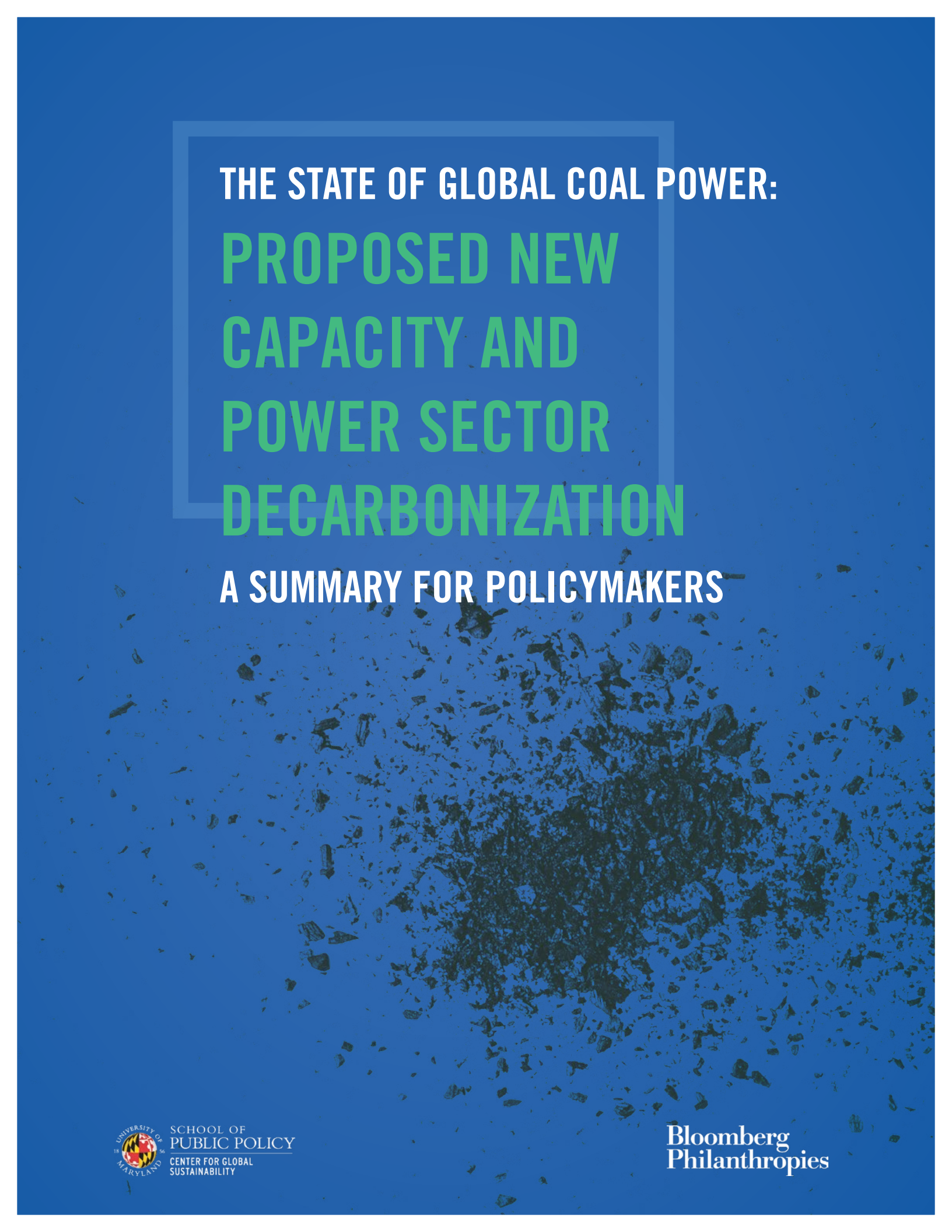
THE STATE OF GLOBAL COAL POWER:

PROPOSED NEW CAPACITY AND POWER SECTOR DECARBONIZATION

A SUMMARY FOR POLICYMAKERS



SCHOOL OF PUBLIC POLICY
CENTER FOR GLOBAL SUSTAINABILITY

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EXECUTIVE SUMMARY

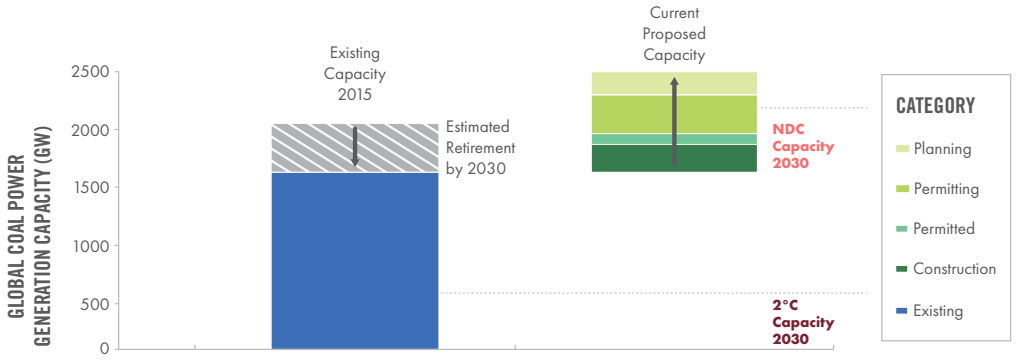
The world is running out of time to dramatically reduce emissions to stabilize climate, and one of the biggest contributors, and potential reduction opportunities, is the massive amount of existing and planned coal-fired electric power capacity. The Paris Agreement, signed by 195 Parties with broad engagement from businesses, subnational actors, and citizen groups, crystallized the world's commitment to stabilizing and reducing emissions while limiting global temperature increase to well below 2°C above pre-industrial levels.

