POLICY BRIEF

REGULATING EMISSIONS OF COAL-BASED POWER SECTOR

Proceedings and recommendations of stakeholder roundtable

Jakarta, Indonesia

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ICEL

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Indonesian Centre for Environmental Law
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Centre for Science and Environment
New Delhi, India

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ABBREVIATIONS

BPPT	Agency for the Assessment and Application of Technology
CEMS	Continuous emission monitoring system
CFBC	Circulating fluidized bed combustion
CSE	Centre for Science and Environment
EPC	Engineering, procurement and construction
ESP	Electrostatic precipitator
FGD	Flue gas desulfurization
ICEL	Indonesian Centre for Environmental Law
IPP	Independent power producer
LEB	Local environmental board
MEMR	Ministry of Energy and Mineral Resources
MoEF	Ministry of Environment and Forestry
MT	Million tonnes
NO_x	Nitrogen oxide(s)
OFA	Over-fire air
PLN	Perusahaan Listrik Negara
PM	Particulate matter
R&M	Renovation and modernization
REEI	Rock Environment and Energy Institute
SC	Supercritical
SCR	Selective catalytic reduction
SNCR	Selective non-catalytic reduction
SO_2	Sulphur dioxide
USC	Ultra-supercritical
WALHI	The Indonesian Forum for Environment

EXECUTIVE SUMMARY

Rising pollutant emissions from coal-based power plants in Indonesia is an urgent and immediate concern. Independent studies project three-times increase in sulphur dioxide (SO_2) and nitrogen oxide (NO_X) emissions, and a two-times increase in particulate matter (PM) emissions during 2011–30 due to the country's rapidly expanding power generation from coal, assuming existing power sector emission norms remain unchanged.

In order to address this challenge, Indonesian Center for Environmental Law (ICEL) and New Delhi-based Center for Science and Environment (CSE) jointly organized a roundtable titled 'Roadmap for Emission Control from Coal-based Power Sector in Indonesia' on 23–24 May 2017 in Jakarta. It was attended by around forty delegates representing a wide range of stakeholders, including senior government regulators from Indonesian Ministry of Environment and Forestry (MoEF) and Ministry of Energy and Mineral Resources (MEMR); officials from power plants including Perusahaan Listrik Negara (PLN) subsidiaries, Indonesia Power, Cirebon Electric Power; civil society groups like Greenpeace Indonesia, the Indonesian Forum for Environment (WALHI), WWF Indonesia; and industry experts. The roundtable provided a platform for discussions on the central role of coal in the country's electricity sector, the enormous environmental impact of its emissions and, consequently, the need to enact tighter emission standards.

The keynote addresses were delivered by Mr Dasrul Chaniago, Director of Air Pollution Control, MoEF and Mr Benhur PL Tobing, Head of Sub-directorate Environmental Electricity Protection, MEMR, both of whom acknowledged the need for revising existing emission standards, which are fairly loose. MoEF representatives confirmed that they are in the process of reviewing the standards, however, they could not provide any firm timelines for the revision.

The participants at the workshop voiced a general agreement that Indonesia should urgently tighten the emission standards for thermal power plants, in line with other major countries. Government representatives from MoEF and MEMR acknowledged that the steps taken by India and China and the standards implemented by these countries could serve as useful data points. Indeed, those standards could be modified for Indonesia based on the country's thermal power fleet characteristics (age, size and technology) and environmental performance. Industry representatives at the event, from PLN subsidiaries and independent power producers (IPPs), also expressed their support for tighter norms for greater public good. Civil society representatives emphasized that introduction of new norms should not be delayed any further, especially in light of the planned increase in coal-based power capacity.

Notably, the data presented by both MoEF and industry executives including Mr Heru Dewanto, President-Director, Cirebon Electric Power, and representatives of PLN subsidiaries showed that the emissions of most large generation units are significantly lower than the existing standards. The generating companies expressed their ability and willingness to meet tighter standards if the government adequately addresses their concerns, such as financing of investments associated with upgrading or installing new pollution control equipment.

CSE, ICEL and Beijing-based Rock Environment and Energy Institute (REEI) presented the findings of their draft report Emissions Norms for Coal-based Power: A comparative study

of Indonesia, India and China. The report suggested an outline of emissions standards for Indonesia based on an analysis of its existing and upcoming coal-based power plants and the emissions performance of a sample of plants. The recommendations also drew upon a comprehensive study of the Indian and Chinese power sectors—coal-based fleet profile of the two countries, emissions from coal-based plants and recent tightening of regulations in the two countries to cut pollution from the sector.

The study suggested several parameters to devise new emissions standards—age, size and geographical concentration of the capacity. Age and size of the units determine technical feasibility of meeting norms and economic viability of investments in pollution control devices—tightest norms were suggested for larger-sized and newer units. At the other end of the spectrum, norms for the very small and old units may not need to change much. Geographical concentration drives the need for tighter standards as areas with a cluster of plants suffer from a higher pollution load. The Agency for the Assessment and Application of Technology (BPPT), technical advisor to the government, noted that emission standards might be established based on technology and location of plants.

Since the existing emissions from a number of plants, especially larger units, were not substantially higher than required under the standards suggested in the report, these plants should be able to meet tighter norms with little effort. Most delegates acknowledged the preliminary recommendations were reasonable and feasible.

