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The Untimely Expansion of Coal Capacity in New External Markets

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In examining the continued use, or even expansion of coal, one cannot restrict the analysis to the national use of coal production or consumption. Many countries have engaged in coal facility expansion in largely emerging market economies. The countries that have engaged in coal facilities abroad, particularly the ‘Big Three’ – China, Japan and the Republic of Korea (Korea) – have also financed numerous projects abroad, even where they have not engaged in the construction or direct operation of these facilities.

Coal capacity expansion, whether through a state’s companies or its public financing, does not appear to be linked with domestic market pressures. The leading role played by the Big Three suggests market competitiveness plays the largest role in determining the behavior of coal capacity expansion in foreign markets. All three countries possess cutting-edge technology in coal power generation. With their ability to build more efficient power plants at cost, these countries have an incentive to support coal power expansion abroad, which in turn will lead to more business for their more competitive coal companies. Thus, in assessing the effort to eliminate coal as a major energy producer, it is not sufficient to just examine domestic efforts. A realistic examination must take into account external expansion efforts.

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Introduction

Reducing coal use is of paramount importance in global efforts to mitigate climate change. In a recently completed companion article we investigated the production and consumption of coal by the leading coal states (Zhao and Alexandroff 2018). While there has been much attention to how existing coal users control their own coal usage domestically, we anticipate much of future coal use growth will be in new external markets where there is much less of a history of coal use.

Country	Existing Capacity	Announced, Pre-Permit, Permitted	Under Construction
China	922,062 MW	152,775 MW	147,143 MW
India	218,091 MW	101,370 MW	43,418 MW
United States	281,127 MW	895 MW	0
Japan	44,244 MW	15,120 MW	5,313 MW
Russia	48,790 MW	8,706 MW	240 MW
South Africa	40,513 MW	5,540 MW	7,940 MW
Korea	34,706 MW	5,340 MW	6,846 MW
Indonesia	28,269 MW	34,230 MW	6,890 MW
Germany	50,826 MW	1,100 MW	1,100 MW
Australia	25,112 MW	0	0
Major Coal Market Total	1,693,740 MW (86%)	325,076 MW (59%)	218,890 MW (83%)
Rest of World	271,628 MW (14%)	223,277 MW (41%)	45,071 MW (17%)

As shown in Table 1, above, while these current major markets hold most of the world's coal generation capacity, as well as current capacity under construction, planned future capacity is spread more evenly. The reality is that 41percent of new capacity is coming from outside of the top ten coal markets. Turkey, Vietnam, Egypt, Bangladesh, and Pakistan currently have the most planned capacity additions, outside of the current top ten coal markets (EndCoal 2017). Projects in these emerging coal markets often involve foreign financing and design and in some instances

management (Urgewald 2017).¹ The support by way of foreign financing and technique is essential to the continued growth of coal capacity in these new markets. As such, understanding the motivations and activities of major coal markets in supporting external coal projects will be essential to finding out how to limit the growth of coal power generation and resultant greenhouse gas emissions. This Working Paper (WP) examines the major supporters of global coal capacity expansion and identifies common characteristics that may help to explain the motivations for this behavior. It may thus provide clues in seeking to limit such coal expansion.

External Coal Capacity Expansion

Despite strong commitments to reducing greenhouse gas emissions by China, Japan, and many other developed states, there has been a tremendous amount of support for coal capacity expansion in recent years. While governments claim that they support the transition to cleaner energies, public financing in 2016 by the G20 countries contributed \$10 billion to coal power but only \$4 billion to renewables in comparison (Chen 2017). Private sector financial institutions such as Morgan Stanley and Wells Fargo have also committed to reducing lending to coal development projects, but the availability of finance for coal remains strong.² From January 2014 to September 2017, international banks have channelled \$630 billion to the 120 top companies planning to construct new power plants.³

The mismatch between expressed commitments to lower domestic coal use and the continued support for coal capacity expansion abroad in both public and private sectors may reflect the lack of incentives in reining in such external capacity expansion. The Paris Agreement's nationally determined contributions (NDC) framework creates voluntary targets for what individual countries choose to do to limit emissions within their own borders, but these NDCs do not involve restrictions on a country's action outside of its own borders. For instance, China does make a commitment to improving South-South Cooperation on climate change but does not commit to restricting its development assistance to projects with green energy and cleaner fossil fuel technology (United Nations 2015). Supporting coal projects abroad provides business opportunities for domestic utility companies as well as supporting industries providing professional services, construction, and materials. However, as shown in Table 2, the bulk of public coal power plant financing in recent years appears to come from a few select major players.

