

Annex

August 2017

This chapter should be cited as

ERIA (2017), 'Annexes', in Motokura, M., J. Lee, I. Kutani, H. Phoumin (eds.), *Improving Emission Regulation for Coal-fired Power Plants in ASEAN*. ERIA Research Project Report 2016-02, Jakarta: ERIA, pp.45-127.

Annex 1

Environmental Legislation in Selected Countries

OECD Countries

Australia

The National Environment Protection (Ambient Air Quality) Measure (1998)

Amendment: 2003, 2011

National Environment Protection (National Pollutant Inventory) Measure (2008)

Germany

Germany (Federal)

Federal Emission Control Act (1990)

Latest amendment: 2000

European Union (EU) Directive

Industrial Emission Directive (IED – 2010/75/EU)

Large Combustion Plant Directive (LCPD – 2001/80/EC)

National Emission Ceilings for Certain Atmospheric Pollutants Directive (NECD – 2001/81/EC)

European Union Emissions Trading Scheme (EU ETS 2009/29/EC)

Japan

Basic Law for Environmental Pollution Control (1967)

Basic Environment Law (1993)

Latest amendment: 1998

Republic of Korea

Environmental Protection Law (1978)

Basic Law for Environmental Policy (1991)

(Emission standards)

NO (1979)

CO, NO₂, dust, ozone, hydrocarbon (1983)

Lead (1991)

Sulphurous acid gas, hydrocarbon (new standard, 1993)

United States

Clean Air Act (CAA) of 1963 and its 1970 amendments
Clean Air Act Amendment of 1977

ASEAN, China, and India**Cambodia**

Law on Environmental Protection and Natural Resources Management (1996)
Law on Standards of Cambodia (2007)
Sub-decree on Air Pollution and Noise Disturbance (2000)
The Sub-decree on Environment Impact Assessment (1999)

Indonesia

Law No. 32 Year 2009 Regarding the Protection and Management of Environment
Law No. 30 Year 2009 Regarding Electricity
Government Regulation No. 14 Year 2012 Regarding Business of Electricity Supply
Government Regulation No. 27 Year 2012 Regarding Environmental License
Government Regulation No. 41 Year 1999 Regarding Air Emission Control
Ministry of Environment Decree No. 21 Year 2008 Regarding Static Emission Sources Quality Standard for business and/or activities of a Thermal Power Plant

Lao PDR

Environmental Protection Law (1999)
National Environmental standard (2009)

Malaysia

Environmental Quality Act 1974
Environmental Quality (Clean Air) Regulations (1978)
Latest amendment: 2014

Myanmar

Environmental Conversation Law 2012
Environmental Conversation Rule 2014
National Environmental Quality (Emission) Guideline (2015)
Environmental Impact Assessment Procedure 2015

Philippines

Philippines Clean Air Act of 1999
National Emission Standards (DENR Administrative Order No. 2000 - 81, 7 Nov 2000)

Singapore

Environment Pollution Control Act (EPCA) (1999)

Environmental Protection and Management Act (EPMA) (2008)

Clean Air (Standards) Regulations (1978)

Environmental Protection and Management (Air Impurities) Regulations (2001)

Amendment: 2002, 2008

Thailand

Enhancement and Conservation of National Environmental and Quality Act (1992)

Ambient Air Standards (1995, 2004, 2010)

Emission standard from Coal-fired power plants (1996, 2001, 2010)

Viet Nam

Environmental Protection Law (2006)

Emission standards for Industrial sources (1995)

Emission standards for thermal power plants (2005 replaced by 2009)

China

Environmental Protection Law (1989)

Emission standards for air pollutants from coal-fired power plants (GB13223-2011) (2012)

India

Prevention and Control of Pollution Act (1981) (amendment: 1987)

Environment (Protection) Act (1986) (Latest amendment: 1991)

National Ambient Air Quality Standards (2009)

Annex 2

Survey Sheet (Selected OECD Countries)

Australia

Regulation of Air Pollutants from Coal-fired Power Plants

(Blue letters: stipulated in law, green letters: actual situation, red letters: example of New South Wales state)

Legislation

National (Federal, Central)

National Environment Protection (National Pollutant Inventory) Measure 1998

National Environment Protection (Ambient Air Quality) Measure

Local (State, Municipality, District, City)

Each state establishes environmental legislation. Procedures vary from state to state.

Regulated pollutants (relating to coal-fired power plants)

SO₂, NO₂, PM₁₀, and PM_{2.5}

Emission standards

Details are described in an annex.

How can authorities recognize the existence of facilities that emit air pollutants?

The occupier of each reporting facility is to be required to provide information.

(Example of New South Wales [NSW] state)

Licensing.

Authority to suspend operation

(Example of NSW state, Protection of the Environment Operations Act 1997)

Clean-up notices, prevention notices, and prohibition notices are the environment protection notices that are provided for under the legislation. Only the minister can issue a prohibition notice, on the recommendation of the Environment Protection Authority (EPA).

Measurement of emission by operator

Methods for pollutant monitoring: Australian standards

Monitoring

The law requires monitoring stations to be installed in areas with populations greater than 25,000.

(Example of NSW state)

The Office of Environment and Heritage (OEH) operates a comprehensive air quality monitoring network to provide the community with accurate and up-to-date information about air quality.

Air quality monitoring sites are set up in Sydney and regional areas of NSW.

Data from the monitoring network are presented online as ambient concentrations and air quality index (AQI) values which are updated hourly and stored in a searchable database.

In 2010, OEH, in partnership with the Upper Hunter coal and power industries, established the Upper Hunter Air Quality Monitoring Network.

Reporting

(Example of NSW state)

The law does not require licensees to report emission data to EPA periodically. Instead of reporting, the law requires licensees to publish pollution monitoring data.

Inspection

(Example of NSW state, Protection of the Environment Operations Act 1997)

Duty to notify pollution incidents

The act provides that mandatory audits may be required as a condition of a licence if the EPA reasonably suspects.

Powers of investigation: Authorized officers' powers include powers to require information or records, powers of entry and search of premises, powers to question and identify persons, powers to disable intruder alarms, and powers with respect to vehicles and vessels.

Archive Requirement

(Example of NSW state)

Unknown.

<p>Public Announcements</p> <p>(Example of NSW state, Requirements for publishing pollution monitoring data)</p> <p>Pollution monitoring data that is required to be collected by a licence condition must be published by the licensee. There are offences for failure to publish monitoring data and for publishing false or misleading data.</p> <p>Publish monthly meaningful summary of pollution monitoring data on website, or required frequency where monitoring occurs less than monthly.</p> <p>NSW EPA publishes the current situation of air quality on the website.</p>
<p>Compensation for Damage and Losses</p> <p>Negligence</p>
<p>Penalty</p> <p>(Example of NSW state)</p> <p>Environmental Offences and Penalties</p>
<p>Assistance (National, Local)</p> <p>(Example of NSW state)</p> <p>Unknown.</p>
<p>Ability of local governments</p> <p>(Example of NSW state)</p> <p>The EPA offers a 2-day course which is designed to equip authorized officers within local government with the necessary competencies to fulfil their responsibilities as outlined in the Protection of the Environment Operations Act 1997.</p>
<p>Relation to local community</p> <p>(Example of NSW state)</p> <p>The law does not require periodical meeting with local community.</p>
<p>Independent inspector</p> <p>(Example of NSW state)</p> <p>The law does not require independent inspector.</p>

Detail of Emission Standards

(Relating to coal-fired power plant)

Australia

Standards for pollutants

Pollutant	Averaging period	Maximum concentration standard	Maximum allowable exceedances
NO ₂	1 hour	0.12 ppm	1 day a year
	1 year	0.03 ppm	None
SO ₂	1 hour	0.20 ppm	1 day a year
	1 day	0.08 ppm	1 day a year
	1 year	0.02 ppm	None
PM ₁₀	1 day	50 µg/m ³	None
	1 year	25 µg/m ³	None
PM _{2.5}	1 day	25 µg/m ³	None
	1 year	8 µg/m ³	None

Goal for Particles as PM_{2.5} by 2025

Pollutant	Averaging period	Maximum concentration
NO _{2.5}	1 day	20 µg/m ³ by 2025
	1 year	7 µg/m ³ by 2025

(Example of NSW state)

Outline of Protection of the Environment Operations (Clean Air) Regulation 2010

Schedule 3 Standards of concentration for scheduled premises: activities and plant used for specific purposes