While deliberating on the way forward for promulgation of the new norms, there was a consensus for wider engagement of all stakeholders. Certain steps for action were identified, which should be urgently executed (in the next two-three months) to address key challenges and to expedite introduction of new emissions standards, as follows:

- A comprehensive database of actual emissions performance of all power plants should be developed by MoEF in partnership with local environmental boards (LEBs). This data should also be independently collected by MEMR from the generation companies.
- Detailed technology mapping of the generation feet should be undertaken by MEMR with the help of major generating companies like PLN.
- Guidelines for pollution control devices should be developed by MEMR in consultation with leading generating companies and with technical inputs from suppliers, engineering, procurement and construction (EPC) consultants and industry experts.
- Indicative costs of installing pollution control devices should be provided by MEMR by compiling data from suppliers, EPC companies, industry experts and power generating companies.
- To strengthen emission monitoring and reporting mechanisms, MoEF should enhance the role and capacity of regency and city level LEBs, and improve monitoring, validation and oversight to discourage data manipulation.
- Civil society should try to build a broader consensus that the public needs to accept some financial costs, which are not material, to control pollution. They should also build public support for data transparency.

1. INTRODUCTION

Indonesia's dependence on coal for electricity generation is steadily increasing. The country's coal-based capacity stands at 24.7 GW, or 44 per cent of the total capacity of 55.5 GW (2015). Over the past decade (2006–15), the steam-based capacity has increased at a compound annual growth rate of 10.4 per cent. Although the government plans to restrict the role of coal to 50 per cent in the generation mix by 2025, 34.8 GW of coal-based capacity is still expected to be added during the next decade.

"Newer existing plants should be able to comply with tighter norms. Their current emission performance confirms these plants can reach emission level around 30 per cent of the existing standards."

—Mr Dasrul Chaniago, MoEF

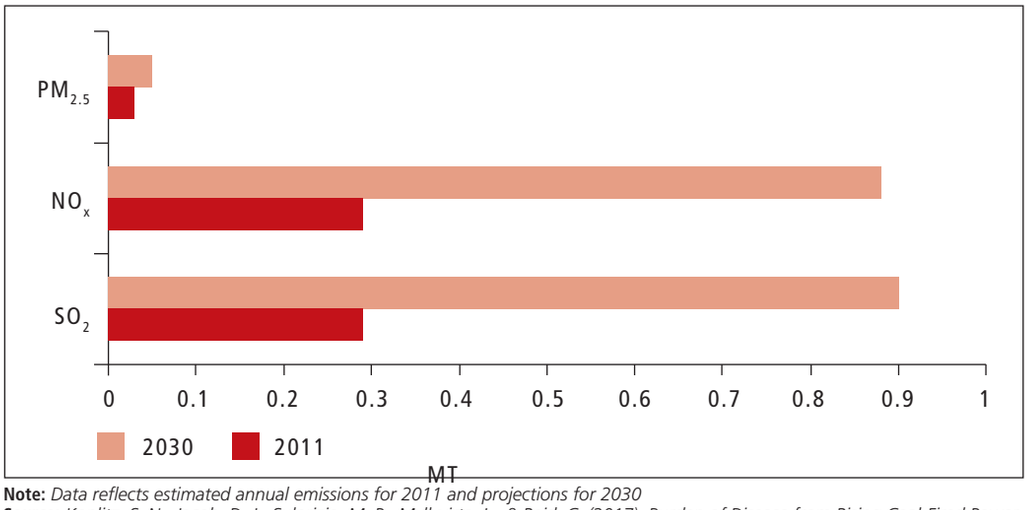
Independent researchers have estimated that emissions from coal-based power sector totalled 0.03 million tonnes (MT) of fine particulate matter ($PM_{2.5}$) and 0.29 MT of SO_2 and NO_X each in 2011. The SO_2 and NO_X emissions from coal power plants would increase three-fold while $PM_{2.5}$ would double by 2030 if no measures to curb their emission are undertaken *(see Graph 1: Projected growth in national inventory of emissions from coal-based plants)*.

Indonesia has some of the weakest emission standards for coal-based power plants in the world *(See Table 1: Emission standards for coal-based power plants in major countries)*. The norms for SO_2 and NO_X are quite loose compared to those in the developed and large emerging economies like India and China.

Given MoEF's plans to tighten emissions norms in Indonesia and the widely shared view of key stakeholders that rising pollution levels require urgent action, ICEL and CSE decided to work together to provide inputs to the ministry on revising regulations. The two organizations also reached out to REEI to source inputs on power sector emissions and pollution control

GRAPH 1: PROJECTED GROWTH IN NATIONAL INVENTORY OF EMISSIONS FROM COAL-BASED PLANTS

Under a business as usual (BAU) scenario, pollutant emissions from coal-based plants in Indonesia are expected to increase two to three times by 2030



Note: *Data reflects estimated annual emissions for 2011 and projections for 2030*
Source: *Koplitz, S. N., Jacob, D. J., Sulprizio, M. P., Myllyvirta, L., & Reid, C. (2017). Burden of Disease from Rising Coal-Fired Power Plant Emissions in Southeast Asia. Environmental Science and Technology.*

TABLE 1: EMISSION STANDARDS FOR COAL-BASED POWER PLANTS IN MAJOR COUNTRIES

Unlike Indonesia, most major countries have adopted very tight emission standards for coal-based plants

	PM	SO_2		NO_x		Mercury
		New plants	Existing plants	New plants	Existing plants	
EU	50–100	200	400	200 (after 2015)	500 (till 2015)	0.03 (Germany)
US	22.5	160 (after 2005)	160 (1997–2005);	117	117 (after 2005); 160 (1997–2005);	0.001–0.006
China	30	100	200; 400*	100	100 (2004–11); 200 (before 2004)	0.03
India	100 (till 2003); 50 (2004–16); 30	100	600 (< 500 MW); 200 (> = 500 MW)	100	600 (till 2003); 300 (2004–16)	0.03
Indonesia	150–100	750	750	850	750	None

Unit: *mg/Nm³*
**SO_2 standards of 400 mg/m³ for four provinces with high sulphur coal*
Source: *World Resources Institute Asia. Environmental Science and Technology.*

regulations. The objective of the research was to study the experience of India and China with emissions control as well as to study the fleet profile and emissions performance of Indonesian power plants. The research provided the parameters and framework for the norms that were suggested for Indonesia's thermal power sector. The study's conclusions were presented in the stakeholder's roundtable, which also provided a platform for stakeholders to give feedback on issues relevant for revising standards such as emissions by the power plants, technical aspects for pollution control, financial challenges, public's expectations about air quality and tariffs, and government's plans.