¹ Market Forces, "The financial backers of Vietnam's latest 3 power stations," *Market Forces*, accessed August 21, 2017. <https://www.marketforces.org.au/the-financial-backers-of-vietnams-latest-3-power-stations/>

² Alex Nussbaum, "Wells Fargo, Morgan Stanley Join Banks Edging Away From Coal," *Bloomberg*, November 30, 2017.

³ Madison Marriage, "Banks criticised for funding coal deals despite Paris agreement," *Financial Times*, December 11, 2017.

Table 2: Existing and Pending Public Financing for Coal Power Projects since 2013 (Chen 2017)	
G20 Country	Coal Power Plant Financing
Argentina	\$ 199,784
Brazil	\$ 753,544
Canada	\$ 7,613,200
China	\$ 36,911,800,934
France	\$ 7,489,014
Germany	\$ 1,533,490,841
India	\$ 1,687,516,099
Italy	\$ 636,846,068
Japan	\$ 15,465,724,814
Multilateral	\$ 2,208,325,000
Russia	\$ 20,000,000
Saudi Arabia	\$ 404,631
South Africa	\$ 159,898,219
South Korea	\$ 5,320,880,334
Turkey	\$ 69,066,371
United Kingdom	\$ 27,890,055
United States	\$ 13,072,636
Total	\$USD 64,070,971,545

China, Japan, and Korea, what we refer to in this paper as the ‘Big Three’, assume the lead, by far. But in addition, Indian and German public financing for coal expansion abroad since 2013 also exceed \$1 billion each. While China holds the lead by far in both, it is interesting to note that the next largest contributors of public financing for coal abroad (Japan, Korea) are not the next largest consumers of coal at home (India, United States). This suggests that different dynamics may be at play for the external expansion of coal capacity than those for domestic coal capacity.

China

Along with being the largest domestic market for coal, China is responsible for a substantial amount of international coal financing and capacity expansion. Data collected by Urgewald, a German environmental NGO, shows that the top 14 Chinese companies have plans to build over 310 GW of coal power capacity abroad (Urgewald 2017). There are plans to build coal capacity in all the following countries: Pakistan, Malawi, Vietnam, Indonesia, Bangladesh, Cambodia, Georgia, Egypt, the United Arab Emirates, Jamaica, Tanzania, Zimbabwe, Morocco, Mongolia, Iran, Turkey, Mozambique, and Russia. As shown below in Table 3, some of these countries already use a significant amount of coal but many do not.

Country	Coal Expansion Plans by Chinese Companies as of 2017 (Urgewald 2017)	Coal Expansion Plans financed by China as of 2015 (Hervé-Mignucci and Wang 2015, 18-32)	2015 Coal Consumption (BP 2016, 33)
Pakistan	Yes	Yes	4.7 (0.1%)
Malawi	Yes	Yes	N/A
Vietnam	Yes	Yes	22.2 (0.6%)
Indonesia	Yes	Yes	80.3 (2.1%)
Bangladesh	Yes	Yes	N/A
Cambodia	Yes	Yes	N/A
Georgia	Yes	No	N/A
Egypt	Yes	No	N/A
United Arab Emirates	Yes	No	N/A
Jamaica	Yes	No	N/A
Tanzania	Yes	Yes	N/A
Zimbabwe	Yes	Yes	N/A
Morocco	Yes	Yes	N/A