Electricity generation

Air impurity	Activity or plant	Standard of concentration	
PM	Any activity or plant using a liquid or solid standard fuel or a non-standard fuel	Group 1	400 mg/m ³
		Group 2, 3, or 4	250 mg/m ³
		Group 5	100 mg/m ³
		Group 6	50 mg/m ³
NO ₂	Any boiler operating on a fuel other than gas, including a boiler used in connection with an electricity generator that forms part of an electricity generating system with a capacity of 30 MW or more	Group 1, 2, 3, or 4	2,500 mg/m ₃
		Group 5	800 mg/m ₃
		Group 6	500 mg/m ₃

Schedule 4 Standards of concentration for scheduled premises: general activities and plant

General standards of concentration

Air impurity	Activity or plant	Standard of concentration	
SO ₃	Any activity or plant	Group 1	200 mg/m ³
		Group 2, 3, 4, 5 or 6	100 mg/m ³

An activity carried out, or plant operated

Group 1: Before 1 January 1972

Group 2: After 1 January 1972 and before 1 July 1979

Group 3: After 1 July 1979 and before 1 July 1986

Group 4: After 1 July 1986 and before 1 August 1997

Group 5: After 1 August 1997 and before 1 September 2005

Group 6: After 1 September 2005

Germany

Regulation of Air Pollutants from Coal-fired Power Plants

(Blue letters: stipulated in law, green letters: actual situation)

Legislation

- German regulations on air quality are aligned with the provisions adopted by the European Union (EU) air quality legislation. Current standards are contained in the Directive 2008/50/EC (European Parliament (EP) & Council of European Union (CEU), 11 June 2008) on ambient air quality and cleaner air for Europe, and the Fourth Daughter Directive 2004/107/EC (EP & CEU 2004), relating to arsenic, cadmium, mercury, nickel, and polycyclic aromatic hydrocarbons in ambient air.
- Industrial emissions within the EU are regulated under the **Directive 2010/75/EU** or Industrial Emissions Directive (**IED**) aiming to reduce harmful industrial emissions across the EU basically through a better application of Best Available Techniques (**BAT**). According to the IED, Member States (MS) may choose to grant a permit to one responsible operator for each installation or to split the responsibility amongst several operators of different parts of an installation. The provision of emission permits depends on the evaluation of plants based on BAT.
- Entered into force on 6 January 2011, the IED was to be adopted in MS national legislation by 7 January 2013. The IED provides an integrated permitting procedure (covering also issues related to water, soil, waste management, energy efficiency, and accident prevention) that allows to coordinate different permits and permitting procedures and to achieve the protection of environment as a whole, avoiding the transfer of pollution to other media.

National (Federal, Central)

Federal Immission Control Act³ (Bundes-Immissionsschutzgesetz, **BImSchG**). Long title: Act on Prevention of Harmful Effects on the Environment caused by Air Pollution as amended and promulgated on 14 May 1990 (Federal Law Gazette I. p. 880), as last amended by Art. 1 of the Act of 3 May 2000 (Federal Law Gazette I. p. 632).

Four strategies to control emissions:

- Laying down environmental quality standard
- Emission reduction requirements according to the BAT
- Product regulations
- Laying down emission ceilings

³ Even though the word “Immission” may sound strange here, it is used in the English version of the Act as in appears in several official government websites. In particular, the Federal Ministry of the Environment, Nature Conservation, Building and Nuclear Safety explains the use of the word Immission instead of Emissions in its website: “Immission relates to the effects of emissions on the environment” (<http://www.bmub.bund.de/en/topics/air-mobility-noise/air-pollution-control/general-information/>).

Local (State, Municipality, District, City):

In addition to the [BImSchG](#), there are also provisions on air quality control at Federal State levels. Basically, they represent the local enforcement of the [BImSchG](#) legal measures.

Regulated pollutants (relating to coal-fired power plants)

Target values are established by the IED 2010/75/EU, Annex II.

AIR

- SO₂ and other Sulphur compounds
- NO_x and other nitrogen compounds
- Carbon monoxide
- Volatile organic compounds
- Metals and their compounds
- Dust including fine particulate matter
- Asbestos (suspended particulates, fibres)
- Chlorine and its compounds
- Fluorine and its compounds
- Arsenic and its compounds
- Cyanides
- Substances and mixtures which have been proved to possess carcinogenic or mutagenic properties which may affect reproduction via the air
- Polychlorinated dibenzodioxins and polychlorinated dibenzofurans

According to the IED, different approaches of controlling emissions into air, water, or soil separately may encourage the shifting of pollution from one environmental medium to another. The IED favours an integrated approach to prevent and control pollutants and includes among the polluting substances also those affecting water (for a detailed list on water pollutants see Annex II of IED - 2010/75/EU).

Emission standards

- The emission limit values (mg/Nm³), i.e. concentrations that must not be exceeded in a given period, are established by the EU legislation (IED 2010/75/EU) and ensure that, under normal conditions, emissions do not exceed the emission levels associated with the BAT. The limit values are determined through standards stipulated in European air pollution control directives and then transposed into German law.
 - Emission limit values shall apply at the point where the emissions leave the installation, and any dilution prior shall be disregarded. Setting of emission limit values must not exceed the levels associated with BAT.
- Alternatively, different emission limits, in terms of values, periods of time and reference

conditions, can be set. In this case, the competent authority shall assess results at least annually to ensure that emission levels do not exceed those associated with BAT.

How can authorities recognize the existence of facilities that emit air pollutants?

- According to the IED regulation, competent authorities in the MS shall grant a permit if the installation emits polluting substances listed in Annex II and other polluting substances, as required by the IED, Art. 14, para. A), and undertaking the industrial activities listed in Annex I of the IED. Usually, they are industrial installations that have the potential to impact air quality and cause air pollution (mainly iron, steel, coal, cement, chemicals, machinery, vehicles, machine tools, electronics, automobiles, food and beverages, shipbuilding, textiles).
- The permits must take into account the whole environmental performance of the plant, in accordance with the integrated approach of the IED regulation.
- Operators shall submit to the competent authority a baseline report before starting operation of an installation. The report shall contain the information necessary to determine the state of soil and groundwater contamination.
- The permit conditions are based on BAT as defined by the BAT Reference Documents (BREFs) set after consultations of experts from MS, industry and environmental organizations. The conclusions reached in BREFs are adopted by the Commission as Implementing Decisions and constitute the reference for setting permits conditions.

Authority to suspend operation

Operators are required to suspend operations in case of non-compliance with requirements. According to **BImSchG**, Art. 20, the competent authority may decide to suspend activities of a plant in whole or in part. The competent authority shall order the closure of an installation built without necessary authorization or if it cannot guarantee the adequate protection of the neighbouring environment.

Measurement of emission by operator

Methods: The Technical Instructions on Air Quality Control (Technische Anleitung zur Reinhaltung der Luft, TA Luft) lay down requirements for calculations, which are based on the Lagrangian particle dispersion model and computed through a computer programme called AUSTAL2000.

- The analytical methods used are standardized internationally, with air quality data gathered by international data centres and used for computer modelling. The Federal Republic of Germany cooperates with other countries in the framework of the Convention on Long-range Transboundary Air Pollution (CLRTAP): the international control instrument under this framework is the European Monitoring and Evaluation Programme (EMEP), which measures transboundary air pollution from 25 countries.

Compliance with emissions limit values (IED, Part 4):

- If continuous measurements are required, compliance depends on:
 - No validated monthly average exceeding limit values;
 - No validated daily average exceeding 110% of limit values;
 - In case of combustion plants using coal with a total rated thermal input below 50 MW, no validated daily average exceeding 150% of limit values;
 - 95% of all the validated hourly average values over the year not exceeding 200% of limit values.
- If continuous measurements are not required:
 - Compliance if the results of each of the series of measurements do not exceed the limit values.

For example, for fine dust (PM₁₀) a maximum permitted average annual level of 40µg/m³ and a maximum permitted daily level of 50µg/m³, with a maximum of 35 exceeding days per year.

Frequency of measures

- The concentrations of SO₂, NO_x, and dust shall be measured continuously. The **German Federal Environment** and the **Agency German's Länder monitoring networks** measure data on ambient air quality several times a day.
- For combustion plants firing coal or lignite, the emissions of total mercury shall be measured at least once per year.