2. BASIS OF NEW STANDARDS

MoEF representatives said that they plan to take into account three aspects while determining the new standards:

1. Existing emission performance of plants and their ability to improve it
2. Availability of technology
3. Affordability of investments.

Key stakeholders and industry experts at the workshop agreed on the need to adopt a balanced approach in deciding new limits for pollutant emissions from coal-based plants.

Investments in pollution control devices should be economically efficient, i.e., the aim should be to maximize emission cuts at a reasonable cost. For that, appropriate technology selection is vital. Emissions limits should, therefore, be established in due consideration of actual emissions performance, age-size profile of the fleet, and technology deployment.

Emissions performance

- The data shared by MoEF at the workshop for 10 larger generation units (seven old and three new) indicates that their emissions are far lower than the current standards. PM levels are at 80–120 mg/Nm^3, SO_2 at 300–500 mg/Nm^3, and NO_X at 200–400 mg Nm^3 *(see Graphs 2 to 7)*. The draft study, which analyzed 23 large units aggregating 12,080 MW of capacity (65 per cent of the capacity accounted for by large units) reported similar emissions levels. Accordingly, large plants can easily comply with norms that less then half of the existing norms, a conclusion that was accepted by MoEF at the workshop.
- Additional emission cuts would be possible for the larger and new units with little effort, allowing Indonesia to tighten emissions norms to levels comparable with global standards.
- However, in order to recommend clear-cut norms, detailed emissions data is needed (especially of smaller sized units).

"Technology options are available globally and have the ability to cut emissions to very low levels, for controlling the PM, SO_2 or NO_X."

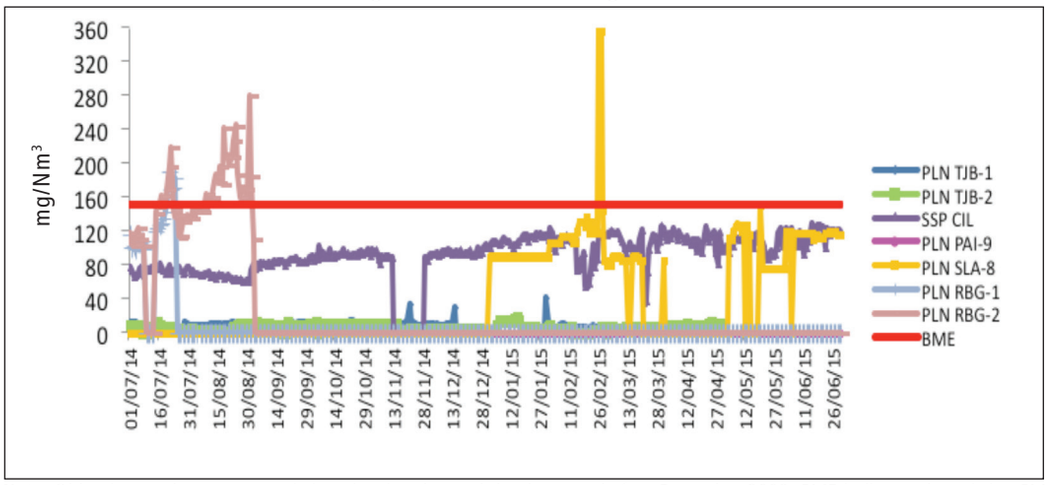
—Prof. Kardono, BPPT

Fleet profile

- Age and size of a coal-based generation unit are crucial determinants of the choice of pollution control technology and feasibility of investments. In general, larger and newer units are best equipped to meet tighter standards from both technical and economic perspective. Typically, these units have installed better combustion and pollution control technologies. Also, they can afford to make larger investments in pollution control equipment, given the longer remaining life to recover costs. On the other hand, older and smaller units often face technical challenges that constrain how much emission cuts are achievable.

GRAPH 2: PM EMISSIONS FROM OLD GENERATION UNITS

For old units, emission of PM ranges from 80 to 120 mg/Nm^3

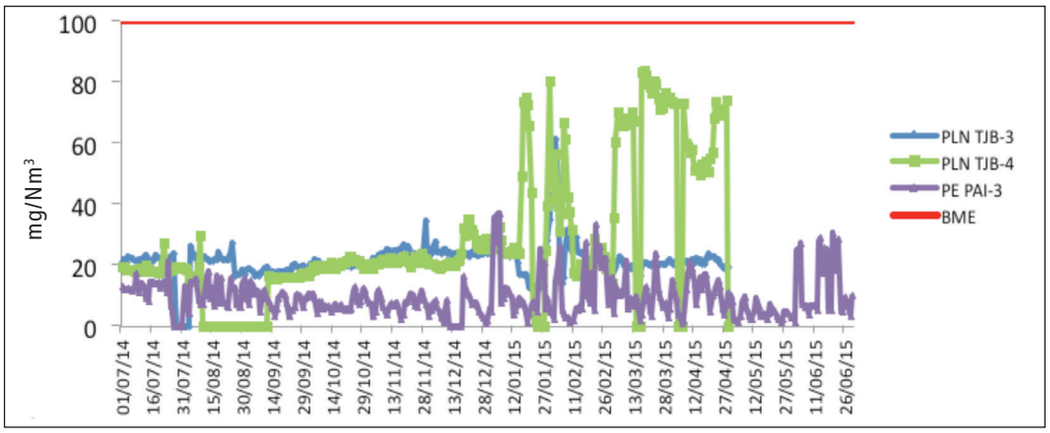


Note: *Old units are the ones commissioned or in advanced development before December 2008. BME indicates the existing PM emission standard of 150 mg/m^3*

