Comparative Analysis of Proposed Emission Standards for Coal-based Power Plants in Indonesia

August 2018

Joint Policy Note for MoEF

Indonesian Center for Environmental Law
Jakarta, Indonesia

Centre for Science and Environment
New Delhi, India

Contents

1. Introduction
2. Proposed New Standards
3. Comparative Analysis and Recommendations
    - 3.1 Particulate Matter
    - 3.2 Sulphur Dioxide
    - 3.3 Oxides of Nitrogen
    - 3.4 Mercury
4. Recommendations for Implementation

Annexure

1. Introduction

The Ministry of Environment and Forestry (MoEF) of Indonesia is in the process of introducing new set of standards to control emissions from power plants. Existing norms for particulate matter (PM), sulfur dioxide (SO_2) and oxides of nitrogen (NO_X) were introduced in 2008 *(See Table 1: Emission standard for coal-based plants in Indonesia)*. These standards need to be urgently updated because the country is fast expanding thermal generation capacity.

Coal-based power plants currently account for nearly half of the country's total installed capacity of 60 GW. This share will be maintained as 27 GW of new coal-based capacity is being added under the Power Supply Business Plan (RUPTL) 2018-27. These generation units can cause serious damage to the country's air quality given that the existing emissions standards are very lax, especially for SO_2 and NO_X.

Table 1: Emission standard for coal-based plants in Indonesia, 2008 (mg per m^3)

	Units commissioned till Dec 31, 2008	Units commissioned since Jan 1, 2009
PM	150	100
SO_2	750	750
NO_X	850	750

Source: MoEF

A study led by Harvard University estimates that at the existing emission standards, the planned coal-based capacity in the country could lead to a three-fold increase in the SO_2 and NO_X emissions, and doubling of $PM_{2.5}$ emissions by 2030. This could cause over 24,000 premature deaths in Indonesia every year.

In addition, tighter emission norms for power plants could prove to be crucial for achieving national climate change objectives. Indonesia, world's fifth-largest greenhouse gas (GHG) emitter, has pledged to reduce its contribution up to 29 per cent by 2030 (41 per cent with international support). Besides CO_2 (Indonesian coal has average emissions factor of 0.0961 metric tons of CO_2 per gigajoule), pollutants like PM and NO_X emitted by coal-based plants also contribute significantly to global warming.

2. Proposed New Standards

The MoEF after several months of deliberations decided on new draft emission standards for thermal power plants in December 2017 *(See Table 2: New emission standard for coal-based plants proposed by MoEF)*. These are not as stringent as the norms implemented in other major Asian economies like China and India, but there is significant tightening compared to the existing norms. This is especially true for upcoming units (to be commissioned 2021 onwards), for which the proposed standards match global levels.

We estimate that under MoEF's new proposed norms the pollution load from coal-based power sector would decrease by 50 per cent for PM, 47 per cent for SO_2, and 58 per cent for NO_X.

Table 2: New emission standard for coal-based plants proposed by MoEF (mg per m^3)

Parameter	Units commissioned till Dec 31, 2008	Units commissioned between Jan 1, 2009 and Dec 31, 2020	Units commissioned since Jan 1, 2021
PM	75	50	30

SO_2	550	400	100
NO_x	550	300	100
Hg	0.03	0.03	0.03

Source: MoEF

Following MoEF's proposal, Indonesia's power sector lobby proposed alternative standards for consideration *(See Table 3: New emission standard for coal-based plants proposed by power sector lobby)*. The new proposal categories coal-based capacity as units planned and/or operating before and after the regulation enacted, recommending very loose standards for both.

