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IESR

HOW AN ACCELERATED COAL TRANSITION IN INDONESIA MAY AFFECT CHINESE DEVELOPERS

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Summary

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At the G20 summit in November 2022, Indonesia and international partners launched a Just Energy Transition Partnership (JETP), featuring accelerated coal transition and a major new set of ambitious climate targets for Indonesia backed by roughly $20 billion of new finance from the United States and other G7 partners. As Indonesia develops and implements a full plan to achieve the JETP goals, more policies and innovative mechanisms will be adopted to push early retirements and accelerated transitions of coal power plants. It is critical that plant owners and developers understand and be prepared for the rapidly changing conditions around the coal power sector in Indonesia.

International companies are important coal power developers in Indonesia – over 70% of the existing and proposed projects from independent power producers (IPPs) involve one or more international developers. These companies need to understand how Indonesia's changing climate goals and policies may affect their overseas coal power assets and investments. At the same time, as foreign developers are involved in decision-making, there might be new opportunities for enhanced action. One particular area is the renegotiation of the contract terms that are often locked in the long-term power purchasing agreements (PPA) between PLN and the IPPs, which has been identified as one of the main challenges for Indonesia's accelerated coal transition.

We find three Chinese companies, namely China Energy, China Datang, and China Huadian, that have been primarily involved in coal power projects in Indonesia. **To help the Chinese developers understand the potential implications of Indonesia's JETP on their overseas coal**

power projects, this paper shows one possible pathway with a detailed early retirement schedule for Chinese-involved IPP plants under Indonesia's accelerated coal transition. Specifically, Cui et al (2022) developed a plant-by-plant retirement plan (2022-2045) for all Indonesia's coal power plants in line with national 2050 net-zero emissions and multiple development priorities, and also estimated the benefits and costs of the proposed plan.[1] This paper further looks into the retirement pathway and summarises key results from Cui et al (2020) for the IPP plants.

Key findings for the (Chinese) IPP plants in the Cui et al (2022) scenario include:

- A total of 4.2 GW of IPP plants retire by 2030, of which 2.7 GW is developed by domestic IPPs, 1.5 GW by Japanese and South Korean companies, and only 50 MW involves Chinese developers.
- With new projects under construction, the total operating capacity of the Chinese-involved IPP plants will continue to grow and reach 7.6 GW – double from today – within the next few years.
- Over 92% of the Chinese-involved capacity does not retire until after 2035, and over 50% not until after 2040.
- None of the Chinese IPP plants operate for more than 20 years, compared to a typical coal lifetime of 30-40 years; and those in operation after 2040 will run less than 900 hours per year, shifting from baseload to peaking service by gradually lowering the utilization levels.
- Total costs from stranded assets, decommissioning, employment transition, and state coal revenue losses related to the Chinese IPP plants are estimated to be $5 billion between 2022 and 2045, with similar cost-per-capacity values across different companies.
- The associated public health benefits and the avoided coal power subsidies are estimated to be $24.7 billion, 3-4 times larger than the induced costs.

By showing one possible pathway for the accelerated coal transition in Indonesia, we provide several recommendations to help Chinese developers prepare for the potential implications on their overseas assets under enhanced climate ambition in the host country. These include: (1) canceling pre-construction projects, (2) taking advantage of the ongoing and new financial mechanisms (i.e., JETP, ADB's ETM) to plan early and avoid locking into long-lived coal assets, (3) actively engaging with Indonesian governments, PLN, and other stakeholders to prepare for an orderly transition, (4) assessing options and costs for converting the suitable facilities to flexible generation and/or alternative low-carbon technologies in line with Indonesia's 2050 climate goals, and (5) getting support from the Chinese public financiers.

While this paper provides an initial analysis of the issue, there are important questions that need to be answered with further research. Topics include but are not limited to: the renegotiation of the PPA terms and the cost allocation among industry (PLN and IPPs) and government stakeholders; options and economic analysis of the repurposing of specific coal facilities; innovative mechanisms to support a smooth transition for developers, workforce, and local communities; avoided economic losses from halting new builds, including the impacts on existing plants; quantification of higher assets value due to broader environmental and social benefits from the early retirement; and international developers' involvement in industrial parks and captive plants and their contribution to facilitating renewable deployment.

[1] R. Cui, F. Tumiwa, A. Zhao, D. Arinaldo, R. Wiranegara, D. Cui, C. Dahl, L. Myllyvirta, C. Squire, P. Simamora, N. Hultman (August 2022). "Financing Indonesia's coal phase-out: A just and accelerated retirement pathway to net zero." Center for Global Sustainability, University of Maryland, College Park, USA; Institute for Essential Services Reform, Jakarta. https://cgs.umd.edu/sites/default/files/2022-08/UMD%20Indo%20Report%20Final_0.pdf

1. Introduction

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An accelerated coal-to-clean energy transition is needed to deliver ambitious climate goals in Indonesia and to keep global temperature change within 1.5C. Several high-level efforts have been developed to accelerate such a process, including the Energy Transition Mechanism (ETM) facilitated by the Asian Development Bank (ADB) and the Just Energy Transition Partnership (JETP) developed by Indonesia with international partners during its G20 presidency. In particular, JETP includes a new set of ambitious coal-to-clean energy transition and emissions reduction targets in the power sector, and an initial $20 billion of financial support from the G7 partner countries as well as private financial institutions to support the implementation of the plan.

Moreover, various early retirement discussions and activities are happening at specific projects. For example, through ADB' ETM fund, PLN has decided to shorten the operational lifetime of the new Pelabuhan Ratu coal power plant to 15 years and retire it by 2037, in support of the government's early retirement program.[2] Another example shows the utilization of the ETM fund where Indonesia signed a non-binding agreement to close Unit 1 of the Cirebon power station owned by Japanese and South Korean companies by 2037,15 years before the initially designed lifespan.[3]

[2] https://www.ptba.co.id/berita/pln-dan-ptba-kerja-sama-pensiun-dini-pltu-pelabuhan-ratu-1546
[3] https://www.adb.org/news/adb-indonesia-partners-sign-landmark-mou-early-retirement-plan-first-coal-power-plant-etm

New climate targets and policies in Indonesia indicate that conditions are rapidly changing for coal power in the country, and an accelerated transition is unavoidable. It is important now for the owners and developers of coal power fleets to better understand the potential implications on their assets. As many existing and new Indonesia's coal power plants by independent power producers (IPPs) involve one or more international developers, it means that increasingly international developers' overseas coal power assets will be affected by the host country's climate and energy transition ambition.

An earlier analysis, Cui et al. (2022), has already shed some light on this question, by developing a possible coal power phaseout pathway for Indonesia and quantifying the associated benefits and costs of early retirement. In particular, a plant-by-plant retirement schedule is developed for all operating and under-construction coal power plants as of May 2022, in line with Indonesia's 2050 net-zero emissions and the global 1.5C goal while balancing environmental, social, and economic priorities for the country. Key results from this research can therefore help inform the international coal power developers in Indonesia about a possible early retirement schedule for their assets to better understand the potential implications of JETP.

Key results from this research can therefore help inform the international coal power developers in Indonesia about a possible early retirement schedule for their assets to better understand the potential implications of JETP.