Monitoring

According to IED, Part 6, sampling and analysis of all polluting substances including dioxins and furans as well as the quality assurance of automated measuring systems and reference measurement methods to calibrate them shall be carried out according to CEN-standards.⁴ If CEN standards are not available, ISO, national or other international standards which ensure the provision of data of an equivalent scientific quality shall apply.

Air quality is measured by a sophisticated national air quality monitoring network. German air monitoring networks are operated by:

- **German Federal Environment Agency** (Umweltbundesamt [**UBA**]), which measures stations far away from densely populated areas and cities. Situated in rural areas, the stations of the Federal Environmental Agency (so-called background stations) collect concentration and deposition data for the investigation of widely dispersed air pollution in rural areas and measure the quality of air masses transported over long distances and across national frontiers. (UBA monitoring sites: Westerland; Zingst, Neuglobsow; Waldhof; Schmücke; Langen; Schauinsland; Zugspitze).
- **German's Länder monitoring networks**, which monitor the quality of the air comprehensively. They operate measuring stations in cities, in conurbations, in areas with high traffic density as well as in rural regions, to monitor and determine local and regional air quality.

⁴ Comité européen de normalization (CEN) or European Committee for Standardization.

The data from the **UBA** and the **Länder** monitoring networks provide the foundation for the presentation of the country's air quality. They are gathered in the centre of air monitoring situated in Langen (Hesse) near Frankfurt/Main.

Reporting

According to the IED, installations operating in accordance with a permit shall supply the competent Authority regularly, and at least annually, with information on the basis of results of emission monitoring (measurement methodology, frequency and evaluation procedure) in order to enable the authority to verify compliance with permit conditions.

Inspection

The IED requires mandatory environmental inspections to be done at least every 1 to 3 years (usually 1 year maximum for installations posing the highest risks and 3 years for installations posing the lowest risks).

According to the **BImSchG** the Federal Government is authorized, with the consent of the Bundesrat, to organize the inspections.

Each inspection plan shall include a general assessment of relevant significant environmental issues; the geographical area covered by the inspection plan; a register of the installations covered by the plan; procedures for drawing up programmes for routine environmental inspections; procedures for non-routine environmental inspections; provisions on the cooperation between different inspection authorities.

Archive Requirement

Publications shall be lodged in the archives of the German Patents Office for safe custody and reference. The ordinance shall indicate the date of publication and full particulars of the source reference (BImSchG, Art. 7).

Public Announcements

All data on air quality are published on the internet shortly after they are gathered in Langen, providing information on current pollution level.

MS shall ensure that the public has effective opportunities to participate in the procedures of granting a permit for new installations, following any substantial change or updating (Art. 24). When a decision on permits is taken, it shall be available to the public, including on the internet.

The IED ensures to the public the right to participate in the decision-making process and to be informed on its consequences by having access to permit applications, permits and the results of the monitoring of releases (IED, Annex IV).

<p>The EU Pollutant Release and the Transfer Register (E-PRTR) is a public register intended to provide environmental information on major industrial activities and include data on emissions as reported by MS. The register contributes to transparency and public participation. It implements for the EU Community the UN/ECE PRTR Protocol to the Aarhus Convention on Access to Information, Public Participation on Decision-making and Access to Justice in Environmental Matters.</p>
<p>Compensation for Damage and Losses</p> <p>Clean-up of soil, water, or damaged goods can be requested if there is a causal connection between the air pollution and the damage. If the responsible party is unwilling or unable to execute the clean-up, the authorities can do so at the polluter's cost.</p>
<p>Penalty</p> <p>Severe cases of non-compliance can result in criminal liability. Criminal sanctions include imprisonment and fines (up to €50,000).</p>
<p>Assistance (National, Local)</p> <p>MS shall ensure that operators afford the competent authorities all necessary assistance to enable those authorities to carry out any site visits to gather the information necessary (IED, Art. 23).</p> <p>MS shall encourage the development and application of emerging techniques, in particular for those emerging techniques identified in BAT documents.</p>
<p>Ability of local governments</p> <ul style="list-style-type: none"> - Germany is a Federal Republic with 16 federal states whose competent bodies may differ since each federal state has its own laws regulating the administration. As a rule, the mid-level administrative bodies of the federal states (Landratsamt or Regierungspräsidium) have permitting authority.
<p>Relation to local community</p> <p>The most relevant relation between local and national authorities takes place at the measurement and monitoring stage, which gathers data from local Länder and German Federal Environment Agency monitoring networks.</p>
<p>Independent inspector</p> <p>Independent inspections are not required.</p>

Detail of Emission Standards

(Relating to coal-fired power plant)

Germany

According to IED (Annex V), all emissions limit values shall be calculated at a temperature of 273,15 K, a pressure of 101,3 kPa and after correction for the water vapour content of the waste gases and at a standardized O₂ content of 6% for solid fuels, 3% for combustion plants, other than gas turbines and gas engines using liquid and gaseous fuels, and 15% for gas turbines and gas engines.

a) For permits granted before 7 January 2013 (for details see IED, Art. 30, par.1), emission limit values are the following:

1. SO₂

Emission limit values (mg/Nm³) for SO₂

Total rated thermal input (MW)	Coal and lignite
50–100	400
100–300	250
>300	200

2. NO_x

Emission limit values (mg/Nm³) for NO_x

Total rated thermal input (MW)	Coal and lignite
50–100	300 (400 in case of pulverized lignite combustion)
100–300	200
>300	200

3. DUST

Emission limit values (mg/Nm³) for dust

Total rated thermal input (MW)	Coal and lignite
50–100	30
100–300	25
>300	20

b) For all permits not covered by paragraph 2 (IED, Art. 30, par. 3), emission limit values are the following:

1. SO₂

Emission limit values (mg/Nm³) for SO₂

Total rated thermal input (MW)	Coal and lignite
50–100	400
100–300	200
>300	150 (200 in case of circulating or pressurized fluidized bed combustion)

2. NO_x

Emission limit values (mg/Nm³) for NO_x

Total rated thermal input (MW)	Coal and lignite
50–100	300 (400 in case of pulverized lignite combustion)
100–300	200
>300	150 (200 in case of pulverized lignite combustion)

3. DUST

Emission limit values (mg/Nm ³) for dust Total rated thermal input (MW)	Combustion plants using solid or liquid fuels except gas
50–300	20
>300	10

Japan

Regulation of Air Pollutants from Coal-fired Power Plants

(Blue letters: stipulated in law, green letters: actual situation)

Legislation

National (Federal, Central)

1. Air Pollution Control Act (Ministry of the Environment, MoE), which includes relevant Cabinet Order and Ordinance of MoE.
2. Following cases will be exempted from application of Air Pollution Control Act.
 - Coal-fired power plant (CPP) which has an authorization of Electricity Business Act. (Ministry of Economy, Trade and Industry, METI) *
 - Event of accidents

* The Electricity Business Act implies the same level of emission standard.

Local (State, Municipality, District, City)

1. Air Pollution Control Act allows prefectures to set their own emission standards (which in general more stringent than that of the central government).
2. Air Pollution Control Act allows local governments to establish necessary regulations (Ordinance) relating to air pollutant emissions.
3. Local governments can establish their own ordinance which is not directly regulating but potentially affect air emission of CPP.
 - e.g. Yokohama city where Isogo CPP locate, establishes ordinance relative to living environment.

Regulated pollutants (relating to coal-fired power plants)

Air Pollution Control Act: SO_x, NO_x, PM

Yokohama city (Ordinance relating to living environment):

- Cadmium/cadmium compound
- Chlorine/hydrogen chloride
- Fluorine
- Hydrogen fluoride
- Silicon fluoride
- Lead/lead compound
- Ammonia
- Cyanogen compound
- NO_x
- SO₂
- Hydrogen Sulphide

Emission standards

Regal mandate: Details are described in an annex

1. Ordinance of MoE (general)
2. Local government ordinance (specified areas, more stringent)

Voluntary:

3. Agreement between local government and power plants operator (more stringent)
4. Internal targets of power plants (operational standards, most stringent)

Standards for Controlling the Total Emissions

Air Pollution Control Act stipulates that prefectural governor shall set standards for controlling the total emissions in an area with a concentration of factories or workplaces.

How can authorities recognize the existence of facilities that emit air pollutants?

Coal-fired power plants shall provide the following items to the prefectural governor.