Implementation of standards suggested for older units would not lead to much change in the existing air quality as most of the existing units are likely to be emitting around the same level *(Refer Annexure 4: Emission performance of units commissioned since January 2009)*. **Introduction of the power sector's proposal would lead to only 5 per cent decrease in PM emissions, 31 per cent in SO_2, and 33 per cent in NO_X.**

Further, the limits proposed by the power sector seem quite arbitrary. For instance, it is unclear why the power sector lobby would oppose a standard of 100 mg per m^3 for SO_2 and NO_X for upcoming units and instead propose it at 200 mg per m^3**. Meeting both the proposals require similar levels of investments in installation of flue gas de-sulphurization (FGD) and selective catalytic reduction (SCR)/selective non-catalytic reduction (SNCR) units.**

Table 3: New emission standard for coal-based plants proposed by power sector lobby (mg per m^3)

Parameter	Units planned and/or operating before enactment of regulation	Units planned and/or operating after enactment of regulation
PM	100	75
SO_2	550	200
NO_x	550	200
Hg	0.03	0.03

Source: MoEF

3. Comparative Analysis and Recommendations

ICEL and CSE closely analyzed the two standards – original, MoEF proposal (Proposal 1) and MNRE proposal (Proposal 2) based on pollution load impact, actual emission performance of power plants and the techno-economic requirements for investments in advanced pollution control equipment. The objective being to establish a middle-ground between the two proposals based on rational reasoning.

Based on the analyses, we suggest MoEF to establish a middle-ground as follow:

- **For oldest units (till 2008)** – MoEF can accept power sector's recommended standards. While PM norms are higher, the difference in pollution load is small as generation units in this category aggregate to only 10 GW. SO_2 and NO_X emission levels are anyways same under both proposals.

- **For new units (2009-2020)** – MoEF should implement Proposal 1 for SO_2 and NO_X as pollution load under Proposal 2 would two time higher. These units, being relatively new and large, have high

feasibility of investing in advance emission control equipment. For PM, a compromise can be reached between the two proposals.

- **For upcoming units (2021 onwards)** – MoEF can accept Proposal 2 for SO_2 and NO_X, because the difference in pollution load under the two proposals is small. Also, similar type of technology investments would be needed to reach emissions levels of 100 or 200 mg per m^3. Even for this category, a compromise can be reached between the two proposals for PM emissions.

Table 4: Summary of recommendations (mg per m^3)

	Oldest units (till 2008)	New units (2009-2020)	Upcoming plants(2021 onwards)
PM	100 (Proposal 2)	75 (between the two)	50 (between the two)
SO_2	550 (Proposal 1 and 2)	300 (Proposal 1)	200 (Proposal 2)
NO_X	550 (Proposal 1 and 2)	300 (Proposal 1)	200 (Proposal 2)

Note: Proposal 1 refers to MoEF's proposal; Proposal 2 refers to power sector's proposal
Source: ICEL and CSE Analysis

The comparative analysis of the proposals is based on the assumption that units planned and/or operating after enactment of regulation indicated in the MEMR proposal include units commissioned from January 1, 2021 onwards.

Detailed analysis of each pollutant is presented as follows:

3.1 Particulate Matter

<u>For oldest units (till 2008)</u>:

- The difference in pollution load under Proposal 1 and 2 for 10 GW of this category is small at 36 per cent. Also, this category comprises a large number of small units (29 out of 43), who may find it difficult to make further investments in PM control. Thus, Proposal 2 of 100 mg per m^3 can be accepted for these units.

<u>For new units (2009-2020)</u>:

- Maximum allowed PM emission under Proposal 2 is double the level proposed in Proposal 1. This is problematic because the emission load for the 40 GW of capacity in this category under Proposal 2 is more than double the load under Proposal 1 and almost same as the load under the original norms. Accepting the power sector's proposal will not make any difference to existing emissions scenario.

- The limited data on emissions performance for units commissioned since 2009 (for 11 units aggregating 6 GW for February 2017 as shared by MoEF) indicates that maximum PM emissions are already under 100 mg/m^3.

- There are no technical barriers to lowering PM emission by these units. All new coal-based units have installed electrostatic precipitators (ESPs). Upgrading existing equipment or increasing its size would not be technically or commercially challenging.

- For this category, MoEF can consider emission standard of 75 mg per m^3 as a compromise between the two proposed standards, considering that most of these units are located far from populated regions.