Source: *MoEF*

GRAPH 3: PM EMISSIONS FROM NEW GENERATION UNITS

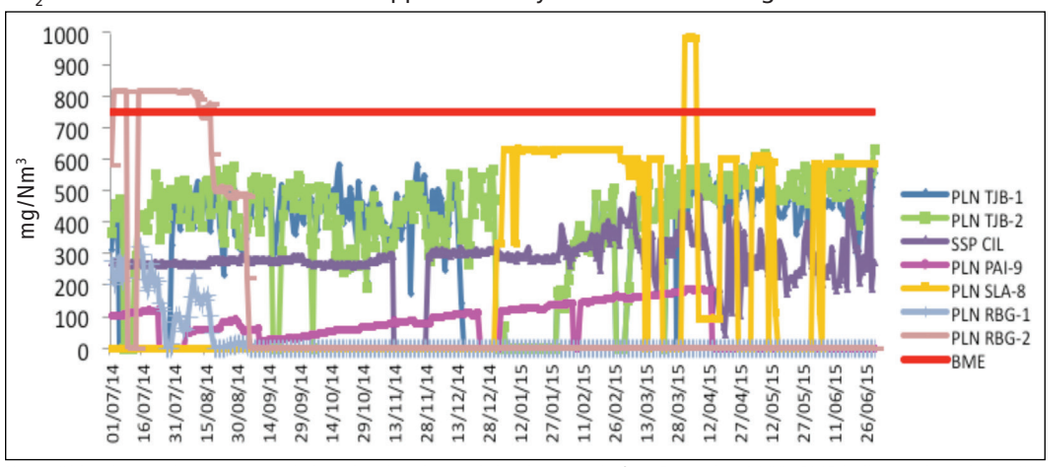
PM emissions from new units appear very low, mostly less than 40 mg/Nm^3



Note: *New units are the ones developed and commissioned after December 2008. BME indicates the existing PM emission standard of 150 mg/Nm^3*
Source: *MoEF*

GRAPH 4: SO_2 EMISSIONS FROM OLD GENERATION UNITS

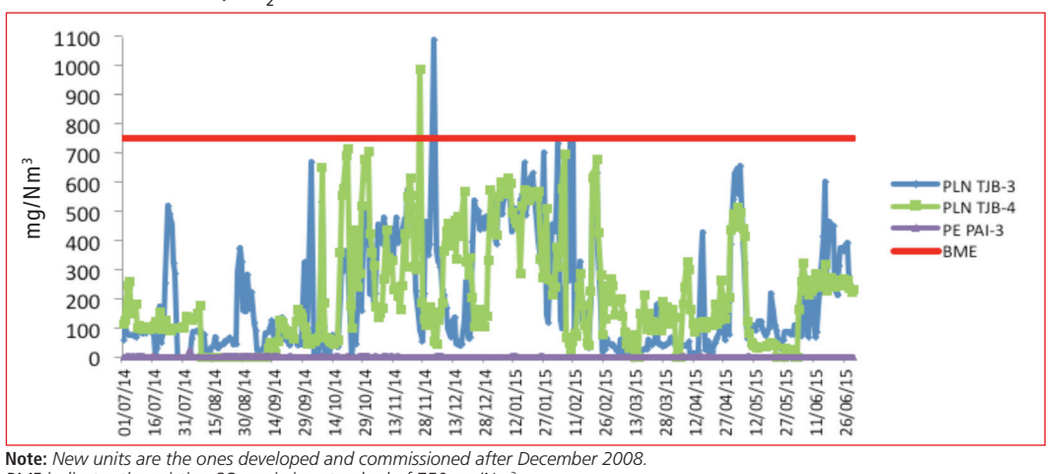
SO_2 emissions in case of old units appears to vary from 300 to 500 mg/Nm^3



Note: *Old units are the ones commissioned or in advanced development before December 2008. BME indicates the existing SO_2 emission standard of 750 mg/Nm^3*
Source: *MoEF*

GRAPH 5: SO_2 EMISSIONS FROM NEW GENERATION UNITS

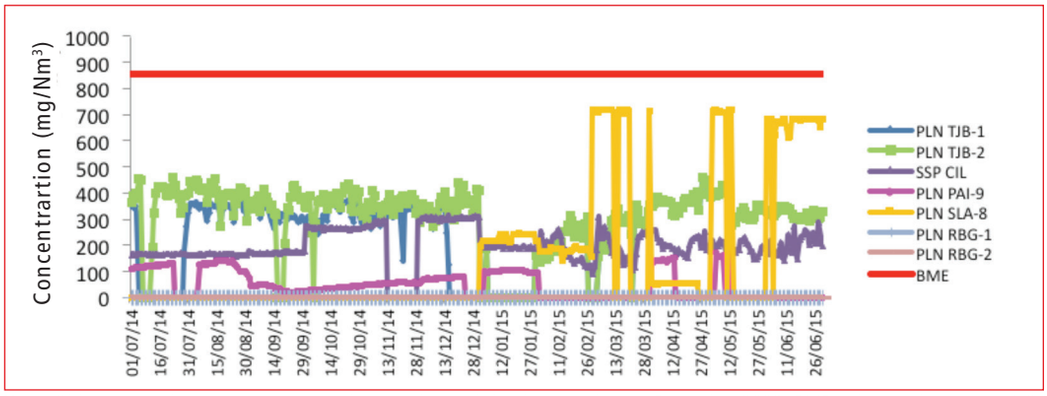
For some new units, SO_2 emissions are lower due to FGD installation