Achieving these goals will not be possible without a rapid phase-out of existing coal-fired electricity and a dramatic reduction in the construction of new coal power. Moreover, as part of the Paris Agreement, countries advanced national targets, known as nationally determined contributions (NDCs), which identify their roadmaps towards lowering emissions. However, at the same time, many of these countries are still actively planning, authorizing, and constructing new coal-fired power plants, which if actually built would prevent many from reaching their national goals and would make reaching global climate goals nearly impossible.

This report examines the current trend of global coal power development and how those trajectories will affect these national and global goals. The key findings include:

- **While coal power is slowing in some areas, growth is still apparent across the world and largely in many key countries:** A total of over 860 GW of new coal capacity could potentially be added in the next few years, adding 4.6 GtCO2e greenhouse gas (GHG) emissions by 2030—an increase of nearly 10% from current total global emissions.
- **Reversing Coal Expansion Creates a Window for Reaching Near-Term Paris Goals:** Aggregate NDC targets can potentially be achieved by canceling proposed coal projects at early development stages (i.e. planning or permitting), equivalent to 3.0 GtCO2e of GHG emissions.
- **Countries Must Accelerate The Retirement Of Existing Capacity:** Significant changes are needed to close the emission gap of 9.3 GtCO2e to the 2°C goal in 2030. Limiting warming to below 2°C requires not only cancelling all newly proposed coal-fired power projects, but countries must also accelerate the retirement of existing capacity.
- **Action Now Would Allow the World to Achieve the Paris Goals with Much Lower Cost:** Countries must cancel all of their newly proposed coal-fired power projects. Otherwise these projects would have to retire prematurely in the post-2030 period to get on track with long-term climate goals.

FASTER RETIREMENT AND CANCELLATION ARE NECESSARY TO REACH OUR CLIMATE GOALS



The goals of the Paris Agreement necessitate rapid decarbonization in the power sector, yet global coal power generation capacity has continued to grow in recent years and the rate of increase is not slowing quickly enough.

The Paris Goals And Coal Power

Existing and proposed coal power infrastructure has major implications GHG emissions and could preclude achievement of the goals of the Paris Agreement. The Paris Agreement has set a goal of limiting the average temperature rise to well below 2 degrees Celsius (2°C) above pre-industrial levels. In the short-term, as part of the Paris process, countries have provided their own commitments and emissions reduction targets in the form of Nationally Determined Contributions (NDCs).[1]

Earlier studies of near- and long-term ambition focused primarily on tracking greenhouse gas emissions only, but recent studies have begun looking at a broader set of sectoral and technological metrics, for example targeting the degree of energy system transformation. It is broadly recognized that emissions cuts well beyond the current NDCs will be necessary to remain below 2°C – approximately 11-13.5 Gt globally according to the UN Gap Report.[2] What's more, to accomplish the subsequent energy system transition, changes must be significantly accelerated from historical and current energy trends.[3]

According to the most recent International Panel on Climate Change (IPCC) report, there are many different emissions trajectories that have more than a 50% chance of keeping the average global temperature rise under 2°C, but almost all of them require a rapid decarbonization of the global power sector.[4] In this context, our findings indicate that **all conventional coal power generation capacity that is not equipped with carbon capture and storage (CCS) will need to be phased out roughly within the next 30 years.**

A switch from coal power generation is critical in the immediate future for three reasons:

1. To achieve the 2°C goal, only about 1,000 Gt of the global cumulative carbon budget is estimated to be remaining as of 2011.[5] No matter which emission pathway is taken, the cumulative allowable emissions are fixed within a range. Therefore, even with significantly decreased emissions in the second half of the century, the amount we can emit up-front is still limited.
2. Coal power infrastructure, once in place, is likely to run more than several decades and lock the world in a carbon-intensive system. Coal combustion has by far the largest carbon footprint in the power sector, contributing to about 70% of global cumulative carbon emissions from power generation during 1950 to 2012. Additionally, existing coal power generation facilities are committed to 206 additional Gt of emissions over their remaining expected lifetime.[6]
3. Decarbonization of the global power sector is often the most cost effective strategy in addition to investing in renewable energy.[7]

