rajesh Kumar Singh and Anto Antony, "Abandoned Power Plant a $38 Billion Warning Sign for India Banks," *Bloomberg News,* June 24, 2018, **https://www.bloomberg.com/news/articles/2018-06-24/abandoned-power-plant-a-38-billion-warning-sign-for-india-banks;** and CFO India, "Banks Stare At $38 Bn Pile Of Bad Loans From Power Sector: Report," *CFO India,* April 6, 2018, **http://www.cfo-india.in/article/2018/04/06/banks-stare-38-bn-pile-bad-loans-power-sector-report**

[20]Singh, "Abandoned Power Plant a $38 Billion Warning Sign for India Banks," *Bloomberg News*

[21]Noor Mohammed, "With New RBI Norms, Power Sector May Identify Additional Rs 1.75 Lakh Crore of NPAs," *The Wire,* April 9, 2018, **https://thewire.in/banking/rbi-norms-npa-power-sector**

[22]Singh, "Abandoned Power Plant a $38 Billion Warning Sign for India Banks," *Bloomberg News*

[23]"Implementing the End of Unabated Coal By 2025: Government response to unabated coal closure consultation," *Department for Business, Energy, & Industrial Strategy,* January 2018, **https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/672137/Government_Response_to_unabated_coal_consultation_and_statement_of_policy.pdf**

[24]Arthur Neslen, "Carbon floor price hike will trigger UK coal slowdown, say analysts," *The Guardian,* April 2, 2015, **https://www.theguardian.com/environment/2015/apr/02/carbon-floor-price-hike-will-trigger-uk-coal-slowdown-say-analysts**

[25]"Implementing the End of Unabated Coal By 2025," *Department for Business, Energy, & Industrial Strategy*

[26]Adam Vaughan, "The coal truth: how a major energy source lost its power in Britain," *The Guardian,* July 19, 2017, **https://www.theguardian.com/business/2017/jul/19/how-coal-lost-power-britain**

[27]"Implementing the End of Unabated Coal By 2025," *Department for Business, Energy, & Industrial Strategy*

[28]Adam Vaughan, "UK government spells out plan to shut down coal plants," *The Guardian,* January 5, 2018, **https://www.theguardian.com/business/2018/jan/05/uk-coal-fired-power-plants-close-2025**

[29]Geoffrey Morgan, "Alberta to pay three power companies $1.36 billion to shut their coal-fired plants early," *Financial Post,* November 24, 2016, **https://business.financialpost.com/commodities/energy/alberta-strikes-1-36-billion-deal-with-coal-companies-as-part-of-plan-to-shut-down-plants-early**

[30]Terry, Boston, "Letter to the Premier of Alberta," September 30, 2016, https://www.alberta.ca/documents/Electricity-Terry-Boston-Letter-to-Premier.pdf

[31]Shawn McCarthy, "Ottawa unveils new coal-fired plant emissions rules," *The Globe and Mail,* September 5, 2012, https://www.theglobeandmail.com/report-on-business/industry-news/energy-and-resources/ottawa-unveils-new-coal-fired-plant-emissions-rules/article4522237/

[32]Darcy Henton, "Terry Boston, the $600,000 man, takes on big coal," *Calgary Herald,* March 18, 2016, https://calgaryherald.com/news/politics/terry-boston-the-600000-man-takes-on-big-coal

[33]Geoffrey Morgan, "Alberta to pay three power companies $1.36 billion to shut their coal-fired plants early," *Financial Post,* November 24, 2016, https://business.financialpost.com/commodities/energy/alberta-strikes-1-36-billion-deal-with-coal-companies-as-part-of-plan-to-shut-down-plants-early

[34]"Alberta Wholesale Market: A description of basic structural features undertaken as part of the 2012 State of the Market Report," *Market Surveillance Administrator,* August 30, 2012, https://albertamsa.ca/uploads/pdf/Archive/2012/SOTM Basic Structure 083012.pdf