Note: *New units are the ones developed and commissioned after December 2008. BME indicates the existing SO_2 emission standard of 750 mg/Nm^3*
Source: *MoEF*

GRAPH 6: NO_x EMISSIONS FROM OLD GENERATION UNITS

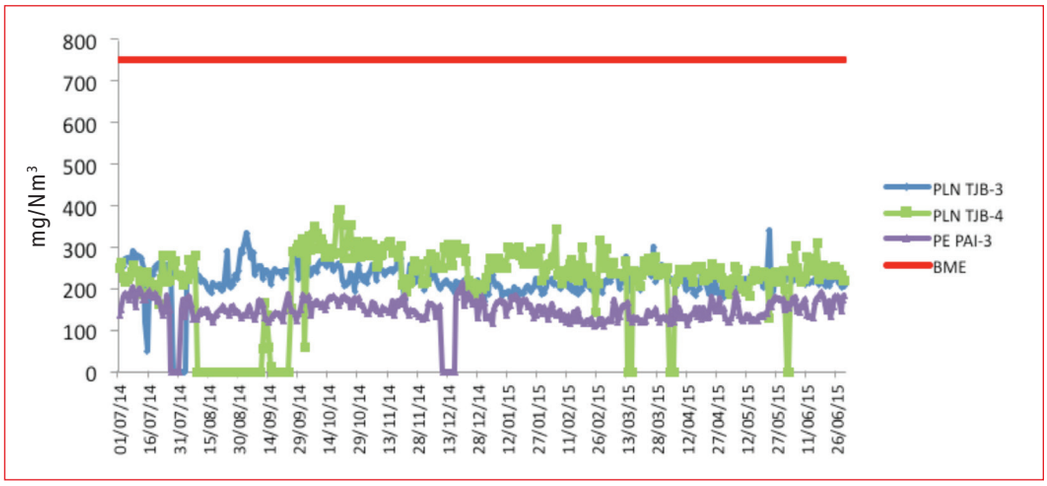
For older units, emission of NO_x appears to range from 300 to 400 mg/Nm³



Note: *Old units are the ones commissioned or in advanced development before December 2008. BME indicates the existing NOx emission standard of 850 mg/Nm³*
Source: *MoEF*

GRAPH 7: NO_x EMISSIONS FROM NEW GENERATION UNITS

Emission of NO_x for newer units appears to be lower, mostly 100-300 mg/Nm³



Note: *New units are the ones developed and commissioned after December 2008. BME indicates the existing NOx emission standard of 750 mg/Nm3*
Source: *MoEF*

"We should set emissions standard for coal-fired power plants that protect public health and are in line with standards in large developing countries. We can't risk our health anymore."

—Ms Hindun Mulaika,

- Substantial information on the fleet profile of coal-based plants in Indonesia has already been collected from MERM and other secondary sources by ICEL/CSE. An analysis of this data included in the draft report indicates larger and newer units have a dominant share of the total *(see Table 2: Age-size profile of coal-based generation fleet)*.
  - Units of 300 MW and above capacity account for three-fourths of the total existing capacity. Nearly two-thirds of this capacity is fairly new, having been installed after 2006.
  - Large units also dominate upcoming capacity with a share of 68 per cent.

TABLE 2: AGE–SIZE PROFILE OF COAL-BASED GENERATION FLEET

Larger-sized newer units account for a majority share in the existing capacity

	Size				Total
	0–99 MW	100–299 MW	300–599 MW	Over 600 MW	
Existing capacity	2,561	3,544	8,195	10,464	24,764
Pre-1990	130	-	1,600	-	1,730
1990–2005	1,034	200	800	4,250	6,284
2006 onwards	885	3,344	5,795	6,214	16,238
NA	512	-	-	-	512
Upcoming capacity	2,967	7,255	2,765	19,179	32,166
Grand total	**5,528**	**10,799**	**10,960**	**29,643**	**56,930**

In MW
Note: *Upcoming capacity analysis is based on 32.2 GW of the aggregate 34 GW for which unit-wise data was available.*
Source: *Analysis based on MEMR data*

- The share of medium-sized units of 100–299 MW capacity is only 14 per cent. Most of these were installed after 2006.
- Very small units (less than 100 MW capacity) account for only 10 per cent of the existing capacity. Moreover, only 35 per cent of this is new (installed after 2006).

Technology

- Information on the fleet's boiler technology and operational performance may be helpful in estimating pollution performance. Some information is available on technology in terms of circulating fluidized bed combustion (CFBC), sub-critical, super-critical (SC) and ultra-supercritical (USC) boilers. The draft study indicates that the share of SC and USC units will broadly increase from 11 per cent in 2015 to 39 per cent in 2025 (implying easy achievability of tighter standards by upcoming plants). More information on unit-wise operational performance (such as heat rates, availability, plant load factor), and renovation and modernization (R&M) history can help in assessment of emissions performance, desirable levels and appropriate pollution control technology.
- Accurate information on the penetration of pollution control devices in the country is not available. The data presently available indicates that almost all plants have installed electrostatic precipitators (ESPs) of varied capacities for PM control but the details are not known in terms of number of fields, ESP design efficiency etc. It seems a few units have put flue gas desulfurization (FGD) systems in place for SO_2 control—this data needs to be verified. Information on existing penetration of de-NO_x technologies— low-NO_x burner, OFA etc.—is also not available. Additional data about penetration, design and performance of existing pollution control equipment can help in refining suggested norms.