For upcoming units:

- Similarly, in case 5.5 GW of upcoming units, PM emissions under Proposal 2 are 2.7 times higher than the emissions under Proposal 1. This gap will increase further as more new units are announced and added in the future. Also, there are no technical barriers for upcoming units to easily meet tightest of PM emission standards.

- Even in this case, MoEF can implement a middle-path between the two proposals at emission levels of 50 mg per m^3, primarily taking into account the location of these power plants in far off regions.

Table 1: Summary table for PM emission analysis

Particulars		**Units commissioned till Dec 31, 2008**	**Units commissioned between Jan 1, 2009 – Dec 31, 2020**	**Units commissioned since Jan 1, 2021**	**Aggregate**
Capacity	MW	10,124	40,693	5,461	56,278
	Number of units	43	262	32	337
Emission standards (mg/m^3)	Existing	150	100	100	-
	MoEF proposal	75	50	30	-
	MEMR proposal	100	100	75	-
Pollution load (tonnes)	Existing	22	75	10	107
	MoEF proposal	14	37	3	54
	MEMR proposal	19	75	8	102
Actual emission data (max range) (mg per m^3)		90-140	40-100	-	-

Source: CSE Analysis

3.2 Sulphur dioxide

For oldest units (till 2008):

- SO_2 norms recommended for this category under Proposal 1 and Proposal 2 remain same, and there is a 27 per cent decline in pollution load compared to the existing scenario.

For new units (2009-2020):

- The pollution load under Proposal 2 for the 40 GW of power plants in this category is 40 per cent higher than Proposal 1.

- Majority of the units in this category indicate actual SO_2 emissions to range between 500 mg/m^3 and 700 mg/m^3 (as per limited MoEF data). Accepting Proposal 2 of 550 mg per m^3 would essentially lead to no change in the existing emissions scenario.

- MoEF must stick to Proposal 1 of limiting SO_2 emissions to 300 mg per m^3 because installation of pollution control equipment in not a challenge for 40 GW of capacity in this category:

    - Almost 70 per cent of the 26 GW of under-construction capacity and 67 per cent of the existing 14 GW capacity are large (over 300 MW) and can easily install FGD units to cut emissions, without much technical or commercial challenge.
    - Units which do not opt for FGD can also adopt low cost options like scrubbing, cleaning coal and sorbent injections to reach these emission levels.

For upcoming units:

- SO_2 emission load for this category is double under Proposal 2 compared to Proposal 1, however the absolute contribution is small. This may increase if more coal-based plants are proposed in the future (which has a limit, given the growing preference for renewable energy).

- Further, reaching emissions levels under both proposals would require FGD installation. MoEF can thus accept the Proposal 2 of 200 mg per m^3 for 5.5 GW of capacity in this category.

Table 2: Summary table for SO_2 emissions

Particulars		Units commissioned by Dec 31, 2008	Units commissioned between Jan 1, 2009 – Dec 31, 2020	Units commissioned since Jan 1, 2021	Aggregate
Capacity	MW	10,124	40,693	5,461	56,278
	Number of units	43	262	32	337
Emission standards (mg/m^3)	Existing	750	750	750	-
	MoEF proposal	550	300	100	-
	MEMR proposal	550	550	200	-
Pollution load (tonnes)	Existing	140	561	75	776
	MoEF proposal	102	299	10	411
	MEMR proposal	102	412	20	534
Actual emission data (max range) (mg/m3)		500-700	500-700	-	-

Source: CSE Analysis

3.3 Oxides of Nitrogen

For oldest units (till 2008):

- Both proposals include same level of NO_X standards for this category, and there is a 35 per cent decline in pollution load compared to the existing scenario.

For new units (2009-2020):

- NO_X pollution load under Proposal 2 is 83 per cent higher than Proposal 1. Existing large units in this category are already reporting low NO_X emissions (150 mg per m^3-500 mg per m^3), thus reaching

levels of 300 mg per m^3 even with low cost solutions (such as combustion optimization) should not be challenging. MoEF should thus implement Proposal 1 for 40 GW of units in this category.