Meanwhile, international developers may also bring new opportunities for enhanced ambition. One of the major challenges identified in implementing the accelerated retirement plan lies within the long-term power purchasing agreements (PPAs) between PLN (the state-owned monopoly of Indonesia's electric power distribution) and the IPPs. PLN acts as the off-taker to purchase the power generated by IPPs by signing the PPA. PPAs usually include terms that guarantee the payments from PLN to IPPs over a long period of time (often 25-30 years) with a fixed price (known as the "take-or-pay" clause) regardless of the operational status of the plants. This potentially induces additional costs for PLN when these plants are closed earlier. Thus, accelerated coal transition would require renegotiating the contract terms. As most of the international coal power developers in Indonesia are from Japan, South Korea, and China, their involvement in decision-making may bring new opportunities to facilitate the renegotiation of the PPA terms.

To help international developers, particularly Chinese companies, better understand the potential implications of Indonesia's JETP on their overseas coal power projects, this paper summarizes key results in Cui et al. (2022) to show one possible pathway with detailed early retirement schedule for Chinese-involved IPP plants under Indonesia's accelerated coal transition. As one of the major international developers and investors of coal power projects in Indonesia, Chinese stakeholders are often involved through equity investment[4], debt financing, EPC (engineering, procurement, and construction), and equipment export. Compared with other types of involvement, equity investment is meant to generate long-term profits for the developers and gives them more power for decision-making. Therefore, equity investors are important stakeholders in the discussion of IPPs' early retirement, and this paper provides analysis to support their decision-making.

[4] Equity investment refers to the investment through cash, physical goods, intangible assets, or purchasing securities such as stocks and bonds

2. IPP Plants Overview

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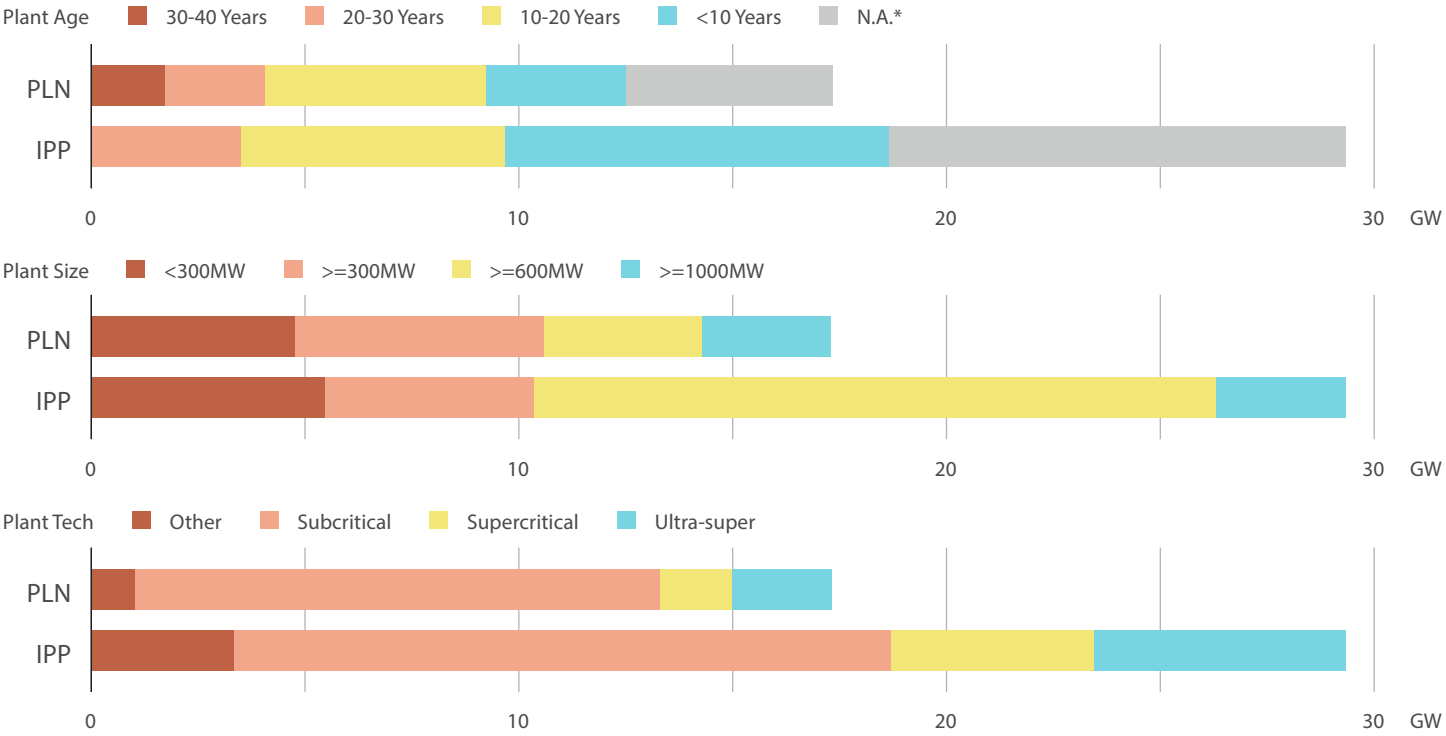
To meet the rapidly growing power demand, Indonesia has implemented a series of policies to attract international developers with funds to develop coal power plants. IPPs have been increasingly dominating the development of coal power plants in Indonesia in recent years. As of October 2022[5], there were 82 operating and new coal power projects (new projects include under-construction, PPA-signed[6], or under-planning), with a total capacity of 46.6 GW. Among them, IPP-owned plants account for 63% of the total capacity (29.3 GW) and PLN plants account for 37% (17.3 GW) (Figure 1).

IPP plants are generally newer and larger and use more efficient combustion technologies. IPPs own the majority of the capacity built within the past decade (77%), while the oldest plants (30~40 years) are all owned by PLN (Figure 1 top panel). IPPs also own a larger share of the capacity (82%) with a unit size above 600 MW (Figure 1 middle panel) and a greater capacity that utilizes super- and ultra super-critical technologies (Figure 1 bottom panel). Moreover, the majority of the new projects (including under-construction, PPA-signed, or under-planning) are developed by IPPs, specifically 10.5 GW out of 18.7 GW. This part of potential emissions and losses, especially from projects that have not started construction, could be easily avoided if they are not moving forward.

[5] Plant data are based on GCPT (July 2022) and authors' verification as of October 2022

[6] Projects have not started construction but signed the PPAs.

Figure 1. Comparison of PLN vs. IPP coal power plants by plant age, size, and technology.



*Note: N.A. represents capacity under construction, PPA-signed, under planning

Therefore, to achieve JETP's power sector transition and carbon emission reduction targets, IPP plants are likely to face stronger challenges for early retirement. Here, we focus on plants that are or will be connected to the grid once built, leaving out the captive plants for further research.

At the same time, over 70% of the existing and new IPP projects involve one or more international developers such as Japan, South Korea, and China. Most of these countries have already committed to stopping building new coal power plants abroad and ending overseas coal finance. This creates opportunities for enhanced actions.

Existing and new projects that involve Japanese and South Korean developers have a total capacity of 11.7 GW, accounting for 40% of the total capacity developed by IPPs. They include six operating plants (6.9 GW) and three under-construction plants (4.8 GW). Projects that involve Chinese developers have a total capacity of 7.6 GW, accounting for 26% of the total capacity developed by IPPs, including 11 operating plants (3.8 GW), seven under-construction plants (2.9 GW), and two PPA-signed[7] plants (0.9 GW). Chinese companies have become more active in developing coal power projects in Indonesia in recent years before China's commitment not to build new overseas coal power plants becomes effective. As a result, the total operating capacity of China-involved coal power plants is expected to almost double within the next few years.