3. RECOMMENDATIONS FOR NEW STANDARDS

The workshop discussed in detail preliminary suggestions for tighter emission standards provided in the draft study. These were based on an analysis of Indonesia's existing (24.7 GW) and upcoming (34 GW) coal-based capacity for factors like age, size, technology, unit-wise emissions performance (of a sizeable capacity of 12.08 GW), and the study of the Indian and Chinese experience with introduction of tighter emission norms. The study recommended that the government must consider the following three factors or methodologies—age, size and location of units—in combination, when deciding new emission norms. Most delegates at the workshop acknowledged these recommendations as well-reasoned and appropriate.

"Three aspects would be taken into account in determining standards. First is the emissions performance of the sector, second is the availability, and third the affordability of technology."

—Ms Fitri Harwati, MoEF

Developing emission norms based on the age of the generation units *(see Table 3: Suggested standards based on age distribution of coal-based capacity):*

- Most stringent norms, in line with global standards, must be prescribed for upcoming capacity (nearly 60 per cent of which comprises large units) given that there are no techno-economic restrictions on investments.
- For units commissioned since 2006 (66 per cent of the capacity), strict SO_2 and NO_X standards should be adopted, given that these comprise mainly larger units with better technology—their NO_x emissions are likely to be better than those of older units. Also, these units would be able to recover relatively larger investment that would be required to meet tight standards. Moderate standards can be adopted for units commissioned during 1990–2005.
- For all existing power plants installed since 1990, strict PM emission standards should be prescribed given that these are already required to meet a standard of 100–150 mg/Nm^3.
- Existing standards can be retained for units installed prior to 1990 (aggregating only 1.7 GW). These may be considered for gradual shutdown.

TABLE 3: SUGGESTED STANDARDS BASED ON AGE DISTRIBUTION OF COAL-BASED CAPACITY

Tightest emission standards should be imposed on new generation units

Commissioning date	Aggregate capacity (MW)	Suggested standards (mg/Nm^3)		
		PM	SO_2	NO_X
Total existing	24,764	-	-	-
Pre-1990	1,730	150	850	750
1990-2005*	6,284	50–100	300–600	300–600
2006 onwards*	16,238	50	200–300	200–300
Upcoming capacity	34,800	30	100	100

Note: **Range may vary based on size with smaller units having looser norms*
***Age data not available for 512 MW of existing capacity*
Source: *Indonesia's Coal Power Emission Norms: Lesson from India and China, CSE/ICEL/REEI, 2017*

TABLE 4: SUGGESTED STANDARDS BASED ON SIZE DISTRIBUTION OF COAL-BASED CAPACITY

Tightest emission standards should be imposed on large units of 300 MW and above capacity

Unit size	Aggregate capacity (MW)	Suggested standards (mg/Nm^3)		
		PM	SO_2	NO_x
0–99 MW	2,561	150	850	750
100–299 MW*	3,544	50–100	300–600	300–600
300–599 MW*	8,195	50	200–300	200–300
Over 600 MW	10,464	50	200	200

Note: **Range may vary based on age with older units having looser norms*
Source: *ndonesia's Coal Power Emission Norms: Lesson from India and China, CSE/ICEL/REEI, 2017*

Developing emission norms based on the size of the generation units *(see Table 4: Suggested standards based on size distribution of coal-based capacity):*

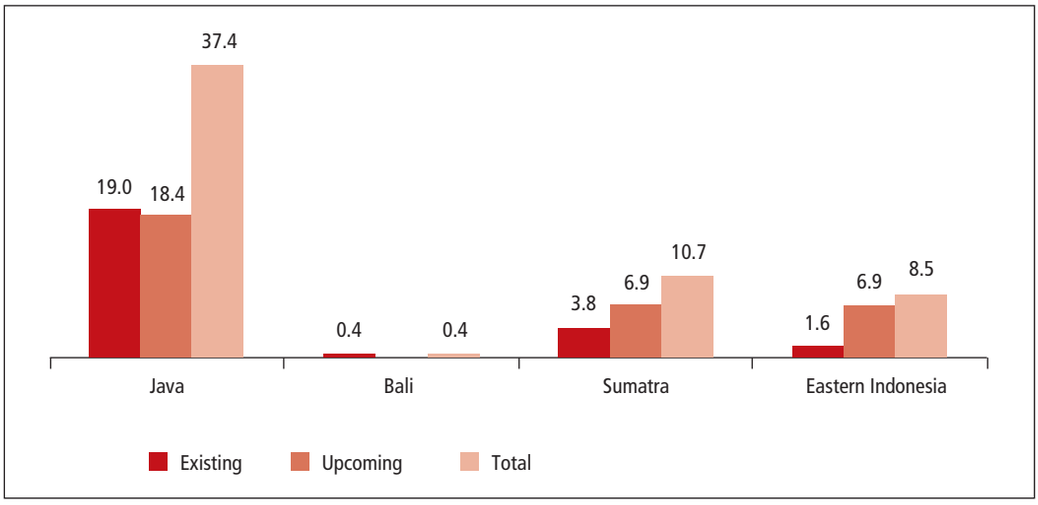
- Strict norms should be prescribed for units of over 300 MW (75 per cent of the capacity).
- Moderate norms should be introduced for small-sized units from 100 to 300 MW (14 per cent of the capacity).
- Existing norms may be retained for very small units (11 per cent of the capacity) given their small aggregate pollution load and low techno-economic feasibility for investments.

Developing emission norms based on regional concentration of capacities: Large concentration of capacity in an area will put excessive strain on its air shed, so it makes sense to have tighter norms for such vulnerable areas *(see Graph 8: Regional distribution of coal-based capacity):*

- Tighter standards should be prescribed for Java, which will account for 65 per cent of the capacity by 2025, most of which will comprise larger-sized units.

