Dirty Coal

Breaking the Myth About Japanese-Funded Coal Plants

Published by: Kiko Network, JACSES, Friends of the Earth Japan, CoalSwarm, Friends of the Earth US, Sierra Club

SUMMARY

The Japanese government is the largest public financier of coal plants globally amongst OECD countries, and the second largest in the world, behind China. From 2003 to 2015, the Japan Bank for International Cooperation (JBIC) provided at least US$8.49 billion in loans and guarantees for new coal plants around the world, amounting to 23,933 MW of new capacity (see Annex 1 for detailed list).[1]

While the Japanese government claims its technology is less polluting and more efficient than that from competing countries,[2] even going so far as to count some of its coal plant investments towards its climate finance commitments,[3] the data tells a different story. **Coal projects supported by JBIC are actually *less efficient* than the worldwide average**, and are often not equipped with the best pollution control technology.

In a room document presented to the OECD Exports Credit Group in March 2015, Japan proposed a continuation of public funding for coal plants by OECD Export Credit Agencies, including additional incentives to slightly higher-efficiency coal-fired power plants, such as longer repayment terms.

Japan's position rests on the notion that exports by Japan and other OECD countries are pragmatically necessary because the alternative would be lower-efficiency, subcritical coal plants provided by China.[4] In fact, as outlined below, the portrayal of Chinese exports of coal technology as sub-par can only be justified by focusing on older time periods and excluding current data. **We document that there has been a considerable increase in exports of more**

1. There have been several different calculations of JBIC support for coal plants over the past 12 years. The data for this paper comes from a combination of OECD figures leaked in October 2014, and a list compiled by Yuki Tanabe from JACSES, based on publicly available data. The dithering figures highlights the need for open and transparent reporting from all export credit agencies on actual loans, insurance and guarantees. For transparency purposes, a list of all projects included in this analysis is in Annex 1.

2. See p.3 of http://www.meti.go.jp/committee/summary/0004685/pdf/002_05_00.pdf and pp 12 and 15 of http://bit.ly/1EJ4TDa

3. http://www.japantimes.co.jp/news/2015/03/29/business/japan-accused-of-financing-coal-fired-power-plants/#.VRyf2mSUfSQ

4. Ueno, Yanagi, Nakano, "Quantifying Chinese Public Financing for Foreign Coal Power Plants," November 2014, available at http://www.pp.u-tokyo.ac.jp/research/dp/documents/GraSPP-DP-E-14-003.pdf

efficient Chinese boilers over the past five years, and that China is fast overtaking Japan as a provider of more efficient coal technologies.

Moreover, efficiency is only one measurement of a project's environmental and human health impact. We also looked at pollution controls deployed in JBIC-financed projects and found that these projects **often fail to utilize the Best Available Technology to limit pollutants from power stations**, exposing local residents to dangerous emissions such as sulfur dioxide (SO_2), nitrous oxides, particulates including fine particulates, acid gases including sulfuric acid mist and hydrochloric acid, and certain heavy metals.

This paper considers each of these topics in turn, first comparing the track record of JBIC-funded coal plants to global averages, then looking at actual data on Chinese coal technology exports, and finally looking at pollution control technologies deployed by JBIC-funded plants.

1. HOW EFFICIENT ARE JBIC-FUNDED COAL PLANTS?

Over the past 12 years, JBIC has provided at least $8.49 billion in financing to 43 new coal boilers with a total capacity of 23,933 MW (see Annex 1 for details). Table 1 below outlines the coal plant technologies deployed in JBIC-financed projects from 2003–2015.

Table 1. Combustion technology in JBIC-funded coal plants 2003–2015.

Combustion Technology	MW	Share
Subcritical	10,144	42%
Supercritical	12,403	52%
Ultra-supercritical	1,386	6%
	23,933	**100%**

Source: Platts WEPP, January 2015

To provide a current comparison between recent JBIC lending and world norms, Table 2 excludes the seven oldest JBIC projects (all subcritical), comparing JBIC-financed plants completed or planned from 2010 onwards to the global average during the same period of time. The overall efficiency of JBIC-funded projects during this period is actually worse than the global average.

