

# Chapter 2

## Summary of Management System in ASEAN, China and India

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## Chapter 2

### Summary of Management Systems in ASEAN, China, and India

#### 1. Survey of management systems in ASEAN countries

The management systems of coal-fired power emission gases were surveyed in the ASEAN member countries, based on the following items. The survey was conducted by the WG members in each country. In Thailand, a hearing was also held at the Ministry of Environment.

- Legislation
  - National (Federal, Central)
  - Local (State, Municipality, District, City)
- Regulated pollutants (relating to coal-fired power plants)
- Emission standards
- How authorities recognize the existence of facilities that emit air pollutants
- Authority to suspend operation
- Measurement of emissions by operator
- Monitoring
- Reporting
- Inspection
- Archive requirements
- Public announcements
- Compensation for damage and losses
- Penalty
- Assistance (National, Local)
- Ability of local governments
- Relation to local community
- Independent inspector

## 2. Summary of selected ASEAN countries, China, and India

Based on the survey in selected ASEAN countries, the results are summarized covering the legal system and the management system. See Annexes 3, 4, and 5 for the emission standards in each country.

The ASEAN countries have different experiences with coal-fired thermal power. For instance, countries such as Cambodia and Lao PDR started using coal-fired thermal power less than 10 years ago, while Thailand has used coal-fired power since the 1960s.

### 2.1. General

#### (A) Legislation (National)

Cambodia	1. Air Pollution Control Act (Ministry of Environment)
China	Environmental Protection Law (1989)  (Emission standards)  GB13223-2011
India	Prevention and Control of Pollution Act, 1981 (amended in 1987)  Environment (Protection) Act (No. 29 of 1986, 23 May 1986, last amended in 1991)  The implementation of power plant projects requires clearance from the Ministry of Environment, Forest and Climate Change ( <a href="http://envfor.nic.in/">http://envfor.nic.in/</a> ) via an environmental impact assessment. These can be stricter than the national emission standards. In addition, emission standards set by the State Pollution Control Boards can be stricter than those set by the Central Pollution Control Boards (CPCB).
Indonesia	a. Law No. 32/2009 Regarding the Protection and Management of Environment b. Law No. 30/2009 Regarding Electricity c. Government Regulation No. 14/2012 Regarding Business of Electricity Supply d. Government Regulation No. 27/2012 Regarding Environmental Licenses e. Government Regulation No. 41/1999 Regarding Air Emission Control f. Ministry of Environment Decree No. 21/2008 Regarding Static Emission Sources Quality Standard for Business and/or Activities of a Thermal Power Plant

Lao PDR	Lao PDR National Environmental Standard
Malaysia	1. Environmental Quality Act 1974 2. Environmental Quality (Clean Air) Regulations 2014
Myanmar	Environmental Conservation Law 2012 Environmental Conservation Rule 2014 National Environmental Quality (Emission) Guideline (2015) Environmental Impact Assessment Procedure 2015
Philippines	The Philippines Clean Air Act of 1999 (Republic Act No. 8749) (Emission standards) DENR Administrative Order No. 2000 - 81, 7 Nov 2000)
Singapore	Environment Pollution Control Act (1 Apr 1999) Environmental Protection and Management Act (1 Jan 2008) (Emission standards) Environmental Protection and Management (Air Impurities) Regulations (1 Jan 2001, as revised in 2002 and 2008)
Thailand	Environmental Act Factory Act There is no conflict between the two Acts.
Viet Nam	Emission standards are set by the Ministry of Natural Resources and Environment. Emission standards for thermal power plants were released on 16 November 2009 and replaced the 2005 standards.

**(B) Legislation (Local)**

Cambodia	1. Air Pollution Control Act allows CPPs to set their own emission standards but follow the government standard to establish regulations relating to air pollution emissions.
Indonesia	According to the Ministry of Environment Decree No. 21 Year 2008, local governments may set: <ul style="list-style-type: none"> <li>a. Emission quality standards for business and/or activities of a thermal power plant with the provisions of the same standards or more stringent than the standards that have been set nationally.</li> <li>b. Additional parameters outside the emission quality standards for business and/or activities of a thermal power plant after the approval of the minister in the environmental field.</li> </ul>
Lao PDR	Local authorities are involved in providing their recommendation for state of feasibility study, construction, and operation of coal-fired power plants.
Malaysia	Not available
Myanmar	Environmental Conservation Law 2012 Environmental Conservation Rule 2014 National Environmental Quality (Emission) Guideline (2015) Environmental Impact Assessment Procedure 2015
Thailand	The law gives local governments power to establish their own emission standards. But to date, no local government has set its own emission standards.