- Name and address
- Location
- Type of air pollutant
- Structure of facilities
- Way of disposing of air pollutants, etc.

Authority to suspend operation

Prefectural governors have the power to order emitters to suspend the operation of facilities when they violate the regulation.

Order for Improvement

Prefectural governors have the power to order a CPP to improve performance when it continuously emit more than regulated limit.

Based on an agreement between local government and CPP operator, when CPP is going to restart after the order for improvement, the local government can resist its restart until improvement has been satisfactorily made. This mechanism lets the CPP operator to comply with voluntary target to avoid receiving order for improvement by the local government.

Measurement of emission by operator

CPP operator shall measure the quantity or concentration of air pollutant, and keep its record.

- Frequency of measuring:
 - SOx: more than every two months (Total emission controlling area: continuously(24hr-7d))
 - NOx: more than every two months
 - PM: more than every two months
- Measuring methods are stipulated in Law.

Coal-fired power plants set observing stations, for example, 10km, 20km, 30km away from CPP, to monitor the emission continuously. The data is automatically transmitted to local government through telemeter.

CPP operator signed agreement with local government, which stipulates, in most cases, stringent emission standards and more frequent measurement. For example:

SOx: monitor quantity and concentration continuously

NOx: monitor quantity and concentration continuously

PM: every month

Monitoring

Prefectural governors shall continuously monitor the status of air pollution.

Local governments have observation stations.

Reporting

MoE or governor of prefecture may require CPP operator to report the status of air pollutant emissions.

MoE conducts integrated survey of quantity of air pollutant emission every three years.

According to an agreement between CPP operator and local government, an operator submits the report to local government every month, although the CPP automatically sends data through telemeter continuously.

Inspection

MoE or a prefectural governor may conduct official inspection.

On-site inspection by METI: On an irregular base, every 5 or 6 years.

On-site inspection by local government depends on an agreement between CPP operator and local government, once in a year generally, in Environment Month typically.

Archive Requirement

3 years.

Generally, most CPP operators keep important data permanently.

Public Announcements

Prefectural governors shall make public the status of air pollution within the prefecture.

Local governments collect environmental data from various facilities and publish the status of air pollution at screen monitor in their city hall. Everyone can see the situation in anytime. Local governments also publish environmental report periodically.

In case of accident, CPP operator publishes the status of air pollutant emissions through a press release.

Compensation for Damage and Losses

Strict Liability

Penalty

Violation of Air Pollution Control Act including disclose of name of subjected operator.

Punishment includes imprisonment and fine.

Assistance (National, Local)

Air Pollution Control Act stipulates the following.

The (national) government shall endeavour to provide financial assistance, technical advice, other assistance.

MoE, in collaboration with Ministry of Economy, Trade and Industry (METI) in some cases, convenes explanatory meetings with CPP operator when the law is amended.

Local governments also convene explanatory meetings with CPP operator.

MoE and local government post explanatory documents and application/report forms on their website for easy download.

Ability of local governments

Ability of officers in local government is high. There are experts of measuring method in local government.

Relation to local community

Air Pollution Control Act does not require periodical meeting with local community.

Another law requires companies to hold a meeting with residents for explanation and discussion when they apply Environmental Impact Assessment before new construction of a CPP.

Independent inspector

Air Pollution Control Act does not require independent inspector.

If a coal-fired power plant has ISO 14001 certification, the plant is audited every year.

Detail of Emission Standards

(Relating to coal-fired power plant)

Japan

1. SO_x

Air Pollution Control Act

$$q = K * 10^{-3} * H_e^2$$

q: Maximum permissible limit of SO_x (m³_N/h)

H_e: Adjusted height of the Outlet (m)

K: Area of classification

General regulation K: from 3.0 to 17.5

Special regulation (new construction, specified area) K: from 1.17 to 2.34

$$H_e = H_o + 0.65 (H_m + H_t)$$

$$H_m = 0.795 \sqrt{Q * V} / \{1 + (2.58/V)\}$$

$$H_t = 2.01 * 10^{-3} * Q * (T - 288) * \{2.30 \log J + (1/J) - 1\}$$

$$J = (1/\sqrt{Q * V}) [1460 - 296 * \{V/(T - 288)\}] + 1$$

H_e Adjusted height of the Outlet (m)

H_o Actual height of the Outlet (m)

Q Quantity of emission at 15°C (m³/s)

V Discharge rate of emission (m/s)

T Temperature of emission (absolute temperature)

Life Environment relevant ordinance (Yokohama City)

Sulphur content in emission: 4 SO₂ equivalent grams/1 fuel oil equivalent kg combustion

2. NO_x

Air Pollution Control Act

200ppm (O₂: 6%)

Life Environment relevant ordinance (Yokohama City)

NO₂: 100ppm

NO_x: 200ppm

3. PM

Air Pollution Control Act

100mg/m³_N (O₂: 6%)

Life Environment relevant ordinance (Yokohama City)

0.05g/m³_N

Republic of Korea

Regulation of Air Pollutants from Coal-fired Power Plants

(Blue letters: stipulated in law, green letters: actual situation)

Legislation

National (Federal, Central)

1. Air Pollution Control Act (Ministry of the Environment [MoE]), which includes relevant Cabinet Order and Ordinance of MoE.
2. Basic Environment Act (MoE) also stipulates the air emission standards which is not directly regulating the air emission of CPP but potentially affect the living environment.

Local (State, Municipality, District, City)

1. Air Pollution Control Act allows prefectures of the more than 500,000 population to set their own emission standards (which in general more stringent than that of the central government).
2. Air Pollution Control Act allows local governments to establish necessary regulations (Ordinance) relating to air pollutant emissions.
3. Air Pollution Control Act stipulates that local governments should report to the MoE and take necessary measures to enable stakeholders to know when their own emission standards are set and amended.

Regulated pollutants (relating to coal-fired power plants)

Directly regulating the air emission of CPP (Air Pollution Control Act)

- SO_x, NO_x, PM

Potentially affect the living environment (Basic Environment Act)

- Sulphur dioxide (SO₂)
- nitrogen dioxide (NO₂)
- Carbon monoxide (CO)
- Micro-dust (PM)
- Ozone (O₃)
- Lead (Pb)
- Benzene

Emission standards

Legal mandate: Details are described in annexes 4, 5, and 6

1. Ordinance of MoE (General)

* In matters of the special measure areas, MoE can set the more stringent emission standards than the general emission standards.

2. Local government ordinance (more stringent than the central government's standards)

Voluntary

3. Agreement between local government and power plants operator (more stringent)

4. Operator's internal targets of power plants (operational standards, most stringent)

Standards for Controlling the Total Emissions

Air Pollution Control Act stipulates that MoE can set standards for controlling the total emissions in an area if the air pollution condition exceeds the standards or it is concentrated at factories or workplaces.

How can authorities recognize the existence of facilities that emit air pollutants?

Coal-fired power plants should report the following items to the prefectural governor.

- Name and address
- Location
- License of facilities
- Type of air pollutant
- Structure of facilities
- Planning of controlling the air pollutant, etc.

Authority to suspend operation

Prefectural governor has the power to order emitters to all or partially suspend the operation of facilities when they violate the regulation.

Order for Improvement

Prefectural governor has the power to order CPP for improvement within 1 year* when it continuously emit more than regulated limit.

* In case of not improving within 1 year with the force majeure, the operator should apply for the extension of 1 year more to prefectural governor.

Based on an agreement between local government and CPP operator, when CPP is going to restart after the order for improvement, local government can resist its restart until the government regard improvement has been satisfactory made. This mechanism let CPP operator to comply with voluntary target to avoid receiving order for improvement by the local government.

Measurement of emission by operator

Air Pollution Control Act obligates operators to install the telemeter in the stack of CPP for measuring emission automatically and continuously.

- Telemeter installation object: Power generation plant (hydro, nuclear power is exemption)
- Measuring pollutants: SO_x, NO_x, PM

CPP operator signed an agreement with local government, which stipulate, in the most cases, very stringent emission standards and real-time measurement.

Monitoring

The central and prefectural governors shall continuously monitor the status of air pollution.

Local governments should monitor through the own observing stations and report to the MoE the monitoring results.

Reporting

MoE or prefectural governor may require operators to report the status of air pollutant emissions.