For upcoming units (2021 onwards):

- Similar to SO_2, the NO_X pollution load for upcoming units is double under Proposal 2 than Proposal 1, however the aggregate contribution is small. Reaching NO_X emissions levels of 200 mg per m^3 under Proposal 2 and 100 under Proposal 1 would both require SCR/SNCR investments. Hence, MoEF can accept Proposal 2 for 5.5 GW of units in this category.

Table 3: Summary table for NO_X emissions

Particulars		Units commissioned by Dec 31, 2008	Units commissioned between Jan 1, 2009 – Dec 31, 2020	Units commissioned since Jan 1, 2021	Aggregate
Capacity	MW	10,124	40,693	5,461	56,278
	Number of units	43	262	32	337
Emission standards (mg/m^3)	Existing	850	750	750	-
	MoEF proposal	550	300	100	-
	MEMR proposal	550	550	200	-
Pollution load (tonnes)	Existing	158	561	75	794
	MoEF proposal	102	225	10	337
	MEMR proposal	102	412	20	534
Actual emission data (max range) (mg/m^3)		400-800	150-500	-	-

Source: CSE Analysis

3.4 Mercury

- The prescribed standard for mercury under both the proposals is 0.03 mg/m^3 which is in line with standards adopted in several countries, including Germany, China and India. Given the Indonesian coal quality (with average mercury content of 0.06 ppm), the proposed standard will not be difficult to achieve as a co-benefit of SO_2 and NO_X control even through preliminary measures like scrubbing, sorbent based systems and low NO_X burners.

4. Recommendations for effective implementation

- In order to ensure effective implementation of the notified norms, MoEF must gather credible baseline data on:
    - Actual emissions performance of existing coal-based units
    - Pollution control equipment currently installed across coal-based units and their operational performance

- The ministry must also ensure a sincere assessment of the time required for pre-engineering activities/studies and installation of advanced emission control equipment. This would require close engagement and continued dialogue with various stakeholders – MEMR, PLN, IPPs, equipment suppliers, independent consultants and think tanks.

- The MEMR (in coordination with PLN and IPPs) must draw out a unit-wise implementation plan utilizing the baseline emissions data and the time requirement assessment. The implementation should be planned in a phased manner, to account for shutdown time etc.

- Unit-wise implementation plan must be submitted with the MoEF. As the new standards enter into force, each plant should be directed to revise the environmental permit to include their implementation plan.

- The compliance monitoring, reporting, and enforcement with respect to the implementation plan can be done as a part of that plant's environmental permit. Local environmental boards (LEBs) would be the nodal agency for ensuring compliance to the implementation plan, as the permit issuer. MoEF can engage in second line enforcement if LEBs take no action.

India's Implementation Experience: Crucial lessons

India had introduced new emission norms for coal-based power plants in December 2015 and set a deadline of two years for plants to achieve them. The tight deadlines were part of the Indian government's deliberate strategy to put implementation pressure on the industry.

Even though 100 per cent compliance to the new norms has not be achieved within given deadline, the strategy of building pressure has been crucial in fast tracking implementation. Already, 60 per cent of the installed coal-based capacity in India is reporting compliance to PM emission norms. Most plants are already in a position to meet low NO_X requirements. As for SO_2 compliance, the process of awarding tenders for FGD installation has been initiated for 23 per cent of the capacity; feasibility studies has been completed for 40 per cent; and these studies are on-going for another 20 per cent.

The pressure on plants to ensure compliance has increased in recent months. Plants in the highly polluted region of National Capital Territory of Delhi (NCTD) have been directed by the Central Pollution Control Board (CPCB) to fast-track FGD installation and report compliance by 2019. CPCB has also sent 'show-cause' notices to power stations asking why they should not be closed if they have not submitted implementation plan.