**(C) Regulated pollutants**

Cambodia	Air Pollution Control Act: SO <sub>x</sub> , NO <sub>x</sub> , PM Potentially affect the living environment: SO <sub>2</sub> , NO <sub>2</sub> , CO, particulates
China	Particulates, SO <sub>2</sub> , NO <sub>x</sub> , mercury and mercury compounds, opacity
India	SO <sub>2</sub> , NO <sub>2</sub> , PM <sub>10</sub> , PM <sub>2.5</sub> , CO
Indonesia	SO <sub>2</sub> , NO <sub>x</sub> stated as NO <sub>2</sub> , total particulates (particulate matter), opacity.
Lao PDR	SO <sub>2</sub> , NO <sub>2</sub> , PM <sub>10</sub> , and PM <sub>2.5</sub>
Malaysia	SO <sub>x</sub> (SO <sub>2</sub> and SO <sub>3</sub> ), NO <sub>x</sub> (NO and NO <sub>2</sub> ), hydrogen chloride, hydrogen fluoride, carbon monoxide, total particulate matter, mercury, PCDD/PCDF

Philippines	SOx, NOx, PM
Singapore	SO <sub>2</sub> , NOx, PM
Myanmar	SOx, NOx, PM, CO, CO <sub>2</sub> , TVOC (hydrocarbon), O <sub>3</sub> , lead
Thailand	PM, SO <sub>2</sub> , NOx
Viet Nam	SOx, NOx, PM

**(D) The way to recognize the facilities of emitting pollutants**

Cambodia	<p>Legislation</p> <ul style="list-style-type: none"> <li>- Government standards and Ordinance of Ministry of Environment</li> </ul> <p>Voluntary</p> <ul style="list-style-type: none"> <li>- Agreement between local government with power plant operator</li> <li>- Internal targets of power plants (operational standards)</li> </ul>
Indonesia	<p>Government Regulation No. 14 Year 2012 Article 13 Paragraph (1): Business licence</p> <p>Government Regulation No. 27 Year 2012 Article 1 and 2: Environmental licence</p> <p>The authority recognizes the power plant facility that emits pollutants based on the environmental documents (Environmental Impact Analysis or <a href="#">Environmental Management and Monitoring Scheme</a>) and the environmental licence.</p>
Lao PDR	<p>The central and local government authorities recognize the information during their environmental impact assessment of coal-fired power plants and mitigation plans and periodic reports of the plants.</p>
Malaysia	<p>All coal fired power plants are required to install continuous emission monitoring systems (CEMS) that are linked to the Department of Environment (DOE) in real-time.</p>
Myanmar	<p>The owner or occupier of any business, material, or place that causes a point source of pollution shall install or use an on-site facility or controlling equipment to monitor, control, manage, reduce, or eliminate environmental pollution.</p>

Thailand	<p>Power plants with capacity between 10MW and 100MW are required to have an environmental impact assessment (EIA)</p> <p>Power plants with capacity 100MW and more are required to have an environmental and health impact assessment (EHIA)</p> <p>Emission permit: not to exceed national standard.</p>
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**(E) Authority to suspend operation**

Cambodia	Based on an agreement between local government and the power plant operator, the CPP can only restart operations after the government considers that improvements have been satisfactorily made.
Indonesia	Authority to suspend operation due to violation of environmental regulation is given to the licensor of the environment licence: minister in the environmental field/governor/regent/mayor.
Lao PDR	The central government (prime minister) and governors of the provinces have full power to suspend the operation of the facilities if the pollutants emitted are above the regulations allowed, based on a daily monitoring unit at the CPP.
Malaysia	Department of Environment (DOE)
Myanmar	The government department and government organization have the power to cancel the issued licence, permit, or registration, or suspend it for a limited period.
Thailand	Ministry of Industry has the power to order partial or full suspension of CPP operations.