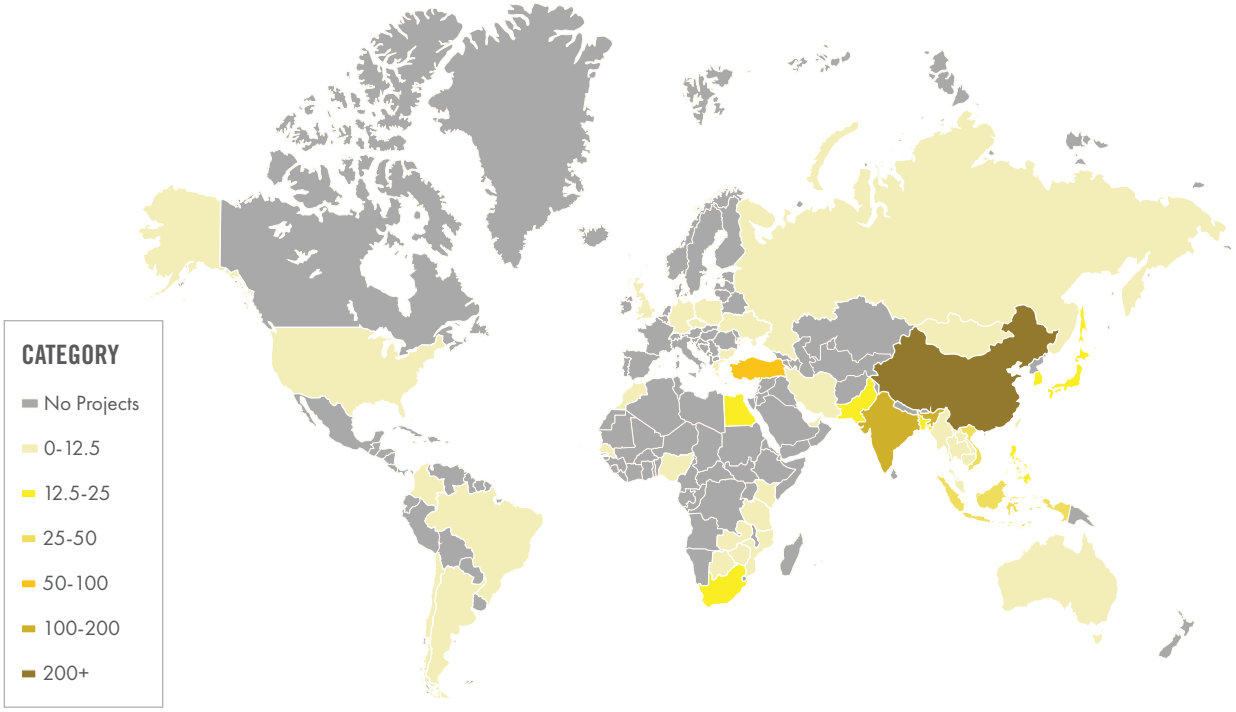
This study assesses the ongoing changes in coal power generation capacity and provides an alternative indicator that tracks countries' progress towards their NDCs as the world attempts to stay on a pathway to "well below 2 degrees."

Current Coal Power Development

Total installed coal power generation capacity has nearly doubled during the last 10 years and exceeded 2,000 GW in 2015.[8] Our unit-level assessment of newly proposed coal power plants indicates that there is a potential total of more than 860 GW of new capacity coming online in the next 15 years, including 233 GW that have already started construction.[9]

THERE ARE MANY DIFFERENT EMISSIONS TRAJECTORIES THAT HAVE MORE THAN A 50% CHANCE OF KEEPING THE AVERAGE GLOBAL TEMPERATURE RISE UNDER 2°C, BUT ALMOST ALL OF THEM REQUIRE A RAPID DECARBONIZATION OF THE GLOBAL POWER SECTOR.

FIGURE 1. NEWLY PROPOSED COAL-FIRED POWER CAPACITY BY COUNTRY

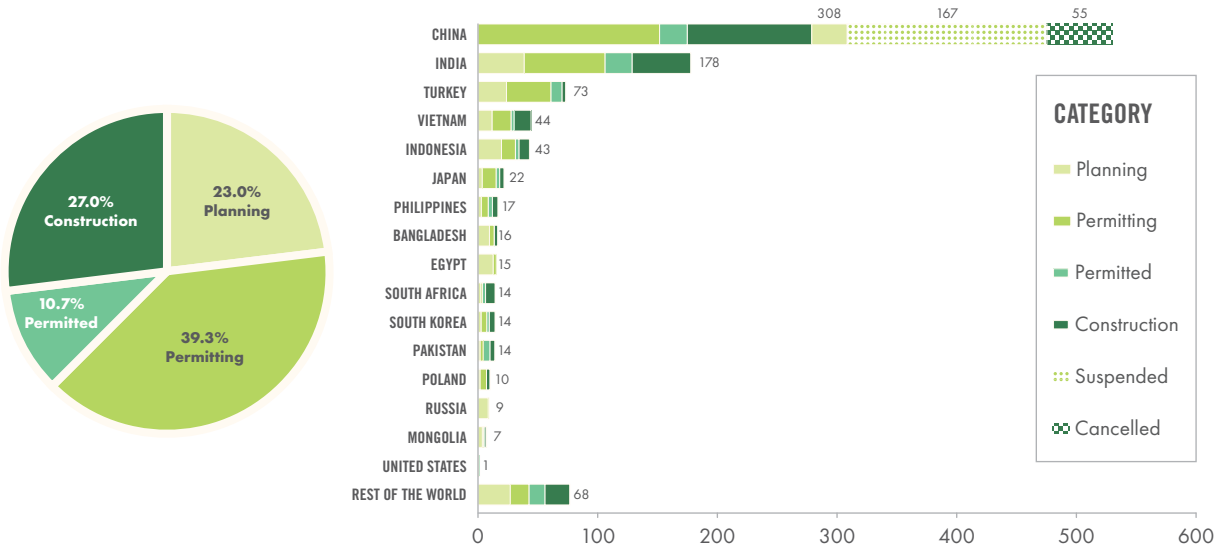


In the context of power sector decarbonization, coal capacity that is planned or in progress, but not yet complete, is of particular interest because changing course for these cases is easier than for existing plants. More than 60 countries have plans to add new coal-fired power capacity, but measured by total capacity, the vast majority of the planned activity is located in Asia. Five countries alone – China, India, Turkey, Vietnam, and Indonesia – account for almost three quarters of the newly proposed capacity (**Figure 1**). Turkey and Vietnam are looking for a five- and four-fold growth increase in coal power capacity, respectively. Indonesia is planning to more than double their current coal operations. This reflects a recent geographic shift in coal power prioritization from OECD countries to many fast developing countries in Asia.