The pressure has further increased due to the direct intervention of country's highest judicial body, the

Supreme Court of India – it has asked for information on plants located in areas of high population density, presumably to accelerate the timeline for such plants. Supreme Court appointed Environment Pollution Control Authority (EPCA) is demanding a penalty of INR 100,000 (USD 1,455) per pollutant per day for each day of delay in compliance.

Overall, power plants have submitted their unit-wise plans for FGD implementation, indicating compliance between 2019 and 2022. Ministry of Power and MoEF have committed to the ensuring implementation in line with these plan, in a submission made to the Supreme Court. A number of stakeholders, including CSE, are working to further tighten the timelines indicated in these plans.

Annexure: Data set

Annexure 1: Fleet profile (Capacity in MW)

	0-99	100-299	300-599	Over 600	Total
Till 2008	1,054	400	3,000	5,670	10,124
2009-2016	855	3,144	5,195	4,794	13,988
NA (existing)	210	-	-	-	210
Total existing	**2,119**	**3,544**	**8,195**	**10,464**	**24,322**
2016-2020	2,366	5,655	2,165	16,519	26,705
2021 onwards	601	1,600	600	2,660	5,461
Total upcoming	**2,967**	**7,255**	**2,765**	**19,179**	**32,166**
Grand total	**5,086**	**10,799**	**10,960**	**29,643**	**56,488**

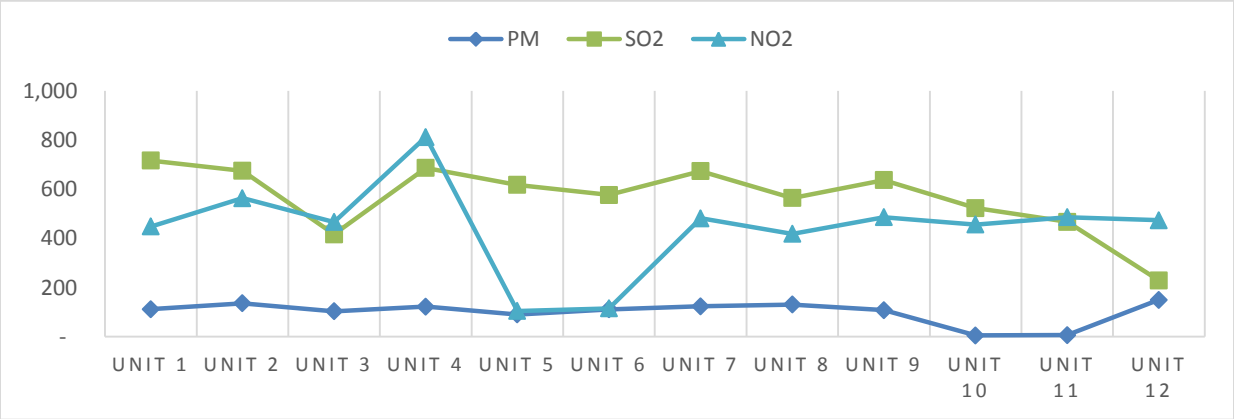
Source: MEMR and RUPTL

Annexure 2: Fleet profile (Number of units)

	0-99	100-299	300-599	Over 600	Total
Till 2008	22	4	8	9	43
2009-2016	37	24	16	7	84
NA (existing)	15	-	-	-	15
Total existing	**74**	**28**	**24**	**16**	**142**
2016-2020	107	44	7	20	178
2021 onwards	17	10	2	3	32
Total upcoming	**124**	**54**	**9**	**23**	**210**
Grand total	**198**	**82**	**33**	**39**	**352**