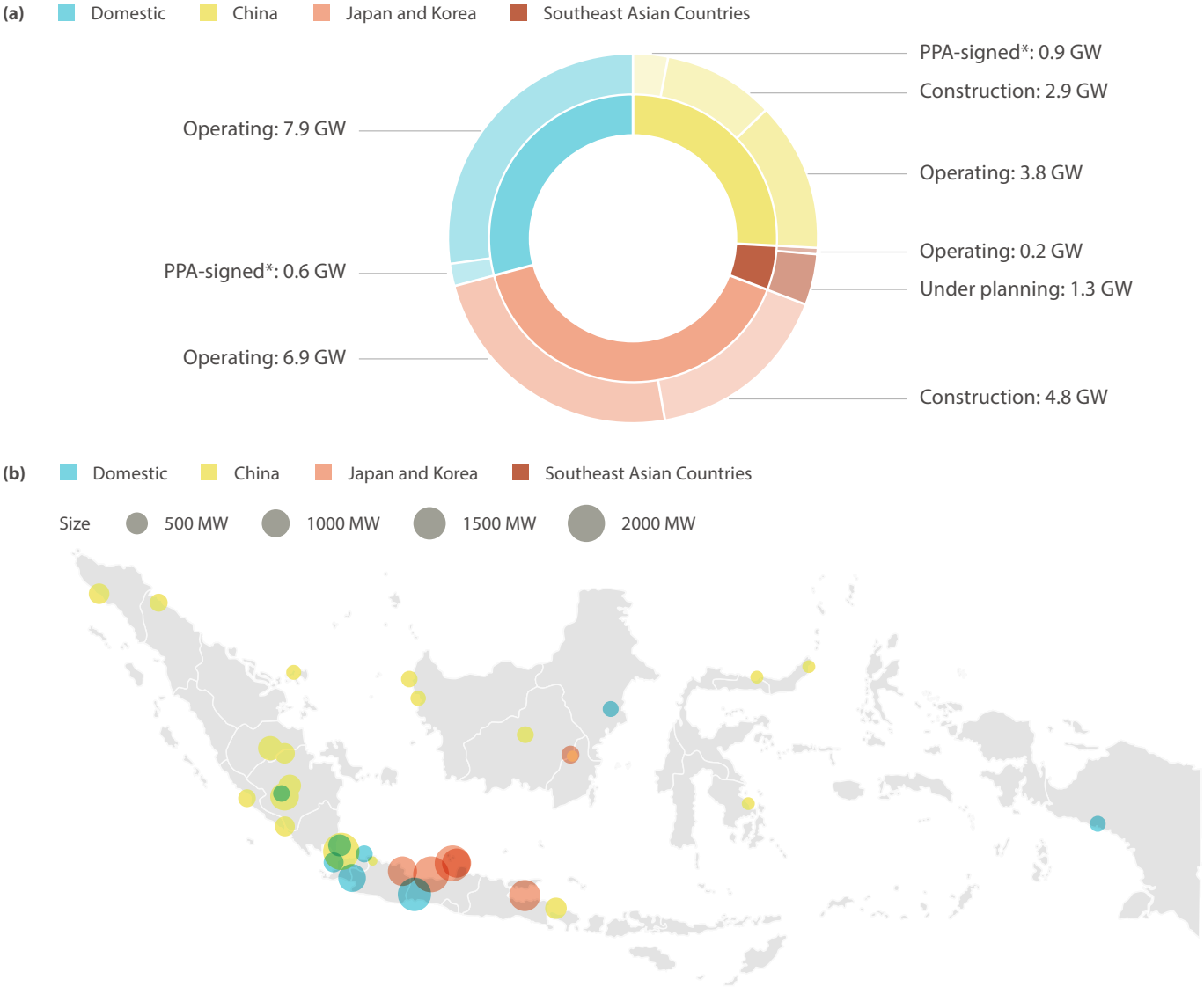
The remaining 5% of the IPP capacity (1.5 GW) is contributed by international developers from Southeast Asian countries, such as Malaysia, Singapore, and Thailand. However, the majority of these projects are still under planning – only

[7] Projects have not started construction but signed the PPAs.

0.2 GW is in operation, and the remaining 1.3 GW capacity has not signed the PPAs (Figure 2), which is assumed to be canceled in the retirement pathway analysis.

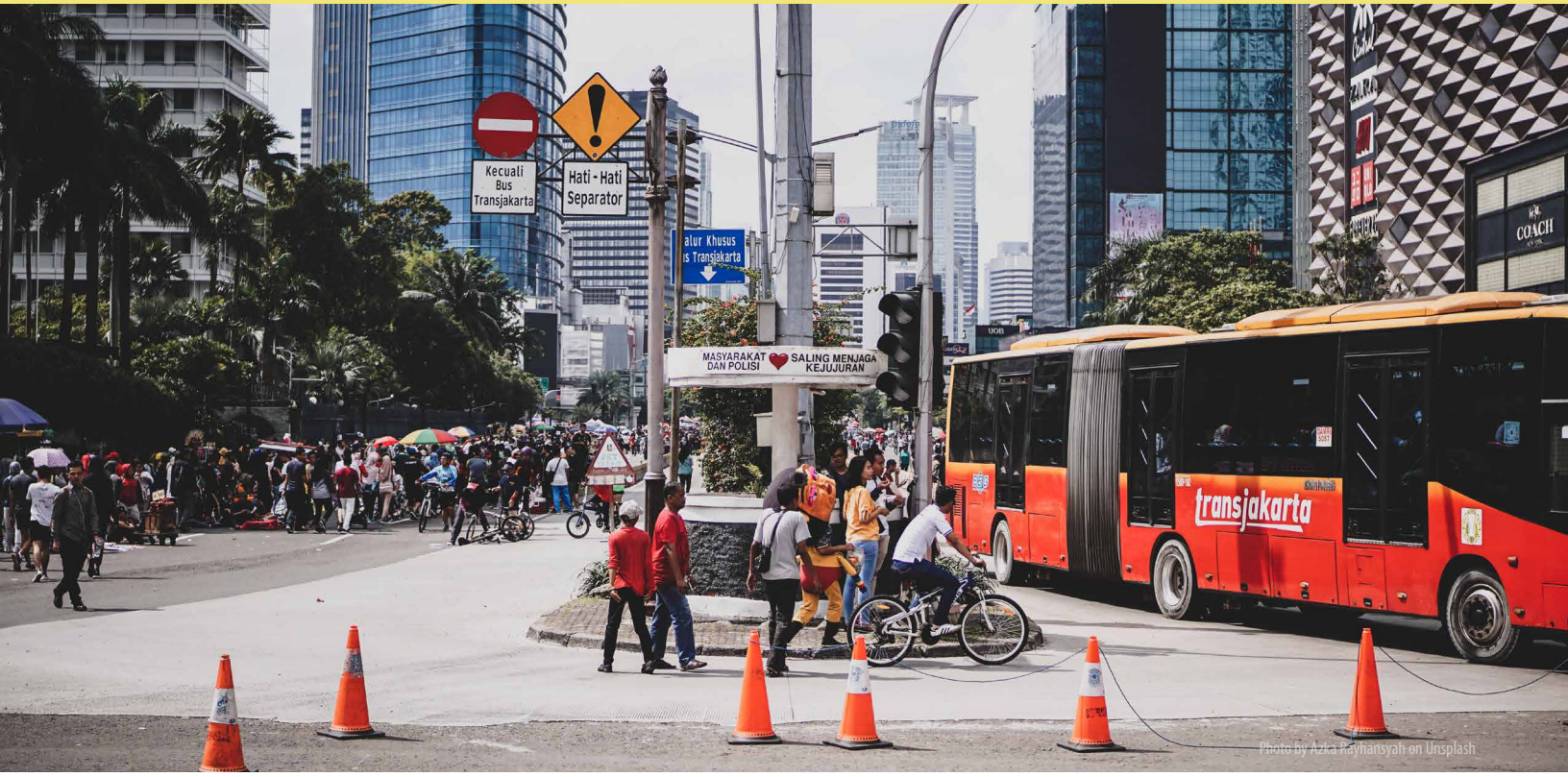
More importantly, international developers have predominantly contributed to the newly developed coal power projects in Indonesia. 94% of the new IPP projects (under-construction, PPA-signed, or under-planning) are sponsored by international companies (9.9 GW), while only 0.6 GW is solely developed by domestic IPPs. While the coal power investment commitments of China, Japan, and South Korea can be effective in terms of slowing down new coal power investments from international developers, halting the ongoing projects, especially those in the final stage of completion, are still facing enormous challenges.