As shown in Table 2, 31% of plants funded by JBIC with completion dates in 2010 or later were subcritical, approximately the same as the worldwide share of 29% for subcritical plants. But what is more revealing is that almost all the other plants funded by JBIC were supercritical. **JBIC has only funded one ultra-supercritical coal plant, the Safi ultra-supercritical coal plant in Morocco. JBIC has not funded a single ultra-supercritical coal plant in Asia.** Compared with the worldwide average of 36% supercritical and 29% ultra-supercritical, **JBIC-financed coal plants are less efficient than the global average.**

Table 2. Comparison of combustion technology mix between JBIC-funded coal plants and all coal plants worldwide, 2010–2018.

	Plants completed or planned 2010 and later (JBIC financed)		Plants completed or planned 2010 and later (Worldwide)	
Combustion Technology	**MW**	**Share**	**MW**	**Share**
Subcritical	6,312	31%	262,809	29%
Supercritical	12,403	62%	327,898	36%
Ultra-supercritical	1,386	7%	268,411	29%
Other/Unknown	0	0%	56,395	6%
Total	**20,101**	**100%**	**823,847**	**100%**

Source: Platts WEPP, January 2015.

Worldwide averages since 2010 show supercritical technology is commonplace, routinely exported by China, and should not be considered as an "efficient" technology. More importantly, the difference in efficiency between subcritical, supercritical and ultra-supercritical is minimal when comparing new plants of comparable size. When Sargent & Lundy modeled the efficiencies of pulverized coal combustion plants for the U.S. EPA, they evaluated a new subcritical 600 MW plant burning bituminous coal compared to new supercritical and ultra-supercritical plants of the same size and burning the same coal. They found the relative efficiencies were 36.68%, 37.84%, and 38.45% respectively.[5] Coal-fired power plants, regardless of their boiler technology, are always major emitters of greenhouse gas pollution and should never be considered low carbon.

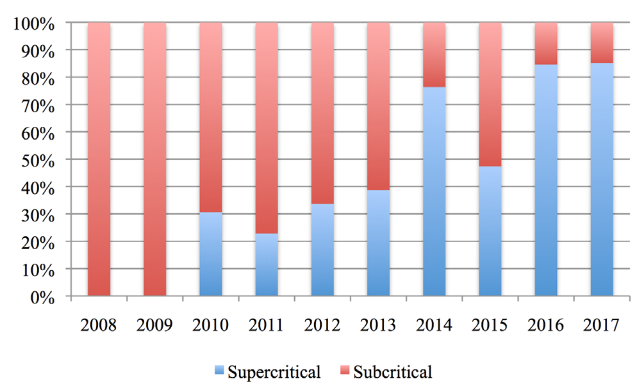
2. HOW EFFICIENT ARE CHINESE COAL PLANT EXPORTS?

The Japanese government is relying on a report from the Graduate School of Public Policy (GraSPP) at the University of Tokyo to justify its contention that Chinese coal exports are dominated by subcritical boiler technology,[6] and therefore OECD export credit support is necessary to promote more efficient coal plants. The GrasPP paper presents data derived from the 2012 Platts UDI World Electric Power Plant Database (WEPP), comparing the types of boilers supplied by Chinese manufacturers to Asian overseas markets to those supplied by Japanese manufacturers. The authors report that only 35% of Chinese boilers supplied to Asian overseas markets "after 2007" were supercritical or ultra-supercritical, compared to 62% of Japanese boilers.

As is often the case with such comparisons, the devil is in the detail. Only in the footnotes do the authors reveal that the data set used to generate their results was confined to those projects that started commercial operation after 2007 or were under construction in 2012. Since this time period, the composition of Chinese boiler exports has changed considerably.