CHINA

China's recent economic growth has brought with it difficult environmental challenges, including severe and large-scale air pollution that has affected most major cities.[24] This stems from China's increasing energy needs over the last decade,[25] its heavy reliance on coal for power generation,[26] and its consumption of coal for other purposes such as infrastructural development.[27] Recently, pollution-related health issues[28] coupled with the central government's strong will to coal power overcapacity[29,30,31] has the potential to steer China away from future coal power development. Having said that, whether coal power's dominant share in China's existing power mix can change in the next decade remains the subject of much uncertainty. This is partly due to China's rigid grid structure and transmissions bottleneck[32,33,34] and partly due to the perpetual "push-and-pull" between environmental goals and other development objectives. In addition, China's coal and power industries are expected to see more mergers in the near future because of state-owned enterprise reform policies that were announced in early 2017. These reforms are particularly important to Chinese leaders when thermal coal prices are high and volatile.[35] However, these potential mergers could shield the coal-fired power plants from unfavorable market conditions and signals that would otherwise have shut them down.

FIGURE 2. NEWLY PROPOSED COAL-FIRED POWER CAPACITY BY DEVELOPMENT STAGE, GLOBAL AND BY TOP COUNTRY



We track this proposed new capacity at its different stages of project development. Globally, about 27% already have started construction, more than 10% have been authorized by their government, about 40% are going through the permitting process, and the remaining 23% are at the early planning stages (**Figure 2**).

China saw a period of rapid expansion over the past 15 years including the construction of the majority of their power plants.[10] However, since 2016, the Chinese central government has imposed a series of restrictive policies under which a total of 222 GW proposed coal power projects have been cancelled or suspended.[11,12,13] Despite this significant cutback, China continues to develop 308 GW of new capacity, a capacity that itself is still much greater compared to other countries (**Figure 2**).

Because of an expected reluctance of project developers to phase out newly built capital investments before their useful lifetime has ended, this new coal power infrastructure planned for completion in the next decade would significantly reduce the likelihood of phasing out all coal power generation capacity by mid-century. Because of this, our analysis targets three linked questions:

1. How does the current trend of coal power development deviate from the trajectories that are consistent with meeting the Paris climate goals?
2. If all these proposed projects are implemented, what is the impact on GHG emissions?
3. Are individual countries on track to complete the goals of their NDCs as well as contribute to the global goal of keeping temperatures well below 2°C?

EXISTING AND PROPOSED COAL POWER CAPACITY WOULD ADD MORE THAN 560 GtCO2e OF GHG EMISSIONS THROUGH 2080, MAKING A 2°C PATHWAY ESSENTIALLY IMPOSSIBLE.

GLOBAL ASSESSMENT

Our analysis indicates that globally, the aggregate NDC targets for 2030 can be met by canceling a portion of proposed projects at their early stages, but reaching the 2°C goal will require far more significant action.