Mongolia	Yes	Yes	N/A
Iran	Yes	Yes	N/A
Turkey	Yes	Yes	34.4 (0.9%)
Mozambique	Yes	No	N/A
Russia	Yes	Yes	88.7 (2.3%)
Botswana	No	Yes	N/A
Ghana	No	Yes	N/A
Nigeria	No	Yes	N/A
Zambia	No	Yes	N/A
Kazakhstan	No	Yes	32.6 (0.8%)
Kyrgyzstan	No	Yes	N/A
Tajikistan	No	Yes	N/A
Uzbekistan	No	Yes	N/A
Bosnia and Herzegovina	No	Yes	N/A
Montenegro	No	Yes	N/A
Romania	No	Yes	6.1 (0.2%)
Serbia	No	Yes	N/A
India	No	Yes	407.2 (10.6%)
Sri Lanka	No	Yes	N/A
Brazil	No	Yes	17.4 (0.5%)
Myanmar	No	Yes	N/A
Philippines	No	Yes	11.4 (0.3%)

*Figures in Million Tonnes of Oil Equivalent, “N/A” represents < 0.05% of global market share.

**Some countries listed without planned coal capacity by Chinese companies may have completed the projects already, some countries listed without coal financing as of 2015 may have acquired financing afterwards from China.

Given the size of China's coal industry and the economic difficulties it faces within the domestic coal market, it is hardly surprising that Chinese companies are exploring business opportunities abroad. While the Chinese domestic market is saturated with supply, many of the countries listed in Table 3 have growing energy needs but poor existing energy infrastructure. In such markets, Chinese firms would presumably have a much better chance of turning a profit.

In addition to building coal capacity, China also provides financing for coal capacity expansion. Researchers estimate that \$USD 21-38 billion worth of Chinese finance in total went to overseas coal power projects from 2005-2015 (Hervé-Mignucci and Wang 2015, 18-32). Aside from supporting projects operated by its own power generation companies, Table 3 shows that Chinese finance is also going to projects in foreign countries that will not be operated by Chinese companies. This financing is incentivized by the competitiveness of Chinese engineering, procurement, and construction firms. Due to their lower costs, Chinese firms are more likely to be successful in bidding for coal projects when compared to competitors (Hervé-Mignucci and Wang 2015, 12). This means that pressures on such firms in the domestic market, whether from oversupply or environmental policy reducing demand, can be partly side-stepped by satisfying demand in international markets.

Emerging markets have rising energy demands and coal may indeed be necessary in the short term to fulfill this increasing need for energy. However, a responsible approach to financing such project means using the cleanest, most efficient technology to minimize the harm the new enlarged capacity will create. China's record, however, on this matter is mixed. New coal generation capacity in China often uses supercritical or ultra-supercritical technology, generating power at temperatures and pressures where there is no difference between water gas and liquid water. These technologies, therefore, maximize efficiency in the burning of coal. Some of its projects abroad employ such technology. The Hubco Power Station in Pakistan currently under construction by a Chinese power generation firm uses such supercritical technology.⁴ The Hamarawein power station announced in Egypt, sponsored by Shanghai Electric Group, will use ultra-supercritical technology.⁵ However, an ongoing project in Sihanoukville, Cambodia, operated by a Cambodian-based Chinese subsidiary, does not employ such technology.⁶ Despite the high technological capacity of the Chinese coal industry, Chinese projects abroad do not always use the most advanced technology.

⁴ "Hubco Power Station," *Source Watch*, last modified June 14, 2017.

http://www.sourcewatch.org/index.php/Hubco_power_station

⁵ "Hamarawein Power Station," *Source Watch*, last modified May 26, 2017.

http://www.sourcewatch.org/index.php/Hamarawein_power_station

⁶ "Sihanoukville CIIDG Power Station," *Source Watch*, last modified May 16, 2017.

http://www.sourcewatch.org/index.php/Sihanoukville_CIIDG_power_station#Project_Details

Japan

Japan possesses an *Importer* trading regime (for details see our companion working paper, Zhao and Alexandroff 2018). While coal mining used to be an important industry in Japan, coal production underwent a turbulent decline during the 1960s and has continued to decline in subsequent years. As a result, Japan imports most of its coal (Culter 1999, 17, 48, 52). Hence, Japan has no imperative to sustain domestic coal consumption to support a domestic mining industry. However, Japan does possess a coal power generation industry that can benefit from expansion of coal capacity outside of Japan.