GRAPH 8: REGIONAL DISTRIBUTION OF COAL-BASED CAPACITY

Java accounts for a significant majority of the existing and upcoming coal-based capacity



Note: Existing capacity is as of 2015, upcoming during 2016–25, and total by 2025.
Source: Analysis based on MEMR data

- Special attention can be focused on the provinces of Banten and Central Java, each of which will account for 11 GW of capacity by 2025. Stricter standards for Banten make additional sense as it is close to Jakarta.
- Varied standards can also be prescribed for plants located within a certain region, province or locality, if the ambient air quality is very poor.

4. KEY ISSUES

While accepting the need for tighter emission standards, a number of delegates at the workshop raised issues that may hinder their ratification or delay implementation and adoption. Some of these concerns were addressed during the discussions, however, others may require further research and policy support and interventions.

Technology for pollution control: This emerged as a concern as, currently, Indonesian power plants have limited experience with advanced pollution control technologies such as FGD, selective catalytic reduction (SCR) and selective non-catalytic reduction (SNCR). However, global experience (expressed by REEI, China) indicates that these technologies are mature and are being widely used for decades. BPPT affirmed that the advanced technological options will work in Indonesian power plants and enable them to reduce PM, SO_2 and NO_X emissions to levels in line with global best standards.

"If the government wants to impose rules to tighten standards, industry can follow. The only thing that needs to be discussed is how the cost implication is to be addressed,"

—Mr Heru Dewanto, PT Cirebon

Cost of investments in pollution control: MEMR, National Energy Council (DEN) and the industry emphasized that the impact of the investments in pollution control equipment on generation costs and retail tariffs is an important consideration. MEMR said that electricity in Indonesia is subsidized and the public may not support any increase in tariff. Second, while IPPs may be able to raise financing for the pollution control equipment, some power plants (PLN and its subsidiaries) have limited financial resources to make fresh investments. Therefore, the government has to address both issues—assist the industry in raising financing and ensure appropriate cost recovery for the investment made by plants.

The Indian and Chinese experience with emissions control is encouraging. Investments in pollution control are easily manageable. For instance, in India, the industry initially estimated that the cost of upgrading or installing pollution control devices to meet tighter standards will range from Rs 12–15 million/MW (US$ 19–23.5 thousand per MW), but Indian regulators now estimate that the costs would be less than half of the initial assessment. CSE research indicates that the costs would be Rs 1.5–2 million per MW (US$ 24–31 thousand per MW) for older plants, Rs 3–5 million per MW (US$ 47–78 thousand per MW) for small and mid-life units, and Rs 4-6 million per MW (US$ 62–93 thousand per MW) for the largest and newest units *(see Table 5: Cost of pollution control equipment in India).*

TABLE 5: COST OF POLLUTION CONTROL EQUIPMENT IN INDIA

Cost of investments in emissions control devices is manageable

Device	Cost (Rs million per MW)
ESP upgradation	0.5–1.5
FGD	4–5
Partial FGD	2.5–3
De-NO_x burners	1–1.5
SCR/ SNCR	2–2.5

Note: *Rs 1 = US$ 0.015*
Source: *CSE, 2016*

Civil society members pointed out that the cost of these investment would be more than offset by the health and environmental benefits of lower pollution. Nonetheless, there is a need to undertake a study on the cost of investments and tariff impact in the Indonesian context given that it is the key concern raised by the industry. This cannot be achieved without detailed technical data. Once the benchmark costs are established, the government may also need to provide financing options and incentives to the industry so that it can meet tighter standards—a demand raised by Cirebon Energy.

Emissions performance and technology penetration data: At present, MoEF has been able to share emissions performance and technology penetration data for 23 large units aggregating 12.1 GW of capacity (included in the draft study). While this represents 65 per cent of the large generation units, it accounts for about half of the aggregate capacity. Analyzing their emissions pattern has been useful as large units account for nearly three-fourths of the country's aggregate capacity.

However, the overall pollution performance of the sector remains unclear. The dataset is incomplete, with information on smaller generation units missing. Further, there are concerns about reliability as the minimum reported emission levels by several units seem extremely low and inconsistent with the installed pollution control equipment. BPPT shared that the low quality of the emissions data can be attributed to issues of CEMS calibration, equipment maintenance, and flawed assumptions. Clearly, detailed data for the remaining units would be immensely helpful in developing the final norms.

5. IMMEDIATE STEPS TO BE TAKEN

The roundtable identified the following actions to be executed over the next two–three months in order to address these issues as well as to expedite introduction of new emissions standards:

1. Detailed survey of the country's existing power plants must be initiated to determine their actual emission performance and the penetration of pollution control devices, given that the data presently available is not comprehensive and some of it is possibly inaccurate. This is crucial for accurately estimating the emission cuts easily achievable by the sector and the effort or investment required in meeting tighter standards.

    a. For developing the emissions database, MoEF must take the lead and closely coordinate with the LEBs. MEMR, in collaboration with leading generation companies, must also independently collect the data to clearly establish results.

"Government missed the momentum to improve the emission standards in 2013. It has already been almost five years since then, we can't afford for another delay."

—Ms Siti Maimunah, JATAM

    b. MEMR and generation companies should take the lead in mapping technology of the power plants, including data on boiler technology (CFBC, sub-critical, SC, USC); operational performance (efficiency levels, PLF and heat rate); quality of coal used; penetration of pollution control equipment (ESPs, FGDs, low-NO_x burners); availability of space for FGD installation etc.

2. In order to provide technical assistance to the power plants, MEMR should notify standard technical guidelines and specifications for installing pollution control devices. Inputs for drafting these guidelines must be provided by equipment manufacturers, consultants, think tanks, academic researchers etc.