According to an agreement between CPP operator and local government, an operator submits the report to local government if necessary anytime, although CPP automatically send data through telemeter continuously.

Inspection

Prefectural governor should conduct inspection on every CPP through the telemeter basically and report to the MoE by the end of March every year.

On-site inspection by local government: it depends on an Agreement between CPP operator and local government.

Archive Requirement

For 6 months after measuring the emission.

Generally, most CPP operators keep the important data permanently in the form of electronic files.

Public Announcements

Air Pollution Control Act stipulates MoE shall predict the air pollution status and announce the results on press release or in the other ways. For this, MoE may require operators to submit the necessary documents.

Local governments collect environmental data from various facilities and publish the status of air pollution at screen monitor in their city hall and on the road. Everyone can see the situation in anytime. Local Governments also publish environmental report periodically.

In case of accident, CPP operators publish the status of air pollutant emissions through press release.

Compensation for Damage and Losses

Strict Liability

Penalty

Violation of Air Pollution Control Act: penalties include fine imposed on operator, suspension of operation, cancellation of licence, or plant shutdown.

Assistance (National, Local)

Air Pollution Control Act stipulates the following.

The (national) government shall endeavour to provide financial assistance, technical advice, other assistance.

MoE and local government post explanatory documents and application and report forms on their website and everyone can easily download them when the law is amended.

Ability of local governments

Ability of officers in local government is generally high. There are experts of measuring method in local government.

Relation to local community

Air Pollution Control Act does not require periodical meeting with local community.

Environmental Impact Assessment Act requires operators to hold a meeting and public hearing with residents for explanation and discussion before they try to get a license and construct a new CPP.

Until the residents agree to construct the CPP, operators should continue such a process.

Independent inspector

Air Pollution Control Act does not require independent inspector. But act stipulates operators to have a special environmental technician for controlling the emission in the plants.

Detail of Emission Standards

(Relating to coal-fired power plant)

Republic of Korea

1. SO_x

Air Pollution Control Act

- Established before 1996: 100ppm (O₂: 6%)
- Established before 2014: 80ppm (O₂: 6%)
- Established after 2015: 50ppm (O₂: 6%)

Voluntary (Operators of new CPP)

- In-cheon: 20 to 25ppm (O₂: 6%)
- Dang-gin: 40ppm (O₂: 6%)
- Yeou-su: 30 ppm (O₂: 6%)

2. NO_x

Air Pollution Control Act

- Established before 1996: 140ppm (O₂: 6%)
- Established after 1996: 70ppm (O₂: 6%)
- Established after 2015: 50ppm (O₂: 6%)

Voluntary (Operators of new CPP)

- In-cheon: 15ppm (O₂: 6%)
- Dang-gin: 50ppm (O₂: 6%)
- Yeou-su: 30 ppm (O₂: 6%)

3. PM

Air Pollution Control Act

- Established before 2001: 25mg/Sm³ (O₂: 6%)
- Established after 2001: 20mg/Sm³ (O₂: 6%)
- Established after 2015: 10mg/Sm³ (O₂: 6%)

Voluntary (Operators of new CPP)

- In-cheon: 5mg/Sm³ (O₂: 6%)
- Yeou-su: 8mg/Sm³ ppm (O₂: 6%)

United States

Regulation of Air Pollutants from Coal-fired Power Plants

(Blue letters: stipulated in law, green letters: actual situation)

Legislation

National (Federal, Central)

Clean Air Act (CAA)

Section 108 (Air quality criteria and control techniques)

National Ambient Air Quality Standards (NAAQS)

EPA Regulation: 40 CFR part 50

Section 111 (Standards of performance for new stationary sources)

New Source Performance Standards (NSPS)

EPA Regulation: 40 CFR part 60 subpart Da

Standards of Performance for Electric Utility Steam Generating Units

Section 112 (Hazardous air pollutants)

National Emission Standards for Hazardous Air Pollutants (NESHAP)

EPA Regulation: 40 CFR part 63

Local (State, Municipality, District, City)

Regulated pollutants (relating to coal-fired power plants)

Section 108, CAA (EPA Regulation 40 CFR part 50)

'criteria' air pollutants: six

CO, Lead, NO₂, O₃, PM, SO₂

Section 111, CAA (EPA Regulation :40 CFR part 60 subpart Da)

§60.42Da Standards for particulate matter (PM)

§60.43Da Standards for sulphur dioxide (SO₂)

<p>§60.44Da Standards for nitrogen oxides (NO_x)</p> <p>Section 112, CAA</p> <p>Currently 189 pollutants</p> <p>EPA's latest regulation: mainly mercury</p>
<p>Emission standards</p> <p>Details are described in annexes 4, 5, and 6</p>
<p>How can authorities recognize the existence of facilities that emit air pollutants?</p>
<p>Authority to suspend operation</p> <p>Title V of CAA (Operating Permits)</p> <p>Title V of CAA requires major sources of air pollutants, and certain other sources, to obtain and operate in compliance with an operating permit. Sources with these 'title V permits' are required by CAA to certify compliance with the applicable requirements of their permits at least annually.</p>
<p>Measurement of emission by operator</p> <p>40 CFR part 60 subpart Da</p> <p>§60.48Da Compliance provisions</p> <p>§60.49Da Emission monitoring</p> <p>§60.50Da Compliance determination procedures and methods</p>
<p>Monitoring</p> <p>40 CFR part 60 subpart Da</p> <p>§60.49Da Emission monitoring</p> <p>(Example of PM)</p> <p>An owner or operator of an affected facility must monitor the opacity of emissions discharged from the affected facility to the atmosphere.</p> <p>The owner or operator of an affected facility shall install, calibrate, maintain, and operate an opacity monitoring system (COMS), and record the output of the system, for measuring the opacity of emissions discharged to the atmosphere.</p>
<p>Reporting</p> <p>40 CFR part 60 subpart Da</p> <p>§60.51Da Reporting requirements</p> <p>For SO₂, NO_x, PM, and NO_x plus CO₂ emissions, the performance test data from the initial and subsequent performance test and from the performance evaluation of the continuous monitors (including the transmissometer) must be reported to the administrator.</p>

(For SO₂ and NO_x: each 24-hour period)

The owner or operator of the affected facility shall submit a signed statement.

Inspection

EPA's policy: Incentives for Self-policing: Discovery, Disclosure, Correction, and Prevention of Violations

On-site visit by EPA

Civil investigations

Record reviews: EPA, state, or local offices

Information requests

(<https://www.epa.gov/compliance/how-we-monitor-compliance>)

Archive Requirement

40 CFR part 60 subpart Da

§60.52Da Recordkeeping requirements

Public Announcements

Air Monitoring

<https://www.epa.gov/outdoor-air-quality-data>

Compensation for Damage and Losses

- Environmental civil liability is **strict**; it arises simply through the existence of the environmental violation. It does not take into consideration what the responsible party knew about the law or regulation they violated.

- Environmental criminal liability is triggered through some level of intent.

Penalty

If a civil defendant is found liable or agrees to a settlement, the result can be:

- a monetary penalty
- injunctive relief (actions required to correct the violation and come into compliance, e.g., install pollution control equipment), and/or
- additional actions taken to improve the environment

If a criminal defendant is convicted or pleads guilty, the result can be:

- a monetary fine paid to the US Treasury, and/or
- restitution (reimbursing the government for the cost of clean-up or response, compensating for the harm caused by the violation, e.g. paying for medical testing for people exposed to asbestos)
- incarceration

<p>Assistance (National, Local)</p> <p>New Source Review (NSR) and Prevention of Significant Deterioration (PSD) require certain large industrial facilities to install state-of-the-art air pollution controls when they build new facilities or make modifications to existing facilities.</p> <p>EPA homepage: Investigations of coal-fired power plant sector have identified a high rate of noncompliance with NSR/PSD when old plants are renovated or upgraded.</p> <p>CAA (Section 108) requires EPA to develop information on pollution control techniques.</p> <p>The Clean Air Technology Center</p>
<p>Ability of local governments</p>
<p>Relation to local community</p> <p>The EPA regulation does not require periodical meeting with local community.</p>
<p>Independent inspector</p> <p>The EPA regulation does not require independent inspector.</p>

Detail of Emission Standards

(Relating to coal-fired power plants)

United States

40 CFR part 50 (air quality)

Pollutant	Primary/ Secondary	Averaging time	Level	Form
NO ₂	primary	1 hour	100 ppb	98th percentile of 1-hour daily maximum concentrations, averaged over 3 years
	primary and secondary	1 year	53 ppb	Annual Mean
PM	PM _{2.5}	primary	12.0 µg/m ³	annual mean, averaged over 3 years
		secondary	15.0 µg/m ³	annual mean, averaged over 3 years
		primary and secondary	24 hours	35 µg/m ³

	PM ₁₀	primary and secondary	24 hours	150 µg/m ³	Not to be exceeded more than once per year on average over 3 years
SO ₂		primary	1 hour	75 ppb	99th percentile of 1-hour daily maximum concentrations, averaged over 3 years
		secondary	3 hours	0.5 ppm	Not to be exceeded more than once per year

Primary standards provide public health protection, including protecting the health of ‘sensitive’ populations such as asthmatics, children, and the elderly. **Secondary standards** provide public welfare protection, including protection against decreased visibility and damage to animals, crops, vegetation, and buildings.