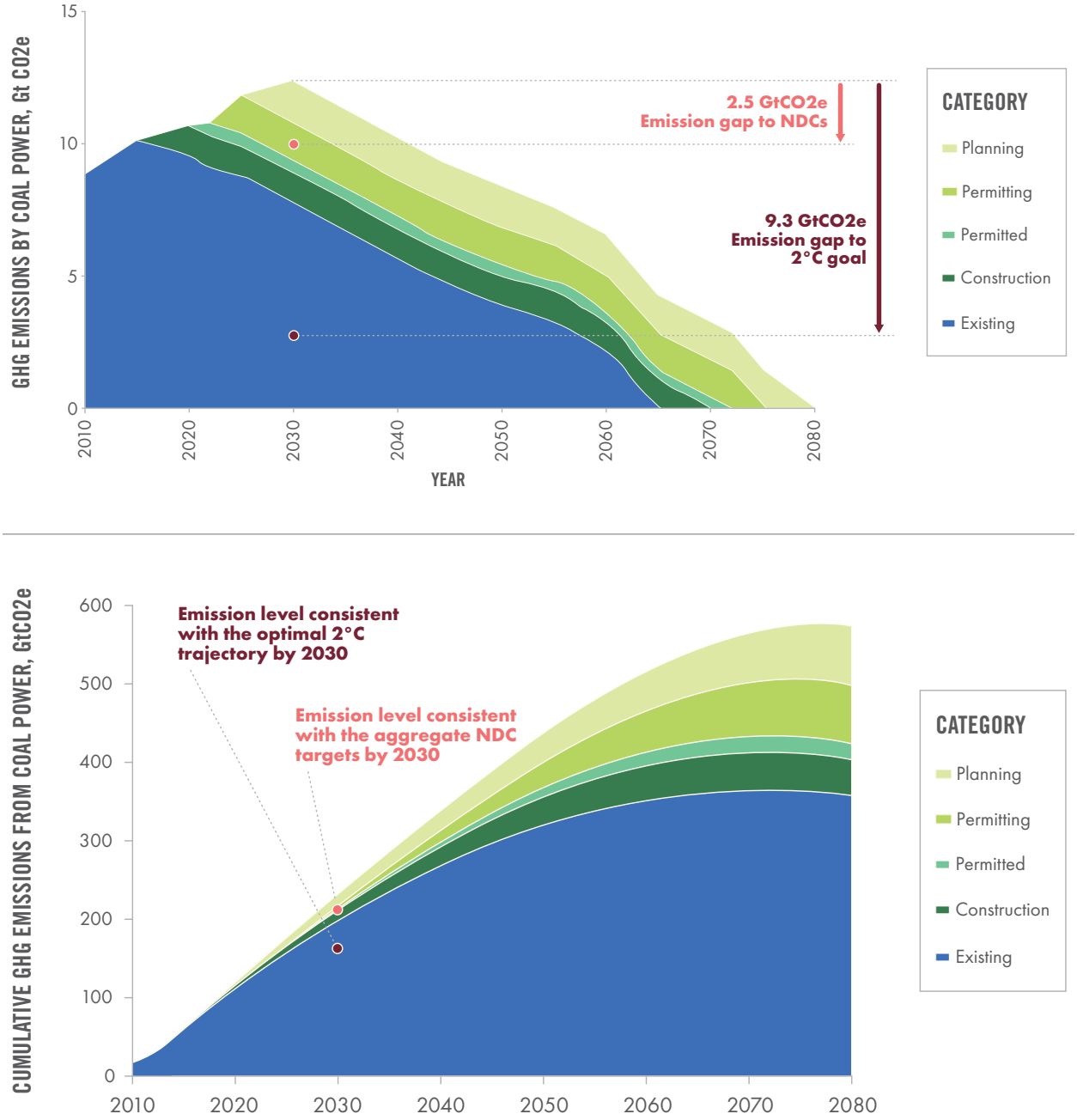
Global Emissions and Aggregate Targets

Committed emissions from existing and future coal power generation facilities have both near- and long-term impacts over a typical plant lifetime of 50 years. We assess the start and end dates of plant emissions based on where they are in the development cycle. For example, projects that are currently under construction would start operation by approximately 2020 and would emit through the plant's retirement in 2070. Similarly, projects that are authorized or are in the authorization process will be implemented by 2020 and will run through 2075, while projects in the planning stages are expected to operate from 2030 to 2080. Figure 3 shows a graphical representation of these cohorts of power plants coming online, and how much additional emissions each cohort would contribute to the global total at both an annual and cumulative level.

UNITED STATES

The United States has announced its intent to withdraw from the Paris Agreement reflecting the current Federal government's priorities, which include enhanced support for the coal industry. The domestic mining industry and power generation are closely connected, with the power sector accounting for over 90% of coal consumed in the US. However, the coal industry is under transition as production and consumption of coal have declined to about two thirds of 2011 levels.[36] The American coal industry's recent decline has had negative impacts on employment and local economies,[37] which in part have shaped the Administration's recent efforts to revive coal. However, market fundamentals challenge the return of coal. The steep decline in natural gas prices after the shale gas boom has made natural gas significantly cheaper and more economically attractive than coal. This shift to natural gas, coupled with low energy demand, increasingly inexpensive renewables, and a continued expectation of future carbon regulation, have made coal increasingly unattractive in the market. Furthermore, a wide range of public and private actors have stepped up to compensate for the federal pro-coal policies that are at odds with actions needed for climate change mitigation, thus creating alternative drivers to curb coal use.

FIGURE 3. COMPLETING PROPOSED COAL PLANTS DRAMATICALLY INCREASES GLOBAL EMISSIONS



In Figure 3, the committed emissions from existing and proposed coal power generation capacity under the continued coal growth scenario are compared to the trajectories of two policy scenarios, by using the Global Change Assessment Model (GCAM):

1. The NDC scenario interprets and translates all the individual country's climate commitments under the Paris Agreement in the form of total national emission constraints by 2030.

2. The 2°C scenario is a global cost-effective mitigation pathway starting in 2020, without overshooting the temperature target throughout the century.

(See the full report for further methodology details)

KEY FINDINGS

1. GHG emission trajectories from existing and proposed coal power generation capacity are not in line with the trajectories to attain the aggregate NDC goals by 2030, but the emission gap can be eliminated by canceling some proposed capacity in the near term.

Globally, the new proposed coal power capacity would result in 4.6 GtCO2e of additional GHG in 2030. This will bring the total GHG emissions from coal power generation to 12.5 GtCOe in 2030, 2.5 GtCO2e higher than what is consistent with the aggregate NDC targets (**Figure 3**). However, canceling all projects at the early planning and permitting stages would reduce 3.0 GtCO2e of GHG emissions and would allow for an overachievement of the aggregate NDCs (**Figure 3**).

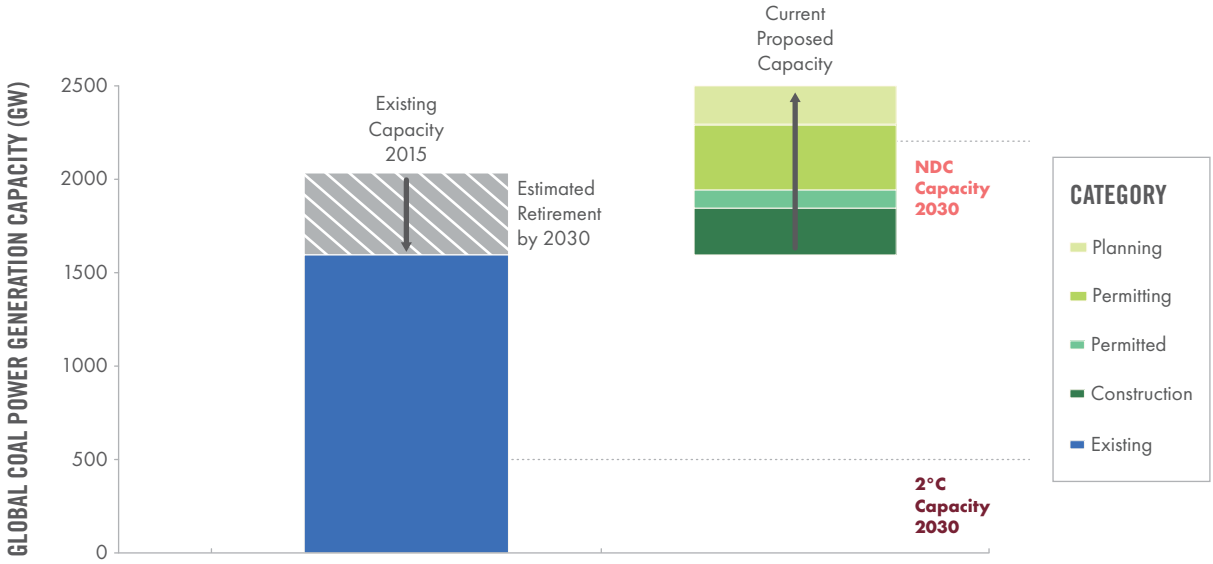
2. Without significant changes in the build out trajectory of proposed coal fired power plants, the emission gap will become much larger and make it much harder to reach the 2°C goal.