As illustrated in Figure 1, the share of subcritical plants in the overall mix of capacity exported by Chinese manufacturers is rapidly dwindling. The chart shows the year-by-year shares for subcritical versus supercritical technology according to the January 2015 release of Platts WEPP for coal plants built or scheduled outside China during the decade 2008–2017, with boilers from the three main Chinese manufacturers, Dongfang, Shanghai Electric, and Harbin. As the chart shows, by 2016 the share of China's coal plant exports utilizing subcritical technology is expected to drop to 15 percent.

Figure 1. Share of capacity exported by Dongfang, Harbin, and Shanghai Electric, 2008–2017



Source: Platts WEPP, January 2015

5. "New Coal-Fired Power Plant Performance and Cost Estimates," Sargent & Lundy, August 28, 2009, Project 12301-003 at http://www.epa.gov/airmarkets/resource/docs/CoalPerform.pdf

6. See note 4 above

Table 3. New coal-fired generating capacity exported by Dongfang, Harbin, and Shanghai Electric, 2008–2017.

	Megawatts		Share	
Year	Subcritical	Supercritical	Subcritical	Supercritical
2008	2,445	0	100%	0
2009	2,145	0	100%	0
2010	4,275	1,890	69%	31%
2011	6,478	1,920	77%	23%
2012	6,495	3,300	66%	34%
2013	7,155	4,500	61%	39%
2014	4,810	15,514	24%	76%
2015	11,472	10,320	53%	47%
2016	1,441	7,920	15%	85%
2017	695	3,970	15%	85%

Source: Platts WEPP, January 2015

Table 3 shows the year-by-year breakdown for Chinese coal boilers sold outside China in megawatts.

Based on the most recent data available, the claim that OECD export credit subsidies are needed to ensure the export of more efficient coal plant technologies overseas cannot be supported, since China's exports of supercritical coal plants are rapidly overtaking its exports of subcritical coal plants.

3. HOW DIRTY ARE JBIC-FUNDED COAL PLANTS?

In addition to falling beneath global norms for coal plant efficiency, JBIC projects also have a questionable track record for control of major air pollutants, failing to utilize the Best Available Technology to limit pollutants from power stations and thereby exposing local residents to dangerous emissions such as SO_2, particulates including fine particulates, acid gases including sulfuric acid mist and hydrochloric acid, and certain heavy metals, all of which can be controlled by scrubbers and baghouses.

(a) Control of Sulfur Dioxide (SO_2)

Table 4 shows the results for SO_2 pollution controls amongst JBIC-funded coal plants from 2003–2015.

Table 4. SO_2 pollution control technology used by JBIC-funded coal plants.

MW	Percent	SO_2 Technology
4,708	20%	Seawater FGD scrubber
8,400	36%	Compliance fuel (no scrubbers)
572	2%	Semi-dry circulating fluidized bed FGD scrubber
1,700	7%	Fluidized bed
5,270	22%	Wet limestone FGD scrubber
232	1%	Wet lime FGD scrubber
2,620	11%	No sulfur control/no information
23,502	100%	**Total**

Source: Platts WEPP, January 2015

Only half of JBIC projects have known scrubbers of any kind. 36% use "compliance fuel," meaning they try to use lower sulfur coal, but lack any pollution control equipment. For 11% of plants (Hai Phong 1 in Vietnam, Meja in India and Pacifico-II in Mexico), the Platts database did not list any scrubber, which may mean there was no scrubber or that Platts did not have any information. The projects that listed "compliance fuel" as the SO_2 control were in India (Barh, Jaypee Nigrie, Kudgi and Rajpura Nabha), Indonesia (Cirebon), and Vietnam (Hai Phong).