3. MEMR must undertake detailed cost analysis of installing pollution control devices, which will require direct engagement with a number of stakeholders, including power plants, manufactures, EPC contractors, consultants etc. This will not only provide benchmarks to power plants and regulators, but also help in accurately assessing the investment requirement for meeting tighter emissions norms.

4. Concerted efforts must be made to strengthen emission monitoring and reporting mechanisms to ensure compliance in the future.

    a. MoEF must enhance the role and capacity of regency and city level LEBs for supervising compliance and data monitoring. This may also require engagement with MEMR and power plants.

    b. MoEF must improve monitoring, validation and oversight to discourage data manipulation.

    c. Civil society must build greater public support and pressure for data transparency.

6. ADDITIONAL RECOMMENDATIONS

- MoEF must consider tight timelines for the new emissions standards to ensure continued pressure on the industry (similar to the approach in India and China). The timelines and norms should ensure that the best available technologies are installed in upcoming units at the earliest—this issue is important since Indonesia is planning to install significant capacity in the next few years
- MoEF must set up robust processes to monitor implementation to ensure that the industry meets the tight timelines. This may require continued engagement with the industry to identify and address their concerns.
- The government must set up a mechanism to provide technical and financial support to the industry for ensuring timely implementation of the new norms. At a later stage, incentives and disincentives may be established to motivate compliance.
- Civil society must work towards building public support for emission reduction by disseminating information about long-term costs of emissions and its impact on health and livelihood. This will help build support for government's intervention as well as address public apprehensions regarding the tariff impact of pollution control.

ANNEXURES

ANNEXURE 1: WORKSHOP AGENDA

Day 1: 23 May 2017	
Welcome remarks by Mr Henri Subagiyo, Executive Director, Indonesia Center for Environmental Law	
Session 1: Keynote address	
Emissions from Indonesian coal-based power plants: contribution to pollution, fundamental challenges in control, and strengthening of standards	Mr Dasrul Chaniago, Director of Air Pollution Control, DG of Environmental Pollution and Degradation, Ministry of Environment and Forest
Indonesia's power sector: operational performance, projected capacity growth, and emission standards	Mr Benhur PL. Tobing, Head of sub-directorate Environmental Electricity Protection, DG of Electricity, Ministry of Energy and Mineral Resources
Session 2: Emissions control in emerging economies	
Comparative study on trends and measures adopted in India and China, and learnings for Indonesia	• Mr Priyavrat Bhati, Programme Director, Centre for Science and Environment • Mr Lin Jiaqiao, Deputy Director, Rock Environment and Energy Institute • Ms Margaretha Quina, Head Division of Environmental Pollution, Indonesia Center for Environmental Law
Session 3: Air pollution in Indonesia	
Compliance to norms, local level impact, ground-level challenges, and public demand for pollution control and trade-off	• Ms Hindun Mulaika, Climate and energy team leader, Greenpeace Indonesia • Mr Meiki Paendong, designation, The Indonesian Forum for Environment (WALHI) • Ms Chrisandini, Adaptation officer, WWF Indonesia
Session 4: Monitoring, compliance and technology	
Status and challenges: MoEF rationale and need for strengthening pollution norms	• Ms Fitri Harwati, Head of Sub-Directorate of Stationary Sources Air Pollution Control, Ministry of Environment and Forest • Prof. Kardono, Senior Researcher, Agency for the Assessment and Application of Technology (BPPT)
Session 5: Power sector	
Environmental performance, challenges in pollution control, and global trends in tightening norms	Mr Heru Dewanto, President Director, Cirebon Electric Power
Session 6: Emission control technologies	
Availability and suitability, investment requirements, and challenges in implementation	• Mr Picki, Environmental Specialist, Pacitan Thermal Power Plant • Mr Tito K, Environmental Specialist, Tuban Thermal Power Plant • Ms Ery Lia, Environmental Specialist, Paiton Thermal Power Plant
Session 7: CEMS implementation	
Policy requirements, key consideration and challenges	Mr. Muslimin Yahrab, PT Quantum Analytics Teknikatama, SICK Distributor, Indonesia
Day 2: 24 May 2017	
Welcome remarks by ICEL and recap of Day 1 by CSE	
The way forward: emerging perspective on tighter emission standards, key considerations and impediments in defining new norms	Round table discussion among representatives from MoEF, MEMR, industry, civil societies, think tanks etc.

ANNEXURE 2: PARTICIPANTS LIST

S. no.	Name	Organization
1	Mr Dasrul Chaniago	Ministry of Environment and Forestry (MoEF)
2	Ms Fitri Harwati	Ministry of Environment and Forestry (MoEF)
3	Mr Irfan Ramadiansyah	Ministry of Environment and Forestry (MoEF)
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12	Mr Syafudin	National Energy Council (DEN)
13	Mr Karnadi Kuistono	Association of Power Producers Indonesia (APPI)
14	Mr Heru Dewanto	PT Cirebon Energy
15	Mr Edi Wibowo	PT Cirebon Energy
16	Mr A. Dhani	PT Cirebon Energy
17	Mr Picki	Pacitan Thermal Power Plant
18	Ms Ery Lia	Paiton Thermal Power Plant
19	Mr Tito K.	Tuban Thermal Power Plant
20	Mr Daman	Indonesia Power
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22	Ms Adila	Greenpeace Indonesia
23	Mr Bondan	Greenpeace Indonesia
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25	Ms Chrisandini	WWF Indonesia
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31	Mr Viriya P. Singgih	The Jakarta Post
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34	Mr Raynaldo	Indonesian Center for Environmental Law (ICEL)
35	Mr Henri Subagiyo	Indonesian Center for Environmental Law (ICEL)
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39	Ms Mandvi Singh	Centre for Science and Environment (CSE)
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