With only existing capacity under the estimated rate of retirement, global total GHG emissions from coal power generation will already overshoot the quota that is in line with the 2°C scenario by 4.7 GtCO2e in 2030, a value equivalent to roughly 10% of current global GHG emissions from all sources. If all the proposed coal power capacity comes online, the world will overshoot by nearly double that amount, to 9.3 GtCO2e in 2030 (**Figure 3**).

SOUTH KOREA

South Korea's emerging concerns about air pollution and public health have reversed recent trends in the country's coal use. Despite its limited domestic fossil fuel resources, South Korea had undergone an expansion in coal power plant capacity in the last decade. More recently, environmental and air quality issues became increasingly central to South Korean politics given that the country has some of the highest levels of air pollution among OECD countries, and evidence points towards domestic coal power plants' contribution to its air pollution.[38] The new government elected in 2017 decided to phase out older coal power plants and has been reconsidering planned new coal builds.[39] However, despite the administration's opposition to coal, it was able to convert only two of the nine coal plants under construction to natural gas, while allowing the rest of the builds. Nonetheless, plans for renewable capacity expansion coupled with continued construction of two new nuclear power plants allay concerns on near-term stability of power supply while challenging the need for coal. Yet, the close ties between the power generation sector and political context bring uncertainty in the long-term future of coal that may change under a different political context.

FIGURE 4. FASTER RETIREMENT AND CANCELLATION ARE NECESSARY TO REACH OUR CLIMATE GOALS



In line with the aggregate NDC goals, by 2030, new capacity can be added through projects under construction and even more can be added only if old facilities are retired. However, to be on track to achieve the long-term 2°C goal, there must be an acceleration in the retirement of existing capacity in addition to the cancellation of all new additions of coal-fired power generation capacity (**Figure 4**).