It is doubtful that "compliance fuel" is an adequate pollution control strategy. India, for example, does not currently have any plant or unit-specific SO_2 or NO_X limits for coal-fired power plants.[7] Thus, "compliance fuel" is meaningless in this context, as there is no enforcement mechanism to comply with. According to a study by Resources for the Future,[8] three-quarters of the premature deaths in India from coal are attributable to SO_2 emissions from supposedly "low sulfur" coal, which averages to 500 deaths per coal plant. Typical sulfur contents of the mostly sub-bituminous coals in India are in the range of 0.2–0.7%, which is comparable to sub-bituminous coal from the U.S.[9]

Resources for the Future recommends that scrubbers, or at least coal washing, should be deployed in every Indian plant in order to minimize health impacts (currently only 5% of coal in India is washed). Numerous coal plants burning sub-bituminous coals with similar sulfur content in the US currently use scrubbers. JBIC could use its leverage to require scrubbers, but clearly has not done so.

(b) Control of Particulate Matter

Exposure to fine particulates (less than 1/30th the width of a human hair) increases rates of heart attack, stroke and respiratory disease. PM2.5, the smallest and most deadly type of particulate matter, penetrates deep into the lungs. Even exposure to a relatively small amount of PM2.5 can result in respiratory and cardio-vascular diseases leading to premature death and increased morbidity. That is why strong pollution controls for PM2.5 are essential in protecting people's health from the effects of coal combustion.

The best available technology for controlling particulate matter, particularly fine particulate matter, includes both fabric filters (baghouses) and wet electrostatic precipitators (wESP). Deploying both of these technologies can remove almost all particulates from the smokestack, but both are rarely deployed because of the cost. The second best option is to deploy just a baghouse. Baghouses can capture 99.9% of total particulates and 99.0–99.8% of fine particulates. The third best option is a wet ESP, and the fourth best option is a dry ESP, which can capture over 99% of total particulates, but only 90–95% of fine particulates.[10] Dry ESPs, by the very nature of their operation, are less robust devices for removal of particulate matter as compared to baghouses and they are not as effective as wet ESPs for the capture of fine particulate matter.

Table 5 shows the particulate matter controls deployed by JBIC-funded coal plants.

Table 5. Particulate control technology used in JBIC-funded coal plants.

MW	Percent	Particulate Control
804	3%	Baghouse (fabric filter)
2,754	12%	Cold side ESP (downstream of air preheater)
18,644	79%	Unspecified type of electrostatic precipitator (elektrofilter)
1,300	6%	No particulate control
23,502	100%	**Total**

Source: Platts WEPP, January 2015

If we look at the type of particulate controls deployed by JBIC, the vast majority (91%) are either cold side dry ESPs or unspecified, likely other types of dry ESP. While the technology for wet ESP has been around for at least two decades, a lack of regulation has

7. http://www.greenpeace.org/india/Global/india/docs/India-China-Air-Quality-Standards-Comparison.pdf

8. Maureen Cropper and Kabir Malik, "The Hidden Costs of Power: Effects of Coal Electricity Generation in India," *Resources Magazine*, 2012 at http://bit.ly/1I7hSO7

9. Mittal, M.L., et. al., *Estimates of Emissions from Coal Fired Thermal Power Plants in India*, available at http://www.epa.gov/ttnchie1/conference/ei20/session5/mmittal.pdf

10. http://www.nescaum.org/documents/coal-control-technology-nescaum-report-20110330.pdf

slowed its implementation. It is unlikely that many of these plants use wet ESP. **This means that almost four-fifths of the coal plants funded by JBIC are using less effective, inferior technology** that will not robustly capture all of the harmful fine particulates (PM2.5) emitted by the smokestack. Only two plants have deployed baghouses, the second best type of technology for controlling particulate matter, and none have deployed a baghouse and wet ESP, the most effective way of removing fine particulates from the smokestack.

4. CONCLUSION

JBIC's central claim that its funding of coal plants is pragmatically necessary to prevent the building of subcritical Chinese coal plants can only be supported by limiting the analysis to outdated statistics on Chinese exports. Up-to-date data shows that the share of subcritical plants in the Chinese export mix dwindles to 15% in the post-2015 period.