[35]"Energy Policies Beyond IEA Countries - Chile Review 2018," *International Energy Agency* (2018): p. 81-82, http://www.iea.org/publications/freepublications/publication/EnergyPoliciesBeyondIEACountriesChile2018Review.pdf

[36]Energy 2050: Chile's Energy Policy, http://www.energia2050.cl/wp-content/uploads/2016/08/Energy-2050-Chile-s-Energy-Policy.pdf

[37]Vanessa Dezem, "French Power Company to Close Coal Plants in Chile With a Move Towards Renewables," *Bloomberg News,* March 27, 2018, https://www.bloomberg.com/news/articles/2018-03-27/engie-to-close-coal-plants-in-chile-after-mulling-potential-sale

[38]Benedict Mander, "Chile learns to harvest its formidable solar power opportunities," *Financial Times,* December 7, 2017, https://www.ft.com/content/f175ba48-d96e-11e7-a039-c64b1c09b482

[39]Lucas Davis, "Four Reasons Why Chile Is the Biggest Solar Market in Latin America," *Energy Institute at Haas,* March 27, 2017, https://energyathaas.wordpress.com/2017/03/27/four-reasons-why-chile-is-the-biggest-solar-market-in-latin-america/

[40]"Energy Policies Beyond IEA Countries - Chile Review 2018," *International Energy Agency* (2018): p. 77, http://www.iea.org/publications/freepublications/publication/EnergyPoliciesBeyondIEACountriesChile2018Review.pdf

[41]《进一步做好煤电行业淘汰落后产能工作的通知》

[42]《关于推进供给侧结构性改革，防范化解煤电产能过剩风险的意见》

[43]China Electricity Council, NEA

[44]China Electricity Council, http://www.cec.org.cn/guihuayutongji/tongjxinxi/

[45]China Electricity Council, NEA

[46]http://www.xinhuanet.com/energy/2017-07/12/c_1121305424.htm

[47]Colorado Energy Office, https://www.colorado.gov/pacific/energyoffice/electricity-overview

[48]Xcel Energy, **https://www.xcelenergy.com/energy_portfolio/electricity/power_plants**

[49]Xcel Energy, "Colorado Energy Plan," 2017, **http://jeffcoedc.org/wp-content/uploads/2017/11/11-Colorado-Energy-Plan-Fact-Sheet.pdf**

[50]Aldo Svaldi, "Xcel Energy plans to retire two coal-fired plants in Pueblo, increase renewables," *The Denver Post,* August 29, 2017, **https://www.denverpost.com/2017/08/29/xcel-energy-pueblo-coal-plants-retiring/**

[51]"In the Matter of the Application of Public Service Company of Colorado for Approval of Its 2016 Electric Resource Plan," *Public Utilities Commission of the State Of Colorado,* August 29, 2017, **https://www.xcelenergy.com/staticfiles/xe-responsive/Company/Rates & Regulations/Resource Plans/CO-Energy-Plan-Stipulation-Agreement.pdf**

[52]Mark Jaffe, 2018, "Xcel is backing away from coal power in Colorado - but who pays?," *The Gazette,* May 13, 2018, **https://gazette.com/government/xcel-is-backing-away-from-coal-power-in-colorado-/article_5833ceab-acb3-554b-8f7e-7b93ea94f9b8.html**

[53]David Roberts, "In Colorado, a glimpse of renewable energy's insanely cheap future," *Vox,* January 16, 2018, **https://www.vox.com/energy-and-environment/2018/1/16/16895594/colorado-renewable-energy-future**

[54]Aldo Svaldi, "Xcel Energy plans to retire two coal-fired plants in Pueblo, increase renewables," *The Denver Post,* August 29, 2017, **https://www.denverpost.com/2017/08/29/xcel-energy-pueblo-coal-plants-retiring/**

22830 Two Rivers Road
Basalt, CO | 81621 USA
http://www.rmi.org