40 CFR part 60 subpart Da (stationary source)

Applicability:

That is capable of combusting more than 73 MW (250 MMBtu/hr) heat input of fossil fuel.

	SO ₂	NOx	PM
1971–1978	520 ng/J heat input	300 ng/J heat input	43 ng/J heat input
Sep 1978–1997	520 ng/J heat input and 90% reduction (or 70% reduction where <260 ng/J);	subbituminous: 210 ng/J heat input other coal types: 260 ng/J heat input	13 ng/J heat input
1978–Mar 2005	180 ng/J gross output 65 ng/J heat input	New plant: 200 ng/J gross output Reconstructed: 65 ng/J heat input	
Commenced construction: Mar 2005–May 2011	180 ng/J gross output 95% reduction	130 ng/J gross output	18 ng/J gross output 6.4 ng/J heat input
Commenced reconstruction: Mar 2005–May 2011	180 ng/J gross output 65 ng/J heat input 95% reduction	130 ng/J gross output 47 ng/J heat input	Or: 13 ng/J input and 99.9% reduction
Modified: Mar 2005–May 2011	180 ng/J gross output 65 ng/J heat input 90% reduction	180 ng/J gross output 65 ng/J heat input	18 ng/J gross output 6.4 ng/J heat input Or: 13 ng/J input and 99.8% reduction
Construction or reconstruction after: 3 May 2011	130 ng/J gross energy output 140 ng/J net energy output 97% reduction	88 ng/J gross output 95 ng/J net output	11 ng/J gross output 12 ng/J net output
Modified after: 3 May 2011	180 ng/J gross output 90% reduction	140 ng/J gross output	18 ng/J gross output 6.4 ng/J heat input Or: 13 ng/J input and 99.8% reduction

Annex 3

Survey Sheet (Selected ASEAN Countries)

Cambodia

Regulation of Air Pollutants from Coal-fired Power Plants

(Blue letters: stipulated in law, green letters: actual situation)

<p>Legislation</p> <p><u>National (Federal, Central)</u></p> <ol style="list-style-type: none">1. Air Pollution Control Act (Ministry of Environment [MoE]) <p><u>Local (State, Municipality, District, City)</u></p> <ol style="list-style-type: none">1. Air Pollution Control Act allows CPP to set their own emission standards but follow the government standard and follow to establish regulation that relating to air pollution emission.
<p>Regulated pollutants (relating to coal-fired power plants)</p> <p>Air Pollution Control Act: SO_x, NO_x, PM</p> <p>Potentially affect the living environment</p> <ul style="list-style-type: none">- Sulphur dioxide (SO₂)- Nitrogen dioxide (NO₂)- Carbon monoxide (CO)- Particulates
<p>Emission standards</p> <p>Regal mandate details are described in annexes 4, 5, and 6</p> <ul style="list-style-type: none">- The government standard and Ordinance of Ministry of Environment <p>Voluntary</p> <ul style="list-style-type: none">- Agreement between local government with power plant operator- Internal targets of power plants (operational standards)
<p>How can authorities recognize the existence of facilities that emit air pollutants?</p> <p>Coal-fired power plants should report the following items to the prefectural governor</p> <ul style="list-style-type: none">- Name and address- Location- Type of air pollutant

<ul style="list-style-type: none"> - Structure of facilities - Planning to control air pollutant
<p>Authority to suspend operation</p> <p>Based on an agreement between local government with power plant operator, when CPP is going to restart after the order for improvement and local government can stand up to its restart until the government regard improvement has been satisfactory made.</p>
<p>Measurement of emission by operator</p> <p>Air pollution Control Act obligates operator to install a public screen monitor to show emission measurements automatically (SO_x, NO_x, PM) and transmit to the public through a telemeter.</p>
<p>Monitoring</p> <p>Prefectural governors shall continuously monitor the status of air pollution.</p>
<p>Reporting</p> <p>According to agreement with the government, a power plant operator submits data air pollution emission every month generally, although CPP automatically send data through to telemeter.</p> <p>Ministry of Environment conducts integrated survey of quantity of air pollution emission every 3 years.</p>
<p>Inspection</p> <p>Ministry of Environment or government should conduct inspection on each CPP through the telemeter.</p>
<p>Archive Requirement</p> <p>All CPP operators should be keep the important data permanently every 6 months after measuring the emission.</p>
<p>Public Announcements</p> <p>MoE or government collect environment data from various facilities and publish the status of air pollution to show on public screen monitor.</p>
<p>Compensation for Damage and Losses</p> <p>Strict Liability</p>
<p>Penalty</p> <p>Violation of Air Pollution Control Act: penalties include fine imposed on operator, suspension of operation, cancellation of licence, or plant shutdown.</p>

<p>Assistance (National, Local)</p> <p>Ministry of Mines and Energy (MME) and Ministry of Finance (MoE) shall provide financial assistance, technical advice, or other assistance.</p>
<p>Ability of local governments</p> <p>The implementation largely depends on the ability of officers or experts in local government to judge and interpret the method of measuring the compliance of CPP.</p>
<p>Relation to local community</p> <p>Environmental Impact Assessment Act requires operator to hold a meeting and publish hearing with residents for explanation and discussion before they get a licence and continue the process of constructing a new CPP after the residents agree.</p>
<p>Independent inspector</p> <p>Air Pollution Control Act stipulates operators have a special environmental technician for controlling the emission in the plants.</p>

Detail of Emission Standards

(Relating to coal-fired power plants)

Cambodia

Emission	Unit	Cambodian standard	World Bank standard
Sulphur dioxide (SO ₂) Dry, 0 ^o c, 1atm, 6% O ₂	mg/Nm ³	500	2000
Nitrogen oxide(SO ₂) Dry, 0 ^o c, 1atm, 6% O ₂	mg/Nm ³	1,000	750
Particulates Dry, 0 ^o c, 1atm, 6% O ₂	mg/Nm ³	400	50

Indonesia

Regulation of Air Pollutants from Coal-fired Power Plants

(Blue letters: stipulated in law, green letters: actual situation)

<p>Legislation</p> <p><u>National (Federal, Central)</u></p> <ol style="list-style-type: none">Law No. 32 Year 2009 Regarding the Protection and Management of EnvironmentLaw No. 30 Year 2009 Regarding ElectricityGovernment Regulation No. 14 Year 2012 Regarding Business of Electricity SupplyGovernment Regulation No. 27 Year 2012 Regarding Environmental LicenseGovernment Regulation No. 41 Year 1999 Regarding Air Emission ControlMinistry of Environment Decree No. 21 Year 2008 Regarding Static Emission Sources Quality Standard for business and/or activities of a Thermal Power Plant <p><u>Local (State, Municipality, District, City)</u></p> <p>According Ministry of Environment Decree No. 21 Year 2008, local government may set:</p> <ol style="list-style-type: none">emission quality standards for business and / or activities of a thermal power plant with the provisions of the same or more stringent than the standard that has been set nationally;Additional parameters outside the parameters of the emission quality standards for business and/or activities of a thermal power plant after the approval of the minister in the environmental field.
<p>Regulated pollutants (relating to coal-fired power plants)</p> <p>Sulphur dioxide (SO₂), nitrogen oxide (NO_x) stated as NO₂, total particulate (particulate matter), and opacity.</p>
<p>Emission standards</p> <p>The detail is in annexes 4, 5, and 6</p>
<p>How can authorities recognize the existence of facilities that emit air pollutant?</p> <ul style="list-style-type: none">Government Regulation No. 14 Year 2012 Article 13 Paragraph (1) and Government Regulation No. 27 Year 2012 Article 1 and 2 <p>Government Regulation No. 14 Year 2012 states that to obtain a business licence in electricity supply, an applicant must meet the administrative, technical, and environmental requirements. In terms of environmental requirement, in Government Regulation No. 27 Year 2012, it is explained that an environmental licence is a prerequisite to obtain business and/or activity licence. An environmental licence is obtained through several stages of activities including:</p>

1. Preparing the Environmental Impact Analysis (EIA) or Environmental Management and Monitoring Scheme (EMMS) (for power plant < 100 MW in one location)
2. Assessment
3. Application and issuance of environmental licence.