Japanese companies have plans to build coal-fired power generation capacity in several emerging economies. In addition to power plant projects in the domestic market, Japanese companies will build or expand coal power generation capacity in Botswana, Egypt, Indonesia, Malaysia, Mongolia, Myanmar, Philippines, South Africa and Vietnam. In total, projects involving Japanese companies will add 34 GW of coal generation globally (Urgewald 2017).

Country	Coal Expansion Plans by Japanese Companies as of 2017 (Urgewald 2017)	Coal Expansion Plans financed by Japan as of 2015 (Chen 2016)	2015 Coal Consumption (BP 2016, 33)
Vietnam	Yes	Yes	22.2 (0.6%)
Indonesia	Yes	Yes	80.3 (2.1%)
Egypt	Yes	No	N/A
Mongolia	Yes	No	N/A
Botswana	Yes	Yes	N/A
India	No	Yes	407.2 (10.6%)
Malaysia	Yes	No	17.6 (0.5%)
Mexico	No	Yes	12.8 (0.3%)
Morocco	No	Yes	N/A
South Africa	Yes	No	85.0 (2.2%)

Myanmar	Yes	Yes	N/A
Philippines	Yes	Yes	11.4 (0.3%)

*Figures in Million Tonnes of Oil Equivalent, “N/A” represents < 0.05% of global market share.

**Some countries listed without planned coal capacity by Japanese companies may have completed the projects already. Some countries listed without coal financing as of 2015 may have acquired financing afterwards from Japan.

Japan is also financing coal capacity expansion. From 2007-2015, Japanese export credit agencies and other public financiers provided over \$USD11 billion to either new coal power plants or power plant expansions - an amount greater than all other members of the G7 combined (Chen 2016). In addition, there were plans to commit over \$USD10 billion to financing additional coal projects as of 2015 (Chen 2016). Japan states that its financing goes toward coal projects that make use of advanced, highly efficient Japanese technology.⁷ This means that even if a non-Japanese company is operating the power plant, high-tech components such as the boilers would need to be imported from Japan, putting money back into the coffers of the broader Japanese coal industry. It should be noted, however, that while Japan promotes the use of high-efficiency coal technology, presumably justifying the Japanese financing of coal expansion as climate finance, there are Japanese projects, such as the Morupule B power station in Botswana, that will still be using less efficient sub-critical boilers to generate electricity.⁸

Though Japan had planned to expand energy self-sufficiency and move away from fossil fuels, in 2010, the Fukushima disaster led Japan to shift back toward fossil fuel use, including coal (Koyama 2013, 279). Prior to this, coal power had experienced a degree of underutilization, which meant that the rise in demand did not lead to a dramatic expansion of coal capacity right after Fukushima (Kuramochi 2015, 1322). Nonetheless, coal power generation remains a growth sector in Japan and the government appears to be committed to the continued expansion of high-efficiency coal power generation to satisfy energy needs (Kuramochi 2015, 1330). This commitment demonstrates that the behaviour of financing external projects is not necessarily related to internal market pressures. If a state has a natural advantage in coal power, it will be incentivized to advocate projects that will bring business to its coal firms at home. However, the absence of domestic market stress might also mean that a state will be more amenable to restrict its financing activities. Japan,

⁷ Thin Lei Win, “Japan, China, and South Korea violate Paris agreement by funding coal in Indonesia ,” *Christian Science Monitor*, July 19, 2017.

⁸ “Morupule B Power Station,” *Source Watch*, last modified May 14, 2017. http://www.sourcewatch.org/index.php/Morupule_B_power_station#Project_Details_of_Units_7-8

for instance, has already concluded a multilateral agreement with other OECD countries to restrict its coal financing to only ultra-supercritical power plants. This agreement takes effect in 2017.⁹

Korea

Korea, like Japan, possesses an *Importer* trading regime (See Zhao and Alexandroff 2018). Coal is Korea's only fossil fuel energy resource, but even the historic high production volume of nearly 25 million tonnes would not be able to satisfy Korea's current demand (Global Methane Initiative 2017).¹⁰ But like Japan, Korea is an active player in the global expansion of coal capacity.