Figure 2. Indonesia's coal power plants owned by independent power producers: (a) Capacity by developers' country and project status (pie chart); and (b) plant location (map).*



*Note: plant data based on GCPT (July 2022) and authors' verification as of October 2022

3. IPP plants retirement pathway and costs



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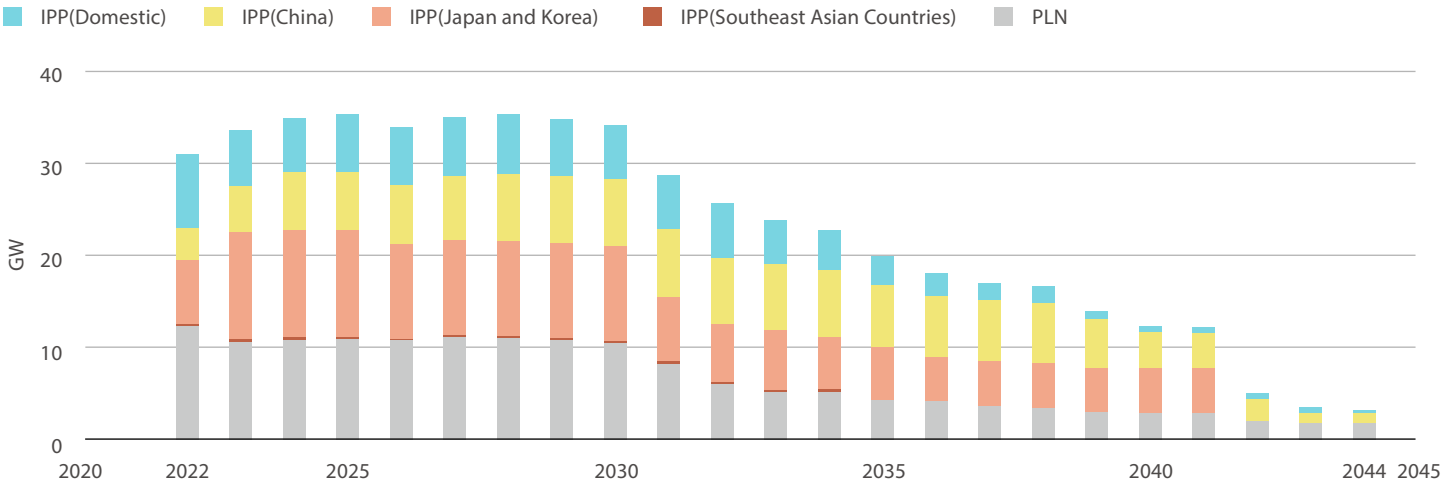
By combining long-term scenarios from a globally integrated assessment model and a multi-criteria plant-by-plant assessment, Cui et al. (2022) developed a detailed retirement schedule for all the operating and under-construction or PPA-signed coal power plants in Indonesia as of May 2022[8]. The retirement pathway is in line with 2050 net-zero emissions in Indonesia and based on a ranking of all the coal power plants with respect to their technical, economic, and environmental performance. Under the retirement priority ranking, the old, small, inefficient, most polluted, and least economic plants are generally retired first.

The results show that the retirement rates vary largely between the PLN and IPP plants and also between different country developers (Figure 3 and Table 1). Overall, the total grid-connected coal power capacity will grow slightly and remains constant through 2030 (Figure 3). New builds between 2022 and 2025, mostly by Japanese, South Korean, and Chinese IPPs, are offset by the retirement of the plants owned by domestic IPPs. The remaining capacity sponsored by the domestic IPPs retires at a similar rate within the 2030s and is mostly phased out by 2040. Projects involving Japanese and South Korean developers start to retire between 2026-2030 and at a much faster speed between 2031-2035. However, roughly 40% of their total capacity will not be retired until 2042.

[8] The analysis in Cui et al. (2022) includes capacity additions and retirements in 2022 that are part of the scenario, not historical data. Here we summarize results from the earlier analysis instead of showing the historical data.

In comparison, the total operating capacity of the Chinese-involved IPP projects is doubled within the next few years, and most of the plants do not retire until after 2035. Specifically, total capacity continues to grow through 2025 and stays nearly constant through 2030, because of the implementation of new projects currently under construction/PPA but limited retirement. Only 1 plant (50 MW) retires in the 2020s, 2 plants (0.5 GW) retire in 2031–

Figure 3. Total grid-connected operating coal power capacity in Indonesia by developer group, 2022–2045*



*Note: based on analysis in Cui et al. (2022), which includes capacity additions and retirements in 2022 that are part of the scenario, not historical data.

Table 1. Retirement schedule of IPP coal power capacity by developer's country

IPP coal power plants retirement in GW (% of country total)	Domestic	China	Japan and Korea	Southeast Asian Countries	Period total
2022-2025*	2.1 (24%)	0.05 (1%)	0.2 (2%)	0	2.3 (8%)
2026-2030	0.6 (7%)	0	1.3 (11%)	0	1.9 (7%)
2031-2035	2.7 (32%)	0.5 (7%)	4.5 (39%)	0.2 (100%)	8.0 (29%)
2036-2040	2.5 (30%)	2.8 (38%)	0.8 (7%)	0	6.1 (22%)
2041-2045	0.6 (7%)	4.0 (54%)	4.8 (41%)	0	9.4 (34%)
Country total	8.5 (100%)	7.4** (100%)	11.7 (100%)	0.2 (100%)	27.7 (100%)

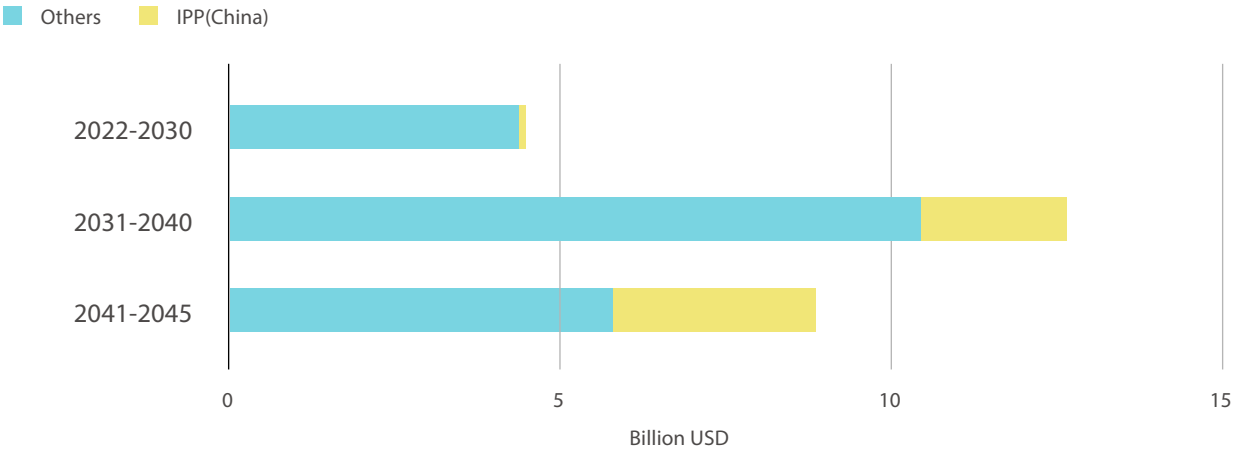
Note: * Based on the analysis in Cui et al. (2022), which includes capacity additions and retirements in 2022 that are part of the scenario, not historical data.
** One operating plant was missing from the retirement pathway analysis (Kaltim-2 power station, 250 MW), which leads to a smaller number in the country's total retired capacity compared to the pie chart above.