The authority can recognize the power plant facility that emit pollutants based on the environmental documents (Environmental Impact Analysis or EMMS) and the environmental licence, which was drafted at the beginning stages of planning the power plant as well as on the reporting of the implementation of the monitoring of air emissions that are routinely prepared by the company to be submitted to the technical authority.

Authority to suspend operation

Authority to suspend operation due to violation of environmental regulation is the licensor of environment licence: minister in the environmental field/governor/regent/mayor.

Measurement of emission by operator

Ministry of Environment Decree No. 21 Year 2008 Article (9)

- For the CPP with capacity above 25 MW or below 25 MW but using coal that has sulphur content above 2%, emissions are measured using Continuous Emission Monitoring System (CEMS) that is installed in power plant's chimney.
- For a power plant that does not have a CEMS installed, manual measurement is required and it must be done by the accredited laboratory with minimum measurement frequency every 6 months.

In practice, even though a CEMS is installed, manual measurement is still required and it is conducted by accredited laboratory every 6 months. The results from manual measurements are used as comparative data and the result is also reported to the regent/mayor with a copy to the governor and minister in the environmental field.

Monitoring

Irregular monitoring by local government.

Reporting

Government Regulation 21 Year 2012 article 9

The responsible of the power plant is obliged to

- a. Report the results of monitoring and measurement of emissions every 3 months for the power plant that equipped with CEMS to the regent/mayor with a copy to the governor and minister in the environmental field.

- b. Report the results of monitoring and measurement of emissions every 6 months for the power plant that manually measured the emission to the regent/mayor with a copy to the governor and minister in the environmental field.
- c. Report annual total emission (ton/year) emitted for NO_x, SO_x, and CO₂ to the regent/mayor with a copy to the governor and minister in the environmental field.

Inspection

Law 32 Year 2009 article 72

Ministry of Environment or governor/regent/mayor are obliged to conduct supervision, and may conduct on-site inspection.

Law 30 Year 2009 article 46

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 term of compliance aspects of environmental protection, and may conduct on-site inspection.

Archive Requirement

Generally, most CPP owners keeps important data permanently.

Public Announcements

Ministry of Environment and Forests is currently developing an online reporting system, where the results of such reporting can be accessed by the public. The Directorate General of Electricity is also developing information systems for monitoring power plant emissions by taking a pilot project of one power plant location (CPP Cirebon 1 x 660 MW).

Compensation for Damage and Losses

Strict Liability

Law 32 Year 2009 article 54

Anyone who pollutes and damages the environment is obligated to do the environmental recovery.

Penalty

Based on Law No. 32 Year 2009, penalty:

- Administrative sanction
- Fine and imprisonment

Anyone who violates the emissions quality standards shall be punished with imprisonment of 3 years and a maximum fine of Rp3 billion. A 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>Assistance (National, Local)</p> <p>National and local government provide technical assistance to the CPP owner.</p>
<p>Ability of local governments</p> <p>Not available</p>
<p>Relation to local community</p> <p>Based on Government Regulation No. 27 Year 2012 article 9, the CPP owner must hold a meeting and public hearing with residents for explanation and discussion as requirement for preparing an EIA document.</p>
<p>Independent inspector</p> <p>Not available</p>

Detail of Emission Standards

(Relating to coal-fired power plants)

Indonesia

Static Emission Sources Quality Standard for CPP

No.	Parameter	Maximum level (mg/Nm ³)	
		A	B
1.	Sulphur dioxide (SO ₂)	750	750
2.	Nitrogen oxide (NO _x) stated as NO ₂	850	750
3.	Total particulate	150	100
4.	Opacity	20%	20%

A. For CPP that has been operation before 1 December 2008.

B. For CPP that has been operation since 1 December 2008.

Notes:

- a. Gas volume is measured under standard condition (25°C and 1 atm).
- b. Opacity is used as a practical indicator for monitoring.
- c. All parameters corrected by O₂: 7 %.
- d. For a CPP with CEMS installed, the imposition of emission quality standard is for 95% of normal operation time for 3 months.

Lao PDR

Regulation of Air Pollutants from Coal-fired Power Plants

(Blue letters: stipulated in law, green letters: actual situation)

<p>Legislation</p> <p><u>National (Federal, Central)</u></p> <p>National Environmental standard (Lao national environmental standard)</p> <p><u>Local (State, Municipality, District, City)</u></p> <p>Local authorities are involved in providing their recommendation for state of feasibility study, construction and operation of coal-fired power plants.</p>
<p>Regulated pollutants (relating to coal-fired power plants)</p> <p>SO₂, NO₂, PM₁₀, and PM_{2.5}</p>
<p>Emission standards</p> <p>Details are described in annexes 4, 5, and 6</p>
<p>How can authorities recognize the existence of facilities that emit air pollutants?</p> <p>The central and local government authorities recognize the information during their review EIA of coal-fired power plants and mitigation plans and periodic reports of the plants.</p>
<p>Authority to suspend operation</p> <p>The central government (prime minister) and provincial governors have full power to suspend the operation of the facilities if the pollutants emitted are above the regulations allowed based on daily monitoring at the CPP.</p>
<p>Measurement of emission by operator</p> <p>CPP and provincial operator measure the quantity or concentration of air pollutant, and keep its record. Frequency of measuring: SO_x: more than every 3months (total emission controlling area: continuously (24hr-7d)) NO_x: more than every 2 months PM: more than every 2 months</p>
<p>Monitoring:</p> <p>Provincial authorities shall continuously monitor the status of air pollution.</p> <p>Local governments have observation stations.</p>
<p>Reporting</p> <p>Ministry of Natural Resource and Environment (MoNRE) or provincial authorities (EMU) jointly with CPP operator to report the status of air pollutant emissions. MoNRE conducts integrated survey of quantity of air pollutant emission 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 generally, although CPP automatically sends data through telemeter continuously.</p>

<p>Inspection</p> <p>Environmental management unit jointly with provincial authorities conduct official inspection.</p>
<p>Archive Requirement</p> <p>3 years.</p>
<p>Public Announcements</p> <p>Provincial authorities and EMU make public the status of air pollution within the prefecture.</p>
<p>Compensation for Damage and Losses</p> <p>Strict Liability</p>
<p>Penalty</p> <p>Base on concession agreement.</p>
<p>Assistance (National, Local)</p> <p>Air Pollution Control Act stipulates the (national) government shall endeavour to provide financial assistance, technical advice, other assistance.</p>
<p>Ability of local governments</p> <p>MEM and MONRE have established steering committees for CPPs.</p>
<p>Relation to local community</p> <p>Base on concession agreement for CPP.</p>
<p>Independent inspector</p> <p>Base on concession agreement for CPP.</p>

Detail of Emission Standards

(Relating to coal-fired power plants)

Lao PDR

Ambient Air Quality Standard

Parameters	Symbol	Average time unit (mg/m ³)					Method of measurement
		Hours			1 month	1 year	
		1hr	8hr	24hr			
Carbon monoxide	CO	30	10.26				Non-dispersive infrared detection
Nitrogen dioxide	NO ₂	0.32					Chemiluminescence method
Sulphur dioxide	SO ₂	0.78		0.30		0.10	UV Fluorescence (1hr, 24hr, 1yr) or Pararosaniline (1hr, 4hr)
Total suspended particulate	TSP	-		0.33		0.10	Gravimetric
Particulate matter less than 10 microns	PM ₁₀	-		0.12		0.05	Gravimetric of beta ray or taper element oscillating microbalance or dichotomous
Ozone	O ₃	0.20					Chemiluminescence or UV Absorption photometry
Lead	Pb				1.5		Atomic absorption spectrometer