**(F) Measurement of emission by operator**

Cambodia	Air Pollution Control Act obligates operators to install public screen monitors to show emission measurements automatically (SO <sub>x</sub> , NO <sub>x</sub> , PM) and to transmit to the public through telemeters.
Indonesia	<p>Ministry of Environment Decree No. 21/2008, Article (9)</p> <p>- For the CPP with capacity above 25 megawatts (MW) or below 25 MW but using coal that has sulphur content above 2%, emissions are measured using a continuous emission monitoring system (CEMS) that is installed in power plant's chimney.</p>

	-For power plants that do not have a CEMS installed, manual measurement is required and it must be done by the accredited laboratory with minimum measurement frequency of once every per 6 months.
Lao PDR	<p>CPP and provincial operator measure the quantity or concentration of air pollutants, and keep records.</p> <p>- Frequency of measuring: SOx: more than every 3 months (total emission controlling area: continuously [24 hours, 7 days]); NOx: more than every 2 months; PM: more than every 2 months.</p>
Malaysia	Malaysian Standards MS1596 or MS 1723 or the Methods published by United States Environmental Protection Agency or any other standards as determined by DOE.
Myanmar	National Environmental Quality (Emission) Guideline (2015)
Thailand	<p>Licensed third party selected by operators check emission data twice a year.</p> <p>- Monitoring station: 5 kilometres away from CPP</p> <p>- Monitored pollutants: PM and SO<sub>2</sub></p> <p>Operators should send emission monitoring data to Ministry of Industry with automatic method.</p>

#### **(G) Assistance (National, Local)**

Cambodia	MME and MoE explanatory notes provide financial assistance, technical advice, or other assistance.
Indonesia	National and local government provide technical assistance to the CPP owner.
Lao PDR	Air Pollution Control Act stipulates: The (national) government shall endeavour to provide the financial assistance, technical advice, other assistance.
Malaysia	Not available
Myanmar	The (national) government shall endeavour to provide the technical advice, other assistance.
Thailand	When a regulation is to be enhanced, the central government holds a meeting with stakeholders before amendment.



**(H) Relation to local community**

Cambodia	Environmental Impact Assessment Act requires operator to hold a meeting and publish hearings with residents for explanation and discussion before they get a licence. Construction of a new CPP will continue only after residents agree.
Indonesia	Based on Government Regulation No. 27/2012 Article 9, the CPP owner must hold a meeting and public hearing with residents for explanation and discussion before preparing the EIA document.
Lao PDR	Base on concession agreement for CPP
Malaysia	Approval of the Detailed Environmental Impact Assessment (DEIA) is a mandatory requirement in new coal-fired power plant development.  The law does not require periodical meetings with local community. However, community outreach programmes are usually performed by plant operators as part of their corporate social responsibility.
Myanmar	The law does not require periodical meetings with local community.  Ministry and operator to hold stakeholder meetings and public hearings with residents for explanation and discussion on the site of the coal-fired power plant.
Thailand	Regular meetings between CPP and residents are held every 3 months.

**(I) Ability of local government**

Cambodia	The implementation is varied based on ability of officers or experts in local government to judge/interpret the measure or method of measurement.
Indonesia	Not available
Lao PDR	Ministry of Energy and Mines (MEM) and Ministry of Natural Resource and Environment (MONRE) had establishment steering committees for CPP
Malaysia	Any issue related to development in the specific local area including CPP can be addressed by local government/council. However, all environmental compliance monitoring and enforcement activities are conducted by the Department of Environment (DOE) through headquarters and state and branch offices.
Myanmar	State and regional governments are participating in public consultation, monitoring, inspection, and meetings with residents.
Thailand	There is an expert in local university.

## 2.2. Management system flow

### (A) Monitoring

Cambodia	Prefectural governors shall continuously monitor the status of air pollution.
Indonesia	Irregular monitoring by local government.
Lao PDR	Provincial authorities shall continuously monitor the status of air pollution. Local governments have observing stations.
Malaysia	Department of Environment (DOE)
Myanmar	The ministry and state and regional governments shall continuously monitor the status of air pollution. The owner or occupiers of any business have a duty to monitor the environmental pollution.
Thailand	CPP submit EIA report to Ministry of Environment, Ministry of Natural Resources, and Ministry of Energy. Report: CPP → Central Government → Local Government Local government has a power to check emission data, but this rarely occurs.