Korean companies are building a sizeable amount of coal capacity both at home and abroad. As of July 2017, Korea plans to build about 23 GW of coal power generation capacity within its domestic market as well as building abroad in Botswana, Myanmar, Vietnam, Indonesia, Philippines, Swaziland, South Africa, and Mongolia (Urgewald 2017). In terms of financing, Korea is one of the world's biggest contributors. In total, from 2007 to 2014, Korea provided \$7.09 billion to coal projects through its export credit agencies (World Wildlife Fund 2015). This is greater than the combined contribution of Germany and the United States to coal financing for power generation (Chen 2016). However, data on recipients of Korean financing is not as readily available as China or Japan, making it difficult to disaggregate the various destinations of Korean finance.

Korea is a leader in high efficiency coal generation. Like Japan, 70 percent of its coal generation capacity uses supercritical or ultra-supercritical plants.¹¹ However, some external Korean projects, such as the Morupule B Power Station, a Korean firm that is jointly running the project with Japan, or the Vung Ang power station in Vietnam, use subcritical boilers.¹² In terms of political incentives and market pressures, Korean firms face a competitive environment with Japanese firms. While recent government changes have led to a more environmentally friendly approach in Korean energy policy, the government seemingly does not intend to put too much pressure on Korean coal.¹³ Korea is also party to the OECD agreement on restricting coal finance (Organization for Economic Co-operation and Development 2015).

⁹ Associated Press, "OECD countries agree to restrict financing for overseas coal power plants," *The Guardian*, November 18, 2015.

¹⁰ Rebecca Jang, "South Korea expects record coal demand in 2016," *Reuters*, March 4, 2016.

¹¹ Rowan Callick, "'Ultra-supercritical' coal power checks on pollution," *The Australian*, January 24, 2017.

¹² "Vung Ang power station," *Source Watch*, last modified June 27, 2017.

http://www.sourcewatch.org/index.php/Vung_Ang_power_station

"Morupule B power station," *Source Watch*, May 14, 2017.

http://www.sourcewatch.org/index.php/Morupule_B_power_station

¹³ Jane Chung, "South Korea plans energy U-turn away from coal, nuclear," *Reuters*, June 4, 2017.

The Smaller Players in the Global Market: Germany, United States, India

German companies are a smaller contributor to external coal capacity expansion than any of the Big Three. The only upcoming external German project is a supercritical power unit addition in Hungary, and the announced German coal capacity additions are about 2.7 GW (Urgewald 2017). These additions are not insignificant, but certainly nowhere near the size of the Asian giants. Where Germany is a much more significant player is in its coal financing. Germany has committed over \$3.1 billion in export credit and other public financing to Serbia, India, South Africa, and Vietnam for new coal-fired plants or plant expansions from 2007-2015 (Chen 2016). While Germany seems to have lost some prominence as a major financier for upcoming projects, German export credit are still funding expansions such as the ultra-supercritical power station in Ptolemaida, Greece (Chen 2016).

The United States is similar in its contributions to those provided by Germany. American companies have upcoming projects in the domestic market, as well as in India and the Philippines totalling 3.1 GW of power generation capacity (Chen 2016). In terms of financing, the United States committed over \$2.2 billion in export credit and other public financing to India, South Africa, and Mongolia for new coal-fired plants or plant expansions from 2007-2015 (Chen 2016). The United States is a much smaller contributor to coal capacity expansion relative to its size, a situation that reflects the aging nature of its own domestic coal market, where the average coal-fired power plant life today is 38 years (United States Energy Information Administration 2016). With a much less competitive coal industry, the United States plays a smaller role in financing and construction of coal power outside its own borders than more advanced coal markets such as the Big Three.

India is a major contributor to coal capacity expansion, but largely limited to its domestic market. India has a planned coal capacity expansion of almost 141 GW (Urgewald 2017). While Indian companies do have projects in Mozambique, Senegal, Botswana, Swaziland, Bangladesh, Myanmar, and Vietnam, these projects make up a small proportion of total expansion by Indian companies. In terms of public financing of coal projects, India does not register as a major player anywhere near China, Japan, or Korea (Chen 2017; World Wildlife Fund 2015).