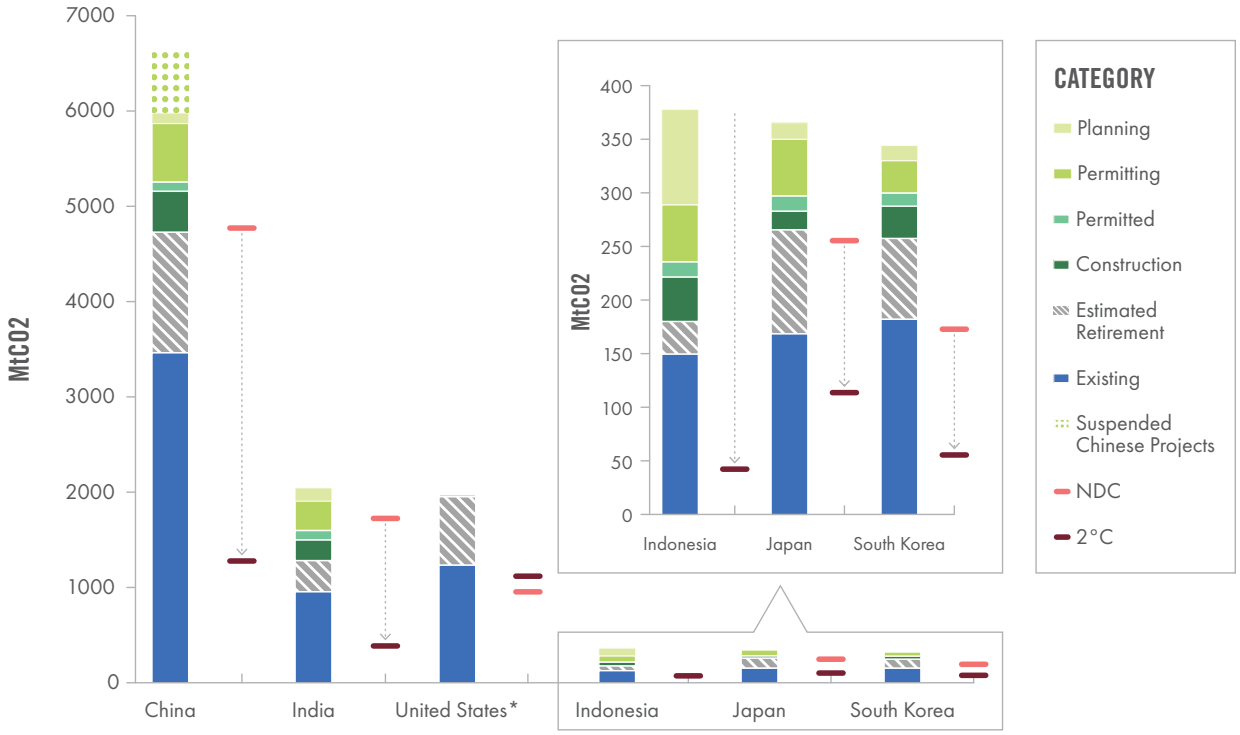
JAPAN

Japan is the only G7 country on a trajectory of increasing coal use. Coal, along with other fossil fuel-based power generation, was used to meet energy demand after the Fukushima Daiichi nuclear disaster of 2011. Under immense public opposition post-Fukushima, Japan decommissioned its entire nuclear power plant fleet cutting 28.6% of its electricity supply in the year following the disaster.[40] The Japanese government continues to actively support coal and specifically considers it a cost-effective and stable source of baseload power supply in an energy-poor country that is heavily reliant on imports of all fossil fuels.[41] Japan is also one of the few OECD countries that actively facilitates the expansion of coal power internationally—between 2007 and 2015, Japan's public financing agencies had provided over $22 billion to finance overseas coal power plants.[42] But if Japan aims to address its domestic challenges related to reducing reliance on fuel imports and if it plans to respond to international pressures to meet emissions targets, it will need to limit its support of coal power.

TO BE ON TRACK TO ACHIEVE THE LONG-TERM 2°C GOAL, THERE MUST BE AN ACCELERATION IN THE RETIREMENT OF EXISTING CAPACITY IN ADDITION TO THE CANCELLATION OF ALL NEW ADDITIONS OF COAL-FIRED POWER GENERATION CAPACITY.

FIGURE 5. CO2 EMISSIONS FROM COAL POWER GENERATION IN 2030

*2025 EMISSIONS ARE SHOWN FOR THE UNITED STATES



Cross-Country Comparison

China, India, Indonesia, the United States, Japan, and South Korea, collectively account for 78% of global total existing coal power generation capacity and 66% of the proposed capacity as of 2017.[14] Although the magnitude of and age of coal power infrastructure vary substantially in 2030 across these countries, with the estimated rate of retirement, most countries have some room for new additions and can still achieve the NDC targets. However, to remain consistent with the 2°C goal, all new projects would need to be cancelled in addition to the accelerated retirement of existing capacity (**Figure 5**).

INDIA

India's expanding coal use in the power sector matches its growing energy demand and need to provide energy services and energy access for development. With expected expansion in population, rapid urbanization, and economic development, energy demand is expected to increase by 5% per year until 2040.[43] India's energy policies aim to facilitate the large-scale development of electricity generation capacity, while diversifying power generation sources, strengthening energy infrastructure, and improving energy access.[44] Although coal will continue to power the country in the near term, recent record low solar and wind prices put significant competitive pressure on coal-fired power.[45,46] In parallel, coal continues to face increased costs due to stricter environmental regulations, land acquisition expenses, water stress, high maintenance costs of older plants, and growing reliance on imports for higher quality coal.[47] Furthermore, India's global climate commitments and renewable energy goals, in addition to domestic concerns over worsening air pollution and environmental degradation may deter increased coal use.

INDONESIA

Coal is currently a major part of the Indonesian economy with coal mining contributing to about 5% of the country's GDP and 12% of all export income.[48,49] However, the Indonesian coal economy is changing. Indonesian coal exports are highly vulnerable to fluctuations in demand from China, India, and global market conditions. At the same time, Indonesia's domestic electricity demand is projected to increase 8.4% per year over the next decade.[50] This is shifting the coal economy from exports to the use of domestic coal-fired power plants. However, the country's geographical features have resulted in the development of smaller, less efficient coal power plant units compared to those developed in other countries.[51] These coal plants are not subject to stringent emission standards[52] and add to the severe air quality issues originating from forest fires. Indonesia's energy policies favor coal, but the expansion in coal use is deeply misaligned with the country's climate targets as well as its environmental and public health issues.

China, despite its recent cancellations of some proposed new capacity, runs a real risk of missing its NDC target in 2030 under current coal power development plans. While estimates show that China's emissions may have already peaked in 2015[15] – one decade and a half earlier than its NDC target – in addition to their goal of reducing their GDP intensity by 60-65% from a 2025 level,[16] there are significant uncertainties after 2020. Our assessment indicates that China could stay on track with its NDC target by cancelling about half of its remaining proposed capacity, specifically the 167 GW of projects that are currently on hold until after 2020. As for staying in line with the 2°C scenario, any projects built after 2010 deviate from the least-cost pathway and retirement of existing capacity needs to occur at a much faster rate.

India has committed in its NDC to reducing their emissions intensity of its GDP by 33 to 35% by 2030 from a 2005 level.[17] In the power sector, they have committed to achieve 40% non-fossil fuel power capacity by 2030, and increase from 32% in 2016.[18] India accounts for about 20% of the newly proposed coal power capacity globally,[19] but the realized expansion may be much lower.[20] They could achieve their goal with the retirement of their existing fleet—which is unlikely in the current political climate— or cancelation of some proposed projects that are at very early stages, but these efforts will not allow India to stay in line with the least cost 2°C trajectory.

Indonesia's NDC targets include a 29% GHG reduction below business-as-usual (BAU) by 2030, or a 41% conditional on international aid. Even with a large coal expansion plan, including significant infrastructure development, Indonesia is likely to be able to reach its NDC goal because of high BAU projections and less ambitious mitigation targets. However, in comparison to other country's NDCs, Indonesia is not on track to reach the least-cost 2°C goal on their current trajectory.

The United States can achieve a trajectory toward the 2°C goal with a moderate amount of additional retirement. But more of an effort is needed to achieve their NDC goal of a 26-28% GHG reduction below 2005 levels by 2025.[21] Like most other OECD countries, the United States has little ongoing new coal power development, but a large amount of existing capacity which, if retired, could assist reaching its NDC.