### (B) Reporting to authority

Cambodia	According to an agreement with the government, power plant operator submits data of air pollution emission every month generally, although CPPs automatically send data through to telemeter.  Ministry of Environment conducts integrated survey of quantity of air pollution emission every 3 years.  [Archive Requirement]  All CPP operators should keep important data permanently (6 monthly) after measuring emissions.
Indonesia	Government Regulation 21/2012, Article 9  The responsibility of the power plant is obliged to:  a. Report the results of monitoring and measurement of emissions every 3 months for power plants that are equipped with CEMS to the regent/mayor with a copy to the governor and minister in the environmental field.

	<p>b. Report the results of monitoring and measurement of emissions every 6 months for power plants that manually measure emissions to the regent mayor with a copy to the governor and minister in the environmental field.</p> <p>c. Report annual total pollutants (ton/year) emitted for NO<sub>x</sub>, SO<sub>x</sub>, and CO<sub>2</sub> to the regent/mayor with a copy to the governor and minister in the environmental field.</p> <p>[Archive Requirement]</p> <p>Most CPP owners keep important data permanently.</p>
Lao PDR	<p>Ministry of Natural Resource and Environment (MoNRE) or provincial authorities (EMU) jointly with CPP operators report the status of air pollutant emissions. MoNRE conducts integrated surveys of quantity of air pollutant emissions every 6 months.</p> <p>According to an agreement between CPP operator and local government, an operator submits the report to local government every month, although CPP automatically send data through telemeter continuously.</p> <p>[Archive Requirement]</p> <p>3 years.</p>
Malaysia	<p>Continuous Emission Monitoring Systems (CEMS)</p> <p>[Archive Requirement]</p> <p>Environmental Quality (Clean Air) Regulations 2014:</p> <p>- The records shall be kept for at least 3 years.</p>
Myanmar	<p>The project proponent shall submit a monitoring report to the ministry not less frequently than every 6 months, as provided in a schedule in the Environmental Management Plan (EMP), or periodically as prescribed by the ministry.</p> <p>Ministry of Electricity and Energy shall require operator to report the status of air pollutant emissions.</p> <p>[Archive Requirement]</p> <p>Coal-fired power plant operators keep the important data permanently in the form of paper and electronic files.</p>
Thailand	<p>Twice a year</p> <p>[Archive Requirement]</p> <p>The law does not require keeping archives.</p>

**(C) Inspection**

Cambodia	<p>Ministry of Environment or government should conduct inspection on each CPP through the telemeter basically.</p> <p>[Independent inspector]</p> <p>Air Pollution Control Act stipulates operators have a special environmental technician for controlling emissions in the plants.</p>
Indonesia	<p>Law 32/2009, Article 72</p> <p>Ministry of Environment or governor/regent/mayor are obliged to conduct supervision, and may conduct on-site inspections.</p> <p>Law 30/2009, Article 46</p> <p>Government (Ministry of Energy and Mineral Resources) or regional government in accordance with authority to provide guidance and supervision of the electricity supply business in terms of compliance aspects of environmental protection, and may conduct on-site inspection.</p> <p>[Independent inspector]</p>
Lao PDR	<p>Environmental management unit joint with provincial authorities conduct official inspection.</p> <p>[Independent inspector]</p> <p>Based on concession agreement for CPP</p>
Malaysia	<p>Department of Environment (DOE)</p> <p>[Independent inspector]</p> <p>The law does not require an independent inspector.</p>
Myanmar	<p>Screening team, which is organized by the ministry, inspect frequently.</p> <p>Inspection team is organized by the relevant ministries and/or organizations.</p> <p>[Independent inspector]</p> <p>The law does not appear to have a requirement for an independent inspector.</p>
Thailand	<p>Department of Estate, Ministry of Industry inspects every industry plant.</p> <p>If CPP is large, there is no site-visit.</p> <p>In case of a severe accident, Ministry of Environment inspects.</p> <p>Local government has a power to inspect, but there is no case.</p>

	<p>[Independent inspector]</p> <p>Independent inspector is not required.</p>
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#### (D) Public Announcements

Cambodia	Ministry of Environment or government collect environment data from various facilities and publish the status of air pollution on screen monitors.
Indonesia	Ministry of Environment and Forests is currently developing an online reporting system, where the results of such reporting can be accessed by the public. Currently the Directorate General of Electricity is also developing information systems for monitoring power plant emissions by taking a pilot project of one power plant site (CPP Cirebon 1 x 660 MW).
Lao PDR	Provincial authorities and EMU make public the status of air pollution within the prefecture.
Malaysia	Announcement through official portal (website) of Department of Environment and newspapers.  Regular updates of Malaysia Air Pollutant Index (API)
Myanmar	Coal-fired power plants publish the status of air pollution on LED screens in front of their power plants (example of Tigyit Coal-fired Thermal Power Plant).
Thailand	Operators' annual report.  Local government does not publish emission data.