Conclusion

Coal capacity expansion, whether through a state's companies or its public financing, does not appear to be linked with domestic market pressures. China, which does suffer from a struggling

domestic coal power generation market, is a major contributor to coal capacity expansion in other countries, but so are Japan and Korea, where both policy and market conditions remain favorable to coal. Nor does it appear to be linked to market size: while China dominates as the largest coal market in the world, the runner ups, India and the United States play smaller roles than either Japan or Korea in promoting coal expansion outside their borders.

The leading role played by China, Japan and Korea, the Big Three, suggests market competitiveness plays the largest role in determining the behavior of coal capacity expansion in foreign markets. All three countries possess cutting-edge technology in coal power generation. With their ability to build more efficient power plants at cost, these countries have a greater incentive to support coal power expansion abroad, which in turn will lead to more business for their more competitive coal companies. In comparison, the power plants of lesser contributors such as Germany and the United States are much older. In fact, for these two countries their coal-fired fleets are 30 and 38 years respectively in comparison to average age of 24 years, for example, in Japan (Dimsdale, Schwartzkopff and Littlecott 2015, 9; Schulz and Schwartzkopff 2015, 18; United States Energy Information Administration 2015). The lack of new capacity also means German and American companies are not providing as many cutting-edge projects at home. Currently, India is also behind in terms of coal technology, though it is attempting to catch up by producing ultra-supercritical facilities of its own.¹⁴ The development of coal technology in India can produce more efficient coal power for India but may also add incentives for Indian companies and financial institutions to support more coal projects outside of India.

Furthermore, countries with competitive advantage in coal power generation, the Big Three in particular, are likely to invest in the expansion of coal capacity beyond their borders. The advancement of coal technology allows for emerging economies to develop cleaner energy solutions if coal remains a means to meet their energy needs. However, as discussed earlier, some projects by the Big Three unfortunately rely on outdated technology. Not all incoming coal projects have readily accessible information regarding the technology they use, which does not allow us to list the technology split of each country's coal financing and external projects. What we can see is that technology standards in the global market lag the leading markets. Of all projects with known technology, 63 percent of China's upcoming coal capacity (planned but not yet constructed) will use ultra-supercritical technology, but, despite China's status as the world's largest supporter of coal energy development abroad, only 24 percent of the rest of the world's planned capacity will use such technology (EndCoal 2018). Thus, there is a gap between the standards being applied domestically and for projects abroad.

¹⁴ IANS, "India's pioneering ultra-supercritical tech for power units by 2020," *Economic Times*, August 15, 2016.

Efforts must be made to ensure that countries leading in coal technology limit the extent to which they export coal capacity to other countries, both in terms of aggregate support and quality control. One potential way of restricting the continued proliferation of low efficiency coal power generation capacity is to institute some form of international prohibition for foreign financing of such projects. Such an agreement could be maintained under the auspices of the United Nations Framework Convention on Climate Change (UNFCCC) or under a sector specific arrangement like the engine standards maintained by the International Civil Aviation Organization. Given that the largest financiers of coal power also possess the most advanced technology, such an arrangement would not disrupt the status quo or affect their market share.

Another route is for the matter of foreign financing to be included in the NDCs of the Paris Agreement of both financier and recipient states. Pressure should be placed on the Big Three to cap their financing of coal projects and to set a minimum technological standard, though a general encouragement to include external projects will mainly impact them anyhow. Countries receiving foreign investment and financing should also look to limit the number of low-efficiency plants they allow within their borders. India, which also receives sizeable external financing in addition to coal capacity expansion by its own domestic players, has managed to maintain a high technological standard for future projects. Of the planned Indian projects where technology information is available, 92 percent will use supercritical technology (EndCoal 2018). It might be difficult to convince states to eliminate altogether, but it should be possible to emphasize a need for high standards in technology and that some limitations in financing is achievable and does not harm the economic interests of the major players involved. Cleaner coal development is a low-hanging fruit, and it is time key states grab it to limit the impact of coal emissions.