JBIC's portrayal of its technology as a "cleaner" and more efficient alternative is belied by comparisons with global norms. JBIC-funded coal plants are actually less efficient than the global average. On pollution controls, JBIC-funded coal plants are not deploying the best available technologies and are therefore jeopardizing the health and lives of people around the world.

It is unacceptable for the Japanese government to continue to defend subsidies for Japanese companies to deploy inferior technology in poorer countries around the world, and the Japanese government cannot possibly claim that it is exporting the least dirty and most efficient coal plant technologies currently available. There is simply no justification for continued investments in coal plants that have far higher CO_2 emissions than any other electricity source and that lock in decades of additional emissions.

The Japanese government should support efforts at the OECD Export Credit Group to rule out export credit support for new coal plants abroad, as well as other fossil fuel financing. Instead, the government should use public resources to support the burgeoning renewable energy industry in the Asia-Pacific region, in order to ensure a clean energy future for all.

Annex 1: JBIC-funded coal plants 2003–2015

Year Funded	JBIC investment (million USD)	Unit	Country	Company	MW	Status	Operation Year	Boiler type	Particulate control	SO_2 control
2003	91	MINDANAO STEAG 1	PHILIPPINES	STEAG STATE POWER INC	116	OPR	2006	SUBCR	BH	WL
2003		MINDANAO STEAG 2		STEAG STATE POWER INC	116	OPR	2006	SUBCR	BH	WL
2003	91	PAROSENI 4	ROMANIA	SC COMPLEX ENERGETIC HUNEDOARA	150	OPR		SUBCR	ESP	FGD
2003	721	TANJUNG JATI-B NO 1	INDONESIA	PT CENTRAL JAVA POWER	660	OPR	2006	SUBCR	CSE	WLST
2003		TANJUNG JATI-B NO 2		PT CENTRAL JAVA POWER	660	OPR	2006	SUBCR	CSE	WLST
2004	408.5	BLCP 1	THAILAND	BLCP LTD	717	OPR	2006	SUBCR	CSE	SWFGD
2004		BLCP 2		BLCP LTD	717	OPR	2007	SUBCR	CSE	SWFGD
2004	138	MARITZA EAST-2 NO 1-4	BULGARIA	TPP MARITZA EAST-2 PLC	696	OPR	2007–2009	SUBCR	ESP	WLST
2005	62.4	HAI PHONG THERMAL-I NO 1	VIETNAM	HAI PHONE THERMAL POWER JSC	300	OPR	2011	SUBCR	BLANK	BLANK
2005		HAI PHONG THERMAL-I NO 2		HAI PHONE THERMAL POWER JSC	300	OPR	2011	SUBCR	BLANK	BLANK
2007	380	BARH 1	INDIA	NTPC LTD	660	CON	2015	SUPERC	ESP	CF
2007		BARH 2		NTPC LTD	660	CON	2015	SUPERC	ESP	CF
2007		BARH 3		NTPC LTD	660	CON	2016	SUPERC	ESP	CF
2007	38	HAI PHONG THERMAL-II NO 1	VIETNAM	HAI PHONE THERMAL POWER JSC	300	OPR	2013	SUBCR	ESP	CF