#### (E) Penalty

Cambodia	<p>Violation of Air Pollution Control Act requires CPP operator to pay a fine or CPP licence could be cancelled or plant shut down.</p> <p>[Compensation for Damage and Losses]</p> <p>Strict Liability</p>
Indonesia	<p>Based on Law No. 32/2009, penalty:</p> <ul style="list-style-type: none"> <li>- Administrative sanction</li> <li>- Fine and imprisonment</li> </ul> <p>Anyone who violates the emissions quality standards shall be punished with</p>

	<p>imprisonment of 3 years and a maximum fine of Rp 3 billion. Criminal offence can only be imposed if administrative sanctions that have been imposed are not complied with or the offences are committed more than once.</p> <p>[Compensation for Damage and Losses]</p> <p>Strict Liability</p> <p>Law 32/2009, Article 54</p> <p>Anyone who pollutes and damages the environment is obligated to do environmental recovery.</p>
Lao PDR	<p>Bases on concession agreement</p> <p>[Compensation for Damage and Losses]</p> <p>Strict Liability</p>
Malaysia	<p>Any person who contravenes or fails to comply with any provisions of Environmental Quality (Clean Air) Regulations 2014 shall be liable to a fine not exceeding RM100,000 or imprisonment for a term not exceeding 2 years or both.</p> <p>[Compensation for Damage and Losses]</p> <p>Environmental Quality Act 1974:</p> <p>Section 46E: ‘the person so convicted to pay the other person the costs and expenses incurred or compensation for loss or damage to the property and any other costs, in the amount as the court considers fit’.</p>
Myanmar	<p>Environmental Offences and Penalties</p> <p>Penalties</p> <p>US\$2,500 to US\$10,000 or equivalent kyats</p> <p>Specific Administrative Punishment of the Ministry</p> <ul style="list-style-type: none"> <li>-Issue Enforcement Notice</li> <li>-Suspension of Approval of EMP, EMP-CP, or EMP-OP in whole or in part</li> <li>-Revocation of Approval of EMP, EMP-CP, or EMP-OP in whole or in part</li> </ul> <p>[Compensation for Damage and Losses]</p> <p>Failure to take reasonable steps to prevent an imminent threat of damage to the environment, social, human health, livelihoods, or property, where applicable based on the EMP, EMP-CP, EMP-OP</p>

Thailand	<p>Industry Act</p> <p>Ministry of Industry can pose fines, maximum B200,000.</p> <p>[Compensation for Damage and Losses]</p> <p>Central government requires CPP to pay compensation, but there is no case to date.</p> <p>(It is difficult to find responsibility of air pollution and evaluate damage and losses.)</p> <p>Operators pay damages and losses voluntarily, i.e. hospital expenses, medical examination, etc.</p>
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### 2.3. Summary

The following discussion outlines the survey results of the selected ASEAN countries.

#### (A) General

- At the central government-level in each country, environment-related acts have been enacted, regulated air pollutants have been identified, and emission standards have been stipulated. Cambodia, Indonesia, and Thailand authorize their local governments to enact the emission standards. As with Japan, Cambodia has further set the emission standards voluntarily with the CPP operator.
- Authority to suspend operation varies as follows.
  - Central government: Malaysia, Myanmar, Thailand
  - Central and local government: Indonesia, Lao PDR
  - Local government: Cambodia (based on agreement between CPP and local government)
- Periodical meeting with a local community after starting CPP operation
  - Lao PDR: Dependent on an agreement with the CPP
  - Thailand: Implemented every 3 months
  - Other countries: Not obligated

#### (B) Management process

- The local governments implement regular monitoring in Cambodia, Lao PDR, and Myanmar. In these countries, coal-fired power generation started after the 2000s.
- Reports should be submitted as follows.

- Central government: Cambodia, Malaysia, Myanmar, Thailand
- Central and local government: Indonesia, Lao PDR
- Local government: None

Archive requirements are not enacted by law, except in Thailand.