2035, and 6 plants (2.8 GW) retire in 2036–2040. While over half of the Chinese IPP capacity (4.0 GW, 10 plants) continues to operate beyond 2040, they have to run at very low utilization with an estimated 890 hours per year (18% of the current level) for the last five years, and retire by 2045, to be compatible with the 2050 national net-zero emissions target and the global 1.5C goal. The low utilization level suggests that coal power plants no longer provide baseload service in the power system, but are more likely to support the integration of renewables. Reduced utilization may also have implications for future profitability.

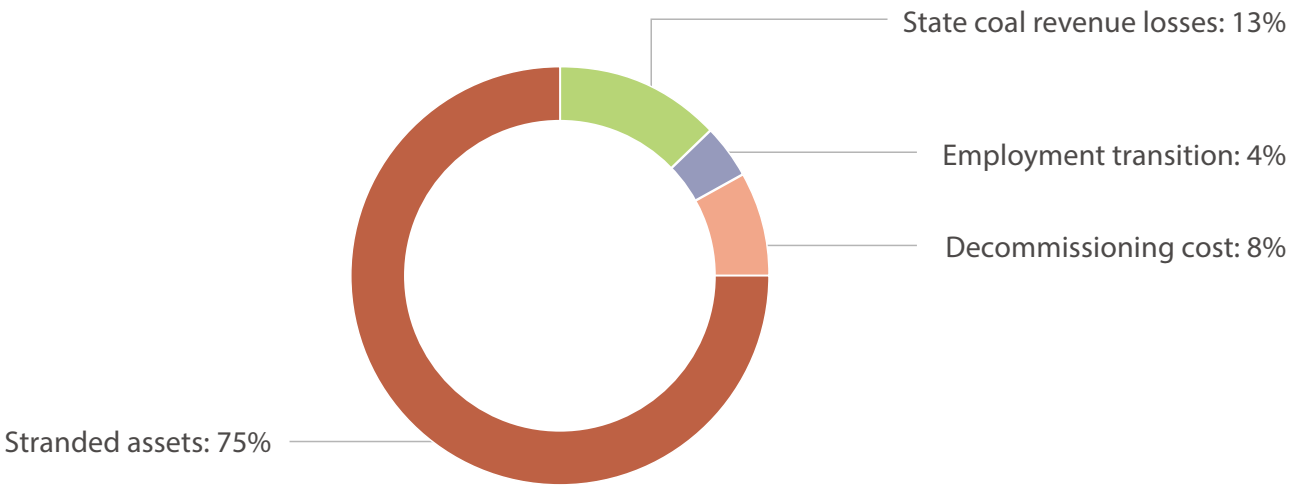
Moreover, Cui et al. (2022) also estimated the financing needs for an accelerated and just coal transition in Indonesia. Specifically, a framework is developed that can systematically quantify the benefits and costs for different stakeholders (industry, government, and the general public) of a just implementation of the proposed coal retirement plan. By quantifying a subset of the benefit and cost metrics in the framework, results show that the shared benefits from the avoided coal power subsidies and health impacts can be 2-4 times larger than the costs of stranded assets, decommissioning, employment transition, and state coal revenue losses.

Figure 4. Retirement costs of a just implementation of the proposed pathway

(a) Retirement costs of Chinese IPP plants vs. other coal power plants by period



(b) Chinese IPP plants by category – stranded assets, decommissioning cost, employment transition, and state coal revenue losses.



In particular, the costs of accelerated retirement of the Chinese IPP plants are estimated to be $5 billion through 2045, accounting for 16% of the total coal retirement cost in Indonesia. The benefits are estimated to be $24.7 billion through 2045, accounting for 26% of the total benefit associated with coal retirement in Indonesia. The accelerated retirement plan of the Chinese IPP projects can potentially deliver socioeconomic benefits to the local communities that are 3-4 times larger than the induced costs.

Of the total $5 billion retirement costs of the Chinese IPP plants, 34% are expected to occur in the last five years before the 2045 phaseout, 49% occurs in the 2030s, and less than 17% occurs between 2022 and 2030 (Figure 4a). Distribution of the retirement costs across periods is mostly driven by the total capacity retired in each period. However, the plants retired after 2040 have a higher average cost per MW compared to the plants retired during the 2030s because of shorter operating lifetimes and subsequently larger stranded assets.

In terms of the distribution across different cost categories (Figure 4b), 75% of the quantified costs through 2045 comes from stranded assets[9], which tends to have larger implications for the project owners/developers compared to the other cost categories. Decommissioning costs account for 8% of the total costs and are likely to be borne by the project owners as well. Despite a smaller share, the project owners may also bear some of the costs associated with the employment transition, such as compensation for plant workers' income losses.

[9] Stranded assets are calculated as investment losses due to early retirements of the coal plants based on a linear depreciation of the capital investments. See method details in Cui et al. (2022).