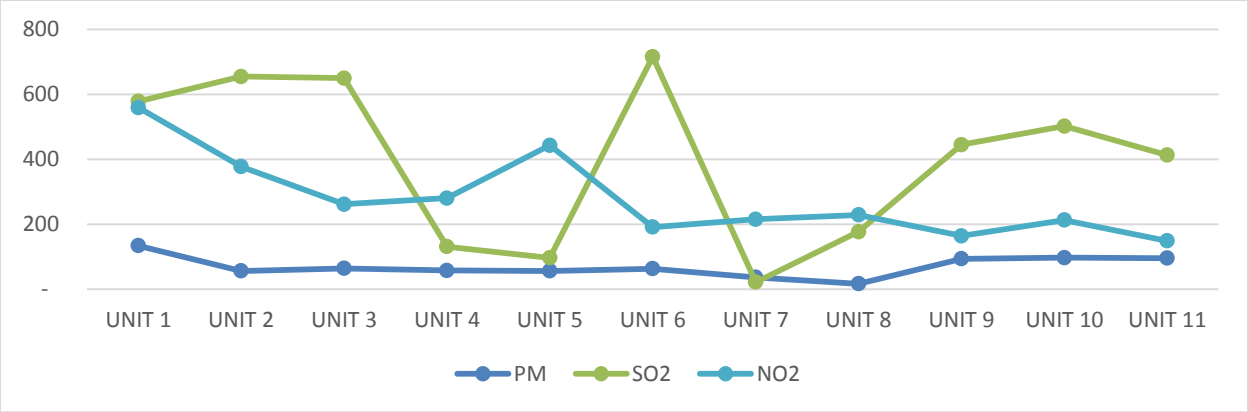
Source: MEMR and RUPTL

Annexure 3: Emission performance of units commissioned by December 2008 (mg per m^3)



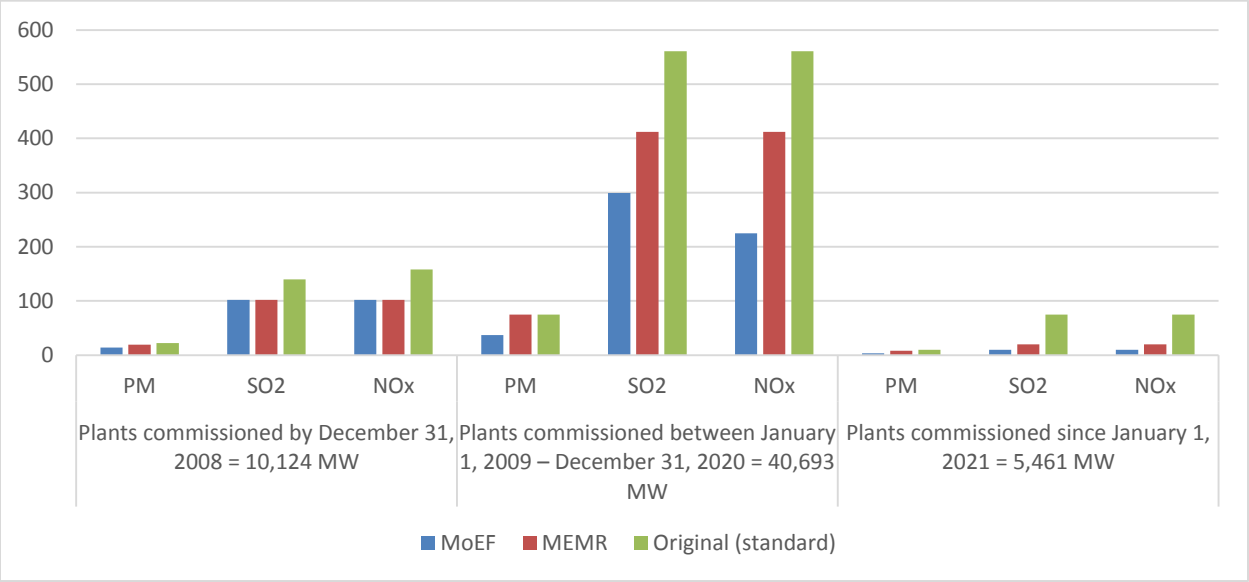
Source: MoEF

Annexure 4: Emission performance of units commissioned since January 2009 (mg per m^3)



Source: MoEF

Annexure 5: Pollution load of comparison across the proposed standards (tonnes)



Source: CSE Analysis