- As with submission of reports, inspection agencies vary as follows.
  - Central government: Cambodia, Malaysia, Myanmar, Thailand
  - Central and local government: Indonesia, Lao PDR
  - Local government: None
- Public announcements vary as follows.
  - Cambodia: Central government publishes it through screen monitors.
  - Indonesia: Central government is developing an online system.
  - Lao PDR: Local government publishes the status.
  - Malaysia: Central government's website
  - Myanmar: CPP publishes the status on LED screen in front of the plant
  - Thailand: CPP operator's annual report
- The following compares the national emission standards from the CPPs in the selected ASEAN countries. Where the standards differ depending on the start year of operation of the plant, the case of a newly constructed CPP was adopted. Where they differ depending on the plant scale, the large-scale case was adopted. Where they differ depending on the period, the daily basis (or 24 hours) was adopted. SO<sub>x</sub> and NO<sub>x</sub> have different units from one country to another. In the countries where parts per million (ppm) measurement is used, accordingly, it is converted into mg/m<sup>3</sup>, regarding them as SO<sub>2</sub> and NO<sub>2</sub>, respectively.
- Like Cambodia and Lao PDR, some countries have been regulating pollutants more strictly than the national emission standards, based on the agreements concluded between the CPP and the local government.



**Table 1: Emission standards for CPP in selected ASEAN countries, China, and India**

Country	SOx	NOx	PM
Cambodia	SO <sub>2</sub> : 500 mg/m <sup>3</sup>	NO <sub>2</sub> : 1000 mg/m <sup>3</sup>	400 mg/m <sup>3</sup>
China	SO <sub>2</sub> : 200 mg/m <sup>3</sup>	NO <sub>2</sub> : 200 mg/m <sup>3</sup>	30 mg/m <sup>3</sup>
India	SO <sub>2</sub> : 80 mg/m <sup>3</sup>	NO <sub>2</sub> : 80 mg/m <sup>3</sup>	100 mg/m <sup>3</sup>
Indonesia	SO <sub>2</sub> : 750 mg/m <sup>3</sup>	NO <sub>2</sub> : 750 mg/m <sup>3</sup>	100 mg/m <sup>3</sup>
Lao PDR	SO <sub>2</sub> : 320 ppm (SO <sub>2</sub> : 853 mg/m <sup>3</sup> )	NOx: 350 ppm (NO <sub>2</sub> : 670 mg/m <sup>3</sup> )	120 mg/m <sup>3</sup>
Malaysia	SOx: 500 mg/m <sup>3</sup>	NOx: 500 mg/m <sup>3</sup>	50 mg/m <sup>3</sup>
Myanmar	SOx: 200 mg/m <sup>3</sup>	NOx: 400 mg/m <sup>3</sup>	50 mg/m <sup>3</sup>
Philippines	SO <sub>2</sub> : 700 mg/m <sup>3</sup>	NO <sub>2</sub> : 1000 mg/m <sup>3</sup>	150 mg/m <sup>3</sup>
Singapore	SO <sub>2</sub> : 500 mg/m <sup>3</sup>	NO <sub>2</sub> : 700 mg/m <sup>3</sup>	100 mg/m <sup>3</sup>
Thailand	SO <sub>2</sub> : 180 ppm (SO <sub>2</sub> : 480 mg/m <sup>3</sup> )	NOx: 200 ppm (NO <sub>2</sub> : 383 mg/m <sup>3</sup> )	80 mg/m <sup>3</sup>
Viet Nam	SO <sub>2</sub> : 500 mg/m <sup>3</sup>	NO <sub>2</sub> : 650 mg/m <sup>3</sup> *	200 mg/m <sup>3</sup>
(Reference) Germany	SOx: 150 mg/m <sup>3</sup>	NOx: 150 mg/m <sup>3</sup>	10 mg/m <sup>3</sup>

ASEAN = Association of Southeast Asian Nations, CPP = coal-fired power plant, mg/m<sup>3</sup> = milligrams per cubic metre, NO<sub>2</sub> = nitrogen oxide, NOx = nitrogen oxides, PM = particulate matter, SO<sub>2</sub> = sulphur dioxide, SOx = sulphur oxides.

Note: \*coal volatile content >10%.

Source: Authors.