2007		HAI PHONG THERMAL-II NO 2		HAI PHONE THERMAL POWER JSC	300	OPR	2014	SUBCR	ESP	CF
2008	1753	TANJUNG JATI-B NO 3	INDONESIA	PT CENTRAL JAVA POWER	660	OPR	2011	SUBCR	ESP	WLST
2008		TANJUNG JATI-B NO 4		PT CENTRAL JAVA POWER	660	OPR	2012	SUBCR	ESP	WLST
2010	1458	PAITON-3	INDONESIA	PT PAITON ENERGY	815	OPR	2012	SUPERC	ESP	FGD
2010	216	CIREBON 1	INDONESIA	PT CIREBON ELECTRIC POWER	700	OPR	2012	SUPERC	ESP	CF
2010	273	PACIFICO-II NO 1	MEXICO	COMISION FEDERAL DE ELEC	700	OPR	2010	SUPERC	BLANK	BLANK
2011	110	JAYPEE NIGRIE 1	INDIA	JAIPRAKASH POWER VENTURES LTD	660	CON	2014	SUBCR	ESP	CF
2011		JAYPEE NIGRIE 2		JAIPRAKASH POWER VENTURES LTD	660	CON	2014	SUBCR	ESP	CF
2011	81	RAJPURA NABHA 1	INDIA	NABHA POWER LTD	700	OPR	2014	SUPERC	ESP	CF
2011		RAJPURA NABHA 2		NABHA POWER LTD	700	CON	2014	SUPERC	ESP	CF
2011	58	VUNG ANG-1 NO 1	VIETNAM	PETROVIETNAM POWER CORP	600	CON	2014	SUBCR	ESP	WLST
2011		VUNG ANG-1 NO 2		PETROVIETNAM POWER CORP	600	CON	2014	SUBCR	ESP	WLST
2012	216	JORF LASFAR 5	MOROCCO	TAQA NORTH AFRICA	350	CON	2014	SUBCR	ESP	FGD
2012		JORF LASFAR 6		TAQA NORTH AFRICA	350	CON	2014	SUBCR	ESP	FGD
2013	500	COCHRANE AES 1	CHILE	AES GENER SA	286	CON	2017	SUBCR	BH	CFBS
2013		COCHRANE AES 2		AES GENER SA	286	CON	2017	SUBCR	BH	CFBS
2013	85	THAI BINH-2 NO 1	VIETNAM	PETROVIETNAM POWER CORP	600	CON	2017	SUPERC	ESP	WLST
2013		THAI BINH-2 NO 2		PETROVIETNAM POWER CORP	600	CON	2018	SUPERC	ESP	WLST
2014	210	KUDGI 1	INDIA	NTPC LTD	800	CON	2016	SUPERC	ESP	CF
2014		KUDGI 2		NTPC LTD	800	CON	2017	SUPERC	ESP	CF
2014		KUDGI 3		NTPC LTD	800	CON	2017	SUPERC	ESP	CF
2014	90	MEJA 1	INDIA	NTPC LTD	660	CON	2016	SUPERC	ESP	BLANK
2014		MEJA 2		NTPC LTD	660	CON	2017	SUPERC	ESP	BLANK
2014	908	SAFI 1	MOROCCO	SAFI ENERGY COMPANY SA	693	CON	2018	ULTRSC	ESP	SWFGD
2014		SAFI 2		SAFI ENERGY COMPANY SA	693	CON	2018	ULTRSC	ESP	SWFGD
2014	202	VINH TAN-4 NO 1	VIETNAM	EVN GENCO NO 3	600	CON	2017	SUPERC	ESP	SWFGD
2014		VINH TAN-4 NO 2		EVN GENCO NO 3	600	CON	2018	SUPERC	ESP	SWFGD
2015	409	DUYEN HAI 3 EXTENSION	VIETNAM		688	CON	2018	SUPERC	ESP	SWFGD
Totals	**8498.9**				**23933**					

Sources: OECD data, press releases from JBIC website, Platts WEPP

Key:

SO_2 Control

SWFGD	Seawater FGD scrubber
CF	Compliance fuel (no scrubbers)
CFBS	Semi-dry circulating fluidized bed FGD scrubber
FGD	Fluidized bed
WLST	Wet limestone FGD scrubber
WL	Wet lime FGD scrubber
BLANK	No sulfur control

Particulate Control

BH	Baghouse (fabric filter)
CSE	Cold side ESP (downstream of air preheater)
ESP	Unspecified type of electrostatic precipitator (elektrofilter)
BLANK	No particulate control