4. Implications across Chinese companies

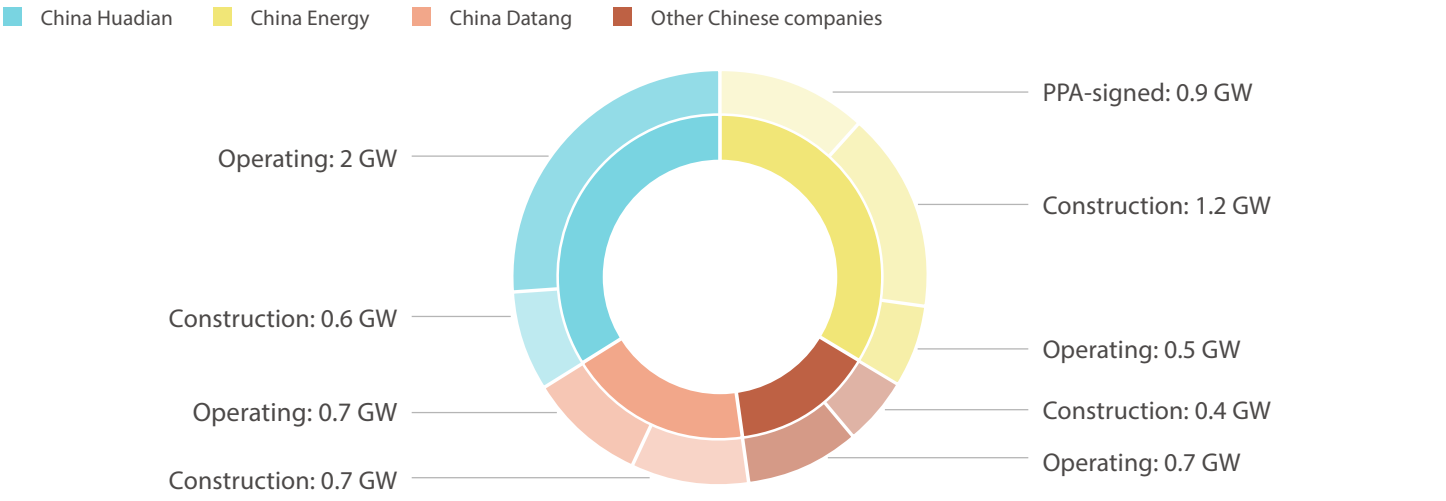

Photo by Mike Setchell on Unsplash

This section further looks at the main Chinese companies that participate in Indonesia's coal power projects to explore potential differences in their implications and strategies. In particular, three Chinese state-owned power companies, China Huadian, China Energy , and China Datang are involved in 12 coal power projects as equity investors, accounting for 82% of the total Chinese IPP capacity (Figure 5). Compared across companies, China Energy owns the largest operating plant –the 2 GW Java-7 power station, while Huadian has the largest capacity under development (including 1.2 GW under construction and 0.9 GW with PPAs).

Five other companies, including PowerChina, Golden Concord Holdings Group, China Energy Engineering Corporation, State Power Investment Corporation, and China Oceanwide Holdings Group, are involved in six coal power plants, accounting for 18% of the Chinese-sponsored coal power capacity. Most of these major Chinese developers are central state-owned enterprises, except for Gold Concord Holdings Group and China Oceanwide Holding Groups which are private-owned companies. However, the involvement of these two companies also indicates a growing trend of China's private investment in Indonesia's power sector, which may result in different coal phase-out and clean investment strategies compared to those state-owned developers.

[10] Also known as China Energy Investment Corporation. China Energy is the official English name for "*国家能源集团 (Guo Jia Neng Yuan Ji Tuan)*" in Chinese. It is worth noting that some literature also uses the National Energy Investment Group as the company's English name.

Figure 5. Coal power capacity with Chinese developers by company and project status



Under the retirement pathway, a 20-year lifetime is guaranteed to most of Indonesia's coal power plants except for a small set of plants that are identified as low-hanging fruit. These plants are most suitable for immediate retirement due to poor technical, economic, and environmental performance. For the Chinese-involved projects, only one plant – the 50 MW Pindo-Deli-li No.1 power station owned by China Datang – is identified as a low-hanging fruit that retires immediately in our scenario. Nevertheless, the analysis shows that the project can still operate for 15 years by its retirement (Table A1).

All other plants involving Chinese developers are expected to run for 20 years under the pathway, and therefore the retirement schedule is mostly determined by plant age or vintage year (Table 2). Except for the immediate retirement of the Pindo-Deli-li No.1 power plant, the rest of the Chinese-sponsored plants are all scheduled to retire after 2030.

According to the analysis, two plants owned by China Huadian – the Tanjung Kasam power station in Riau (two 65 MW units) and the Celukan Bawang power station in Bali (three 127 MW units) – with a total capacity of 0.5 GW are scheduled to retire during 2031-2035 (see Table A2 in Appendix). Retirements during 2036-2040 include the 2 GW plant owned by China Energy, three plants owned by China Datang with a total capacity of 0.6 GW, and three individual units with a total capacity of 0.2 GW involving other Chinese companies.

After 2040, all companies have a remaining capacity that continues to operate during the last five years of the coal phaseout in Indonesia, of which Huadian owns more than half of the total. As mentioned earlier, plants that operate through 2045 end up with very low utilization levels during the last five years and thus play a different role in the power system.

Total retirement costs are the highest for China Huadian at nearly 2 billion USD, of which 80% happen in 2041-2045; followed by China Energy at 1.65 billion USD, of which 73% happen in 2036-2040 (Figure 6). Total retirement costs for China Datang are about 0.81 billion USD and are relatively evenly distributed between 2036-2040 and 2041-2045. The rest of the Chinese companies have much lower retirement costs, which all happen after 2035. Distribution of the retirement costs across companies and across periods is mostly related to the amount of capacity retired.

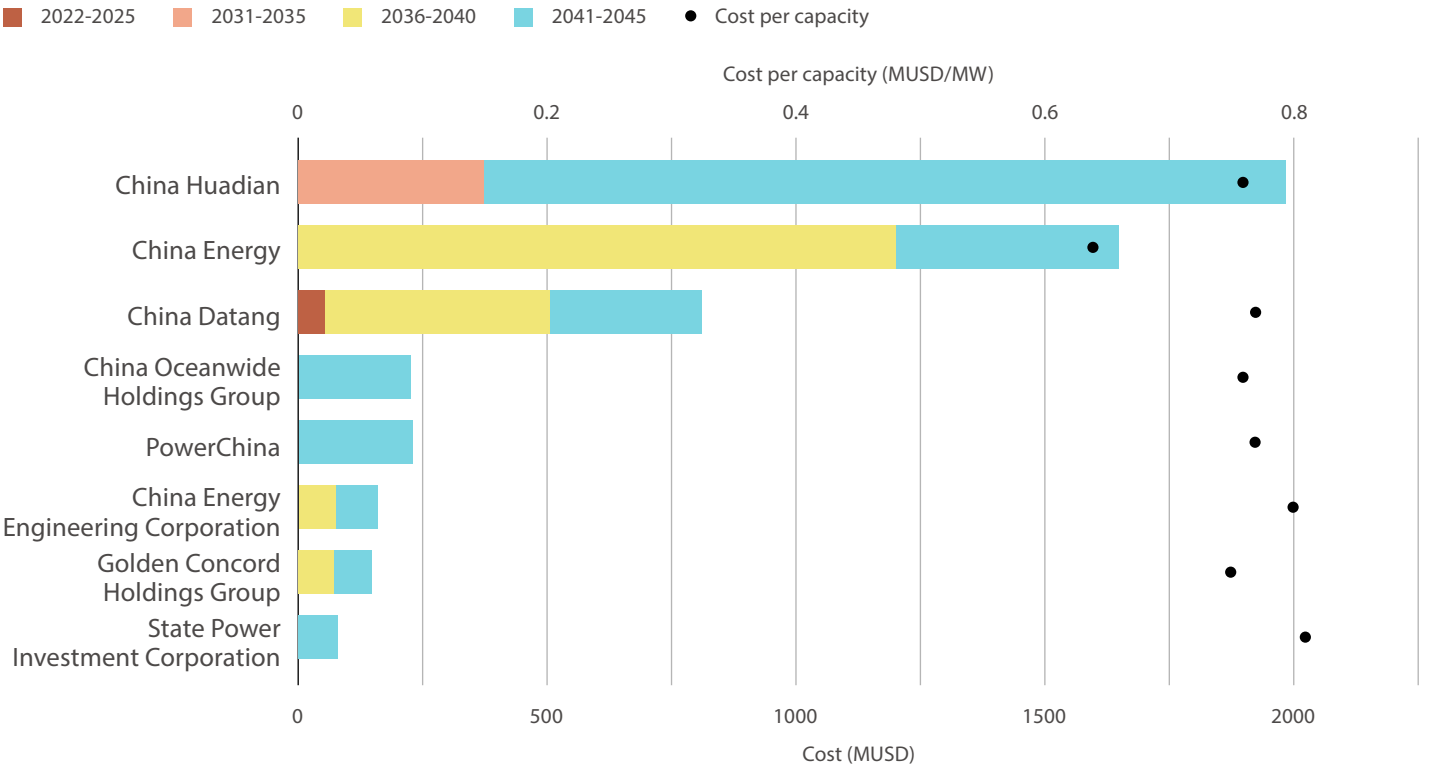
When looking at the average costs per capacity, we find that the numbers are quite close across companies between 0.76 to 0.81 million USD per MW, with the only exception of China Energy being 0.64 million USD per MW. This is mainly driven by the 2 GW Java-7 power station that has lower costs on employment transition because of fewer workers employed per MW and smaller state coal revenue losses because of more efficient use of coal.