Japan and South Korea are the only OECD countries that have a considerable amount of new conventional coal power capacity actively under development, and neither is on track to achieve their NDC targets without significant action to curtail this proposed capacity. Japan's NDC targets a reduction of 26% from 2013 levels by 2030[22] and we estimate this is only achievable if they retire their existing fleet or cancel proposed projects that are at early stages. Reaching a 2°C trajectory is even harder because Japan would need to combine both retirement and cancelation at an even faster phase-out schedule. South Korea has little room for any new coal power development if they want to reach both their NDC goal of 37% less emissions than BAU by 2030[23] or a 2°C trajectory. None of their proposed projects are consistent with a trajectory to deliver the NDC, and a much faster retirement schedule is necessary to get on track with the 2°C goal.

CONCLUSIONS

The continued development, investment in, and production of coal power threatens the ability of the world to hit global climate goals and for countries to achieve their near-term climate targets. Nevertheless, there is hope for reaching these targets with immediate action. Our assessment focuses on the opportunities to reduce proposed coal capacity globally, and indicates that a clear, significant, and low-cost step toward reaching national and global goals is to dramatically curtail planned capacity.

Limiting warming to below 2°C requires the most significant changes. Not only do countries need to show their commitment by halting the construction of new plants, but they also need to accelerate the retirement of existing plants. Moreover, failure to cancel these plants now could end up being extraordinarily costly by creating large quantities of stranded assets. Any new addition of coal power generation capacity from today would subsequently have to retire prematurely in the post-2030 period for the world to achieve our long-term climate goals.

Stronger policy efforts are necessary to decelerate coal power generation, but development needs and challenges can add additional complications to domestic discussions about energy access and energy security. But the rapidly changing technological and economic landscape in energy raises the possibility that solutions can be found that can achieve multiple goals for development and sustainability.

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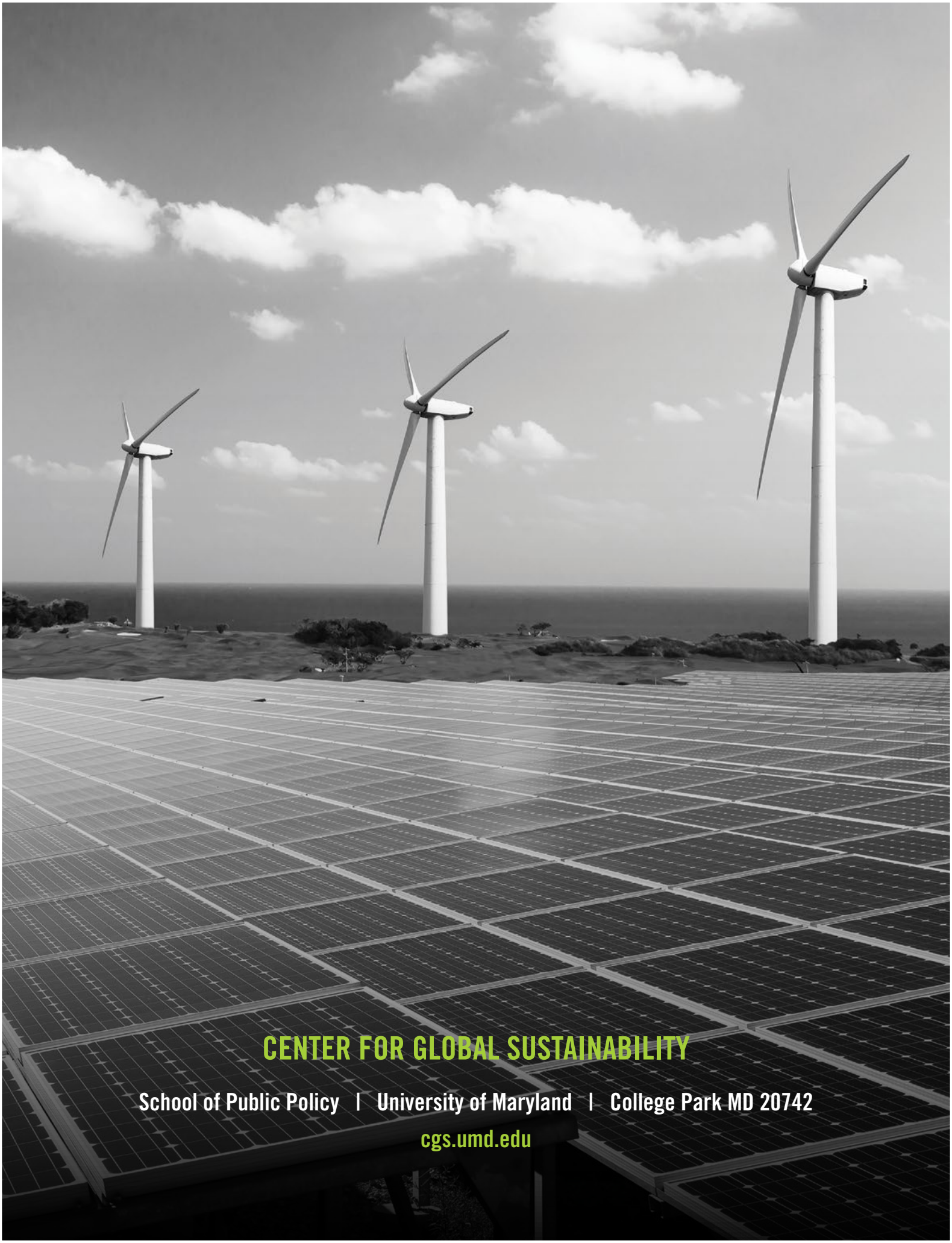

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