References

- BP. *BP Statistical Review of World Energy 2016*. London: BP, 2016.
<https://www.bp.com/content/dam/bp/pdf/energy-economics/statistical-review-2016/bp-statistical-review-of-world-energy-2016-full-report.pdf>
- Chen, Han. 2016. "Some G7 Countries Still Providing Billions in Financing for Coal Plants: Findings from Our New Report." *National Resource Defense Council*. Last modified May 24. <https://www.nrdc.org/experts/han-chen/some-g7-countries-still-providing-billions-financing-coal-plants>
- Chen, Han. 2017. "Why Are G20 Governments Financing Coal Over Renewables?" *National Resource Defense Council*. Last modified July 17. <https://www.nrdc.org/experts/han-chen/why-are-g20-governments-financing-coal-over-renewables>
- Culter, Suzanne. 1999. *Managing Decline: Japan's Coal Industry Restructuring and Community Response*. Honolulu: University of Hawaii Press.
- Dimsdale, Taylor, Julian Schwartzkopff and Chris Littlecott. 2015. *G7 Coal Phase Out: Japan*. London: E3G. https://www.e3g.org/docs/Japan_G7_Analysis_September_2015.pdf
- EndCoal. 2017. "Coal Plants by Country." *EndCoal*. Accessed August 18. <http://endcoal.org/wp-content/uploads/2017/07/PDFs-for-GCPT-July-2017-Countries-MW.pdf>
- EndCoal. 2018. "Summary Statistics." *EndCoal*. Accessed March 9. <https://endcoal.org/global-coal-plant-tracker/summary-statistics/>
- Global Methane Initiative. 2017. "CMM Profiles: Republic of Korea." *Global Methane Initiative*. Accessed August 21.
https://www.globalmethane.org/documents/toolsres_coal_overview_ch28.pdf
- Hervé-Mignucci, Morgan and Xueying Wang. 2015. *Slowing the Growth of Coal Power Outside China: The Role of Chinese Finance*. San Francisco: Climate Policy Initiative.
<https://climatepolicyinitiative.org/wp-content/uploads/2015/11/Slowing-the-Growth-of-Coal-Power-Outside-China.pdf>
- Koyama, Ken. 2013. "Japan's Post-Fukushima Energy Policy Challenges." *Asian Economic Policy Review* 8:2. 274-293.
- Kuramochi, Takeshi. 2015. "Review of energy and climate policy developments in Japan before and after Fukushima." *Renewable and Sustainable Energy Reviews* 43. 1320-1332.
- Organization for Economic Co-operation and Development. 2015. "Statement from Participants to the Arrangement on Officially Supported Export Credits." *OECD*. Last modified November 18. <http://www.oecd.org/newsroom/statement-from-participants-to-the-arrangement-on-officially-supported-export-credits.htm>
- Schulz, Sabrina and Julian Schwartzkopff. 2015. *G7 Coal Phase Out: Germany*. London: E3G.
https://www.e3g.org/docs/Germany_G7_coal_analysis_September_2015.pdf
- United Nations. 2015. "China's intended nationally determined contribution." *United Nations Framework Convention on Climate Change*.
<http://www4.unfccc.int/Submissions/INDC/Published%20Documents/China/1/China's%20INDC%20-%20on%2030%20June%202015.pdf>
- United States Energy Information Administration. 2016. "Coal made up more than 80% of retired electricity generating capacity in 2015." *U.S. Energy Information Administration*. Last modified March 8. <https://www.eia.gov/todayinenergy/detail.php?id=25272>

- Urgewald. 2017. "Companies on Coal Expansion Course Exposed." *CoalExit*. Accessed August 21. <https://coalexit.org/database>
- World Wildlife Fund. 2015. "Rich countries sweep billions in public finance for coal under the rug as climate deadlines loom." *World Wildlife Fund*. Last modified June 2. <http://wwf.panda.org/?uNewsID=247554>
- Zhao, Stephen and Alan S Alexandroff. 2018. "Coal Trading Regimes and the Future of Coal: The Political Struggle to Eliminate Coal." Environmental Innovation Lab, Munk School of Global Affairs, *Working Papers Series*. <https://munkschool.utoronto.ca/egl/files/2018/02/EGL-Working-Paper-4.pdf>