Table 2. Plant retirement schedule by Chinese developer company

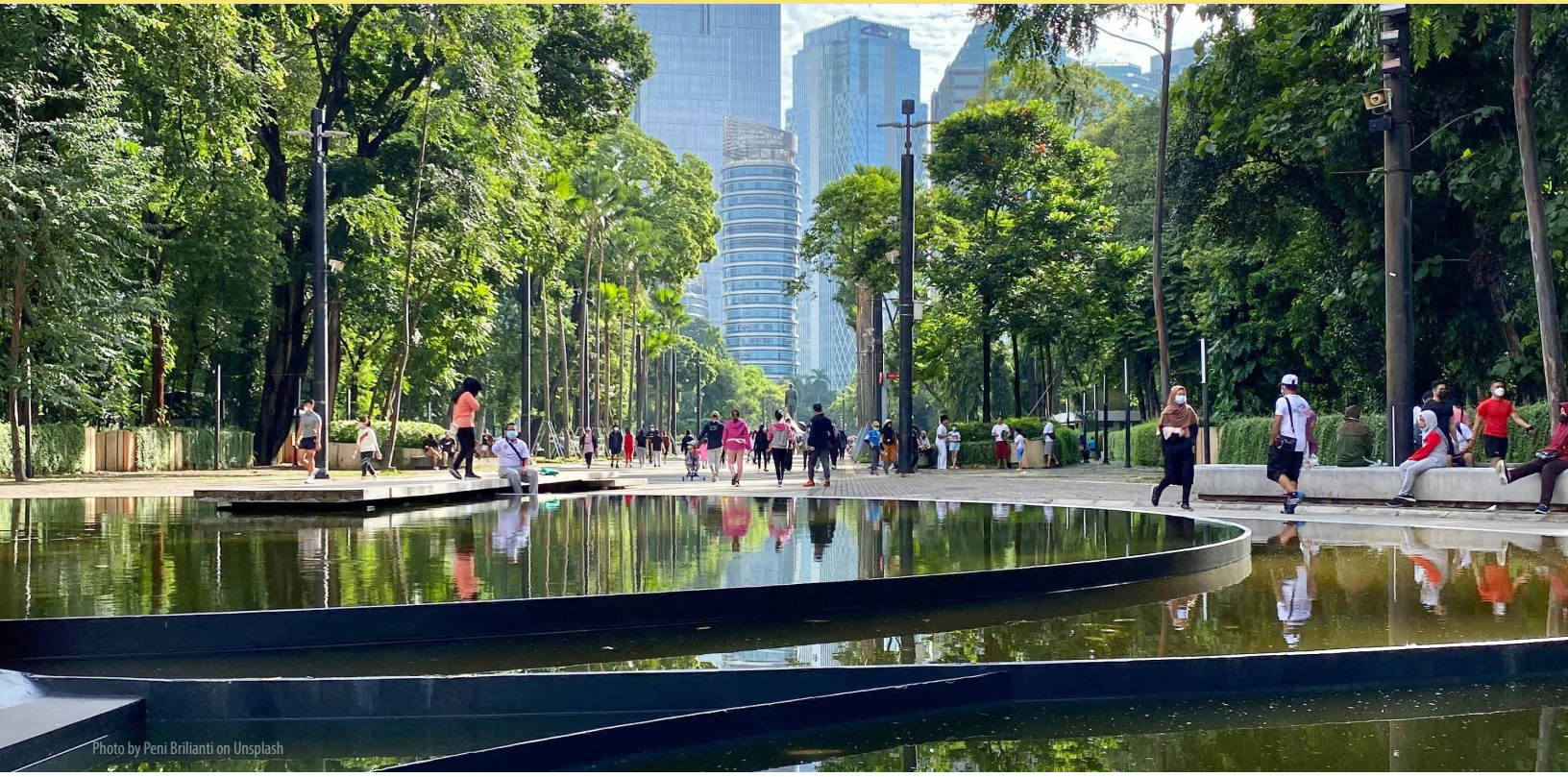
Retirement in GW (# of projects)	China Huadian	National Energy Investment Group	China Datang	Other Chinese companies
2022-2025*	0 (0)	0 (0)	0.05 (1)	0 (0)
2026-2030	0 (0)	0 (0)	0 (0)	0 (0)
2031-2035	0.5 (2)	0 (0)	0 (0)	0 (0)
2036-2040	0 (0)	2.0 (1)	0.6 (3)	0.2 (2)
2041-2045	2.1 (3)	0.6 (1)	0.4 (1)	0.9 (6)

Note: * Based on the analysis in Cui et al. (2022), which includes capacity additions and retirements in 2022 that are part of the scenario, not historical data.

Figure 6. Estimated costs of the accelerated retirement plan for each Chinese company by period.



5. Conclusion and policy implications



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This study provides important information for the Chinese companies that develop coal power projects in Indonesia to better understand the implications to their overseas assets under a possible coal phaseout pathway towards the long-term climate target that Indonesia is envisioning to pursue. In addition, this analysis also provides important information to Indonesian policymakers and PLN about the potential opportunities that international developers may bring to the table to help facilitate the early transition of IPP plants.

In the context of enhanced climate ambition and accelerated coal-to-clean energy transition in Indonesia, particularly through the recently announced JETP, international investors, specifically Chinese developers, can no longer assume their traditional business models and investment decision-making can sustain. **In the scenario developed by Cui et al (2022), we find that:**

- Total operating capacity of the Chinese-involved IPP plants will continue to grow and reach 7.6 GW – double from today – within the next few years, because of projects already under construction.
- Over 92% of the Chinese-involved capacity does not retire until after 2035, and over 50% not until after 2040.
- None of the Chinese IPP coal power plants in Indonesia operate for more than 20 years, compared to a typical lifetime of 30-40 years.
- In addition, these coal power plants will play a different role in the future power system, shifting from baseload to peaking service by gradually lowering the utilization levels – those in operation after 2040 will run less than 900 hours per year.

Investors, therefore, need to adjust their strategies to align with the country's climate goals, move away from building new coal power plants, and act proactively to prepare for the accelerated transition of existing coal power plants. Several specific recommendations include:

1) For those pre-construction coal power plants, IPPs should suspend them and explore the possibility of substituting them with renewable energy plants in order to avoid sunk costs.
2) For the coal power plants that are already under construction or operation, Chinese IPPs should actively engage with governments, PLN, and other stakeholders, and take advantage of existing and new financial mechanisms (i.e., ADB's ETM, JETP) to explore an orderly and just coal phase-out approach and timeline.
3) For the coal power plants that can remain operating after 2035, in preparation, project owners/ developers need to start evaluating options and costs to convert the facility to flexible generation at low utilization levels.
4) For plants that intend to operate beyond 20 years, project owners/developers need to explore potential options and costs to repurpose the plants to alternative low-carbon facilities that are in line with the country's long-term climate goals.
5) Chinese public financiers (e.g., policy banks) should explore the coal early retirement mechanism with the companies, PLN, and the Indonesian government. With the leadership of the Chinese government, public financiers can be first movers and provide financial expertise and mechanisms to assist with early coal retirement.

While this paper provides an initial analysis of the issue, there are important questions that need to be answered with further research. For example, the renegotiation of the PPA terms between PLN and IPPs (including Chinese companies) will determine the cost of early retirement (e.g., stranded assets) and the cost allocation among industry, government, and other stakeholders. Through ongoing efforts with international partners, innovative mechanisms need to be explored to support a smooth transition for project developers, the workforce, and local communities.

While the costs of early coal retirements are relatively concentrated on certain stakeholders, the environmental and social benefits are often broader and diffused to the general public. Policy mechanisms to link the broad societal benefits to the assets' value could potentially provide motivation with economic compensation for early actions. For example, cases in Germany show that to encourage IPPs to retire coal power plants earlier, the auction starting benchmark decreases as time passes, and after 2027, the remaining plants are subject to forced closure without any compensation.[11]

Moreover, similar to Indonesia, other emerging economies, such as Vietnam, are increasingly shifting towards clean energy, raising the alarm for Chinese developers – one of the world's largest overseas coal power investors – to reevaluate their overseas coal power assets and avoid unwanted costs derived from stranded assets. It is important to conduct a comprehensive economic analysis of new builds – including possible cancellation of projects under-construction to the extent possible. It can help quantify the avoided economic losses from not only the stranded assets of new builds themselves, but also the potential impacts on existing plants – which might otherwise be pushed out earlier because of the added coal power capacity under the same emissions budget for long-term climate goals.

Meanwhile, an increasing number of financial institutions are trying to lower the carbon intensity of their asset portfolio, and more financial instruments and tools are available for renewable energy deployment and the low-carbon transition. Thus, companies with clear long-term decarbonization goals and plans may have better access to various transition finance schemes, such as sustainability-linked bonds. The benefit of replacing assets from coal with renewable energy is increasing.

China's recent commitment to help other developing countries' clean energy transition may provide additional opportunities

[11] https://initiatives.weforum.org/micee/ctr-toolkit-finance/aJY6800000000DUGAY#

for a just transition of these coal power plants, and investment prospects in clean energy. The JETP in combination with falling renewable energy costs will drive demand for RE projects for Chinese developers. The Indonesian JETP calls for renewables to comprise 34% of power generation by 2030, from 11.5% in 2021. Renewables need to replace the capacity of coal power plants retired. As the world's largest renewable energy producer and investor, China is therefore able to bring those countries investments and technologies to bolster a clean and just energy transition towards carbon neutrality.

This analysis only looks at the coal power projects that are connected to the grid, while Chinese companies are in fact largely involved in coal-fired captive plants, which is a more complex situation and requires different strategies. Indonesia's JETP has restrictions on the development of captive power plants, which may influence off-grid power plants inside China-built industrial parks. We will explore that in a second report of the series.

APPENDIX.

Plant information and retirement schedule by each Chinese developer company

Table A1. China Datang

Plant	Unit	State	District	County	Capacity (MW)	Status	Vintage year	Retirement year	Costs (MUSD)
Pindo-Deli-Ii	Unit 1	West Java			50	operating	2007	2022	41.3
Sumsel-5 power station	Unit 1	South Sumatra	Musi Banyuasin	Bayung Lencir	150	operating	2016	2036	82.5
	Unit 2	South Sumatra	Musi Banyuasin	Bayung Lencir	150	operating	2016	2036	82.5
Kendari-3 power station	Unit 1	Southeast Sulawesi			50	operating	2019	2039	27.5
	Unit 2	Southeast Sulawesi	South Konawe	Tanjung Tiram	50	operating	2019	2039	27.5
Kalselteng-1 power station	Unit 1	Central Kalimantan	Gunung Mas Regency		100	operating	2020	2040	56.7
	Unit 2	Central Kalimantan	Gunung Mas Regency		100	operating	2020	2040	56.7
Nagan Raya power station	Unit 3	Aceh	Nagan Raya		200	construction	2023	2043	110.0
	Unit 4	Aceh	Nagan Raya		200	construction	2023	2043	110.0

Table A2. China Huadian

Plant	Unit	State	District	County	Capacity (MW)	Status	Vintage year	Retirement year	Costs (MUSD)
Tanjung Kasam power station	Unit 1	Riau	Batam	Nongsa	65	operating	2012	2032	35.8
	Unit 2	Riau	Batam	Nongsa	65	operating	2012	2032	35.8
Celukan Bawang power station	Unit 1	Bali	Buleleng	Gerokgak	127	operating	2015	2035	69.9
	Unit 2	Bali	Buleleng	Gerokgak	127	operating	2015	2035	69.9
	Unit 3	Bali	Buleleng	Gerokgak	127	operating	2015	2035	69.9
Bangko Tengah	Unit 1	South Sumatra	Muara Lenim / Lahat		600	construction	2022	2042	330.0
	Unit 2	South Sumatra	Muara Lenim / Lahat		600	construction	2022	2042	330.0
Jambi-1 power station	Unit 1	Jambi	Batang Hari	Bajubang	300	permitted (contract/ PPA)	2027	2045	198.0
Jambi-2 power station	Unit 1	Jambi	Batang Hari	Bajubang	300	permitted (contract/ PPA)	2026	2045	181.5
	Unit 2	Jambi	Batang Hari	Bajubang	300	permitted (contract/ PPA)	2026	2045	181.5

Table A3. China Energy

Plant	Unit	State	District	County	Capacity (MW)	Status	Vintage year	Retirement year	Costs (MUSD)
Jawa-7 power station	Unit 1	Banten	Serang	Kramatwatu	991	operating	2019	2039	462.5
	Unit 2	Banten	Serang	Kramatwatu	991	operating	2020	2040	462.5
Sumsel-1 power station	Unit 1	South Sumatra	Rambang Dangku District		300	construction	2023	2043	165.0
	Unit 2	South Sumatra	Rambang Dangku District		300	construction	2023	2043	165.0

Table A4. Other Chinese companies

Company	Plant	Unit	State	District	County	Capacity (MW)	Status	Vintage year	Retirement year	Costs (MUSD)
China Energy Engineering Corporation	Parit Baru power station	Unit 1	West Kalimantan	Pontianak	Siantan	50	operating	2018	2038	27.5
		Unit 2	West Kalimantan	Pontianak	Siantan	50	operating	2019	2039	27.5
		Unit 3	West Kalimantan	Pontianak	Siantan	50	construction	2025	2045	27.5
		Unit 4	West Kalimantan	Pontianak	Siantan	50	construction	2025	2045	27.5
China Oceanwide Holdings Group	Sumut-1 power station	Unit 1	North Sumatra	Deli Serdang		150	construction	2023	2043	82.5
		Unit 2	North Sumatra	Deli Serdang		150	construction	2023	2043	82.5
Golden Concord Holdings Group	Kalbar-1 power station	Unit 1	West Kalimantan			100	operating	2020	2040	55.0
		Unit 2	West Kalimantan			100	operating	2021	2041	55.0
PowerChina	Sulut-3 power station	Unit 1	North Sulawesi	Kema		50	operating	2021	2041	27.5
		Unit 2	North Sulawesi	Kema		50	operating	2021	2041	27.5
	Bengkulu power station	Unit 1	Bengkulu			100	construction	2022	2042	55.0
		Unit 2	Bengkulu			100	construction	2022	2042	55.0
State Power Investment Corporation	Sulbagut-1 power station	Unit 1	Gorontalo			50	construction	2022	2042	27.5
		Unit 2	Gorontalo			50	construction	2022	2042	27.5

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