Air Emission Standard for Power Plants

No.	Type of substances or pollutant	Source	Permitted emission value	
			ppm	mg/m ³
1	Sulphur dioxide	Coal or gas power plant	ppm	mg/m ³
		1. With the capacity of not more than 300 MW.	640	NA
		2. With the capacity above 300 MW, not more than 500 MW	450	NA
		3. With the capacity above 500 MW	320	NA
2	Sulphur dioxide	- Natural gas power plant	20	NA
3	Nitrogen oxides	Power plant generating electricity from:		
		1. Coal	350	NA
		2. Fuel	180	NA
		3. Natural gas	120	NA
4	Particulate substances	Power plant generating electricity from:		
		1. Coal	NA	120
		2. Fuel	NA	120
		3. Natural gas	NA	60

Malaysia

Regulation of Air Pollutants from Coal-fired Power Plants

(Blue letters: stipulated in law, green letters: actual situation)

Legislation

National (Federal, Central)

1. Environmental Quality Act 1974
2. Environmental Quality (Clean Air) Regulations 2014
 - a. Any premises used for any industrial or trade purpose, or on which matter is burnt in connection with any industrial or trade purposes including burning of waste, whether or not the premises are under section 18 of the act;
 - b. Any other premises or process that discharges or is capable of discharging air pollutants into the open air;
 - c. Any industrial plant; and
 - d. Any fuel burning equipment.
3. Environmental Quality (Clean Air) Regulations 2014
(Obligation to comply on or before the expiry of five years on which Regulations come into operation.)

Local (State, Municipality, District, City)

Not available

Regulated pollutants (relating to coal-fired power plants)

Environmental Quality (Clean Air) Regulations 2014

1. SO_x (SO₂ and SO₃)
2. NO_x (NO and NO₂)
3. Hydrogen chloride
4. Hydrogen fluoride
5. Carbon monoxide
6. Total PM
7. Mercury
8. PCDD/PCDF

Emission standards

Environmental Quality (Clean Air) Regulations 2014

Pollutant	Capacity	Limit value
SO _x	>10 MW _e	500 mg/m ³
NO _x	>10 MW _e	500 mg/m ³
HCl	>10–<100 MW _e	200 mg/m ³
HCl	≥100 MW _e	100 mg/m ³
HF	>10–<100 MW _e	30 mg/m ³
HF	≥100 MW _e	15 mg/m ³
CO	>10 MW _e	200 mg/m ³
PM	>10 MW _e	50 mg/m ³
Hg	>10 MW _e	0.03 mg/m ³
PCDD/PCDF	>10 MW _e	0.1 ng TEQ/m ³

How can authorities recognize the existence of facilities that emit air pollutants?

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.

Authority to suspend operation

Department of Environment (DOE)

Measurement of emission by operator

Malaysian Standards MS1596 or MS 1723 or the Methods published by United States Environmental Protection Agency or any other standards as determined by DOE.

Monitoring

Department of Environment (DOE)

Reporting

CEMS

Inspection

Department of Environment (DOE)

<p>Archive Requirement</p> <p>Environmental Quality (Clean Air) Regulations 2014:</p> <ul style="list-style-type: none"> The records shall be kept for at least 3 years.
<p>Public Announcements</p> <p>Announcement through official portal (website) of Department of Environment and newspapers Regular updates of Malaysian Air Pollutant Index (API)</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>
<p>Penalty</p> <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>Ability of local governments</p> <p>Any issue related to development in the specific local area including CPPs can be addressed by local government/council. However, all environmental compliance monitoring and enforcement activities are conducted by DOE through headquarters and state and branch offices.</p>
<p>Relation to local community</p> <p>Approval of the Detailed Environmental Impact Assessment (DEIA) is a mandatory requirement in the new coal-fired power plant development, being the prescribed activity under the Environment Quality (Prescribed Activities) (Environmental Impact Assessment) Order 1987. Potential impact to local community (both positive and negative) and planned interventions will be identified and assessed under DEIA.</p> <p>The law does not require a periodical meeting with the local community. However, community outreach programmes are usually performed by plant operators as part of their corporate social responsibility.</p>
<p>Independent inspector</p> <p>The law does not require independent inspector.</p>

Detail of Emission Standards

(Relating to coal-fired power plants)

Malaysia

Pollutant	Capacity	Limit value
SO _x	>10 MW _e	500 mg/m ³
NO _x	>10 MW _e	500 mg/m ³
HCl	>10—<100 MW _e	200 mg/m ³
HCl	≥100 MW _e	100 mg/m ³
HF	>10—<100 MW _e	30 mg/m ³
HF	≥100 MW _e	15 mg/m ³
CO	>10 MW _e	200 mg/m ³
PM	>10 MW _e	50 mg/m ³
Hg	>10 MW _e	0.03 mg/m ³
PCDD/PCDF	>10 MW _e	0.1 ng TEQ/m ³

Myanmar

Regulation of Air Pollutants from Coal-fired Power Plants

(Blue letters: stipulated in law, green letters: actual situation)

<p>Legislation</p> <p><u>National (Federal, Central)</u></p> <p>Environmental Conversation Law 2012 Environmental Conversation Rule 2014 National Environmental Quality (Emission) Guideline (2015) Environmental Impact Assessment Procedure 2015</p> <p><u>Local (State, Municipality, District, City)</u></p> <p>Environmental Conversation Law 2012 Environmental Conversation Rule 2014 National Environmental Quality (Emission) Guideline (2015) Environmental Impact Assessment Procedure 2015</p>
<p>Regulated pollutants (relating to coal-fired power plants)</p> <p>SO_x, NO_x, PM, CO, CO₂, TVOC (hydrocarbon), O₃, lead</p>
<p>Emission standards</p> <p>Details and describe in annexes 4, 5, and 6</p>
<p>How can authorities recognize the existence of facilities that emit air pollutants?</p> <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. If it is not practical, it shall arrange to dispose the waste in accordance with an environmentally-sound method.</p>
<p>Authority to suspend operation</p> <p>The ministry shall, if the person obtained the prior permission who was impose with administrative penalty under section 25 fails to comply with the terms and conditions, inform the relevant government department, government organization authorized to issue licence, permit, or register for the relevant business, work-site or factory, work shop to enable to take action as may be necessary. The government department, government organization that received information under subsection(a) may, after making necessary inquiries, if it is found that any terms and conditions of environmental conservation contained in the prior permission is not complied with, cancel the issued licence, permit or register or suspend it for a limited period.</p>

<p>Measurement of emission by operator</p> <p>National Environmental Quality (Emission) Guideline (2015)</p>
<p>Monitoring</p> <p>The ministry and state and regional government shall continuously monitor the status of air pollution. The owner or occupiers of any business have the duty to monitor the environmental pollution.</p>
<p>Reporting</p> <p>The project proponent shall submit monitoring report to the ministry not less frequently than every 6 months, as provided in a schedule in the EMP, or periodically as prescribed by the ministry.</p> <p>The monitoring reports shall include:</p> <ul style="list-style-type: none"> (a) documentation of compliance with all conditions; (b) progress made to date on implementation of EMP against the submitted implementation schedule; (c) difficulties encountered in implementing the EMP and recommendations for remedying those difficulties and steps proposed to prevent or avoid similar future difficulties; (d) number and type of non-compliance with the EMP and proposed remedial measure and timelines for completion of remediation; (e) accidents or incidents relating to the occupational and community health and safety, and the environment; and (f) monitoring data of environmental parameters and conditions as committed in the EMP or otherwise required. <p>Ministry of Electricity and Energy shall require operator to report the status of air pollutant emissions.</p>
<p>Inspection</p> <p>Screening team that is organized by the Ministry inspect frequently. Inspection team that is organized by the relevant ministries and/or organizations.</p>
<p>Archive Requirement</p> <p>Generally, coal-fired power plant operator keeps the important data permanently in paper and electronic files.</p>
<p>Public Announcements</p> <p>Coal-fired power plant publish the status of air pollution at LED screen board in front of power plant. (example of Tigyit Coal-fired Thermal Power Plant)</p>

Compensation for Damage and Losses		
Non-compliance	Penalties	Specific administrative punishment of the ministry
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	US\$2,500 to US\$10,000 or equivalent Myanmar kyats	-Issue Enforcement Notice -Suspension of approval of EMP, EMP-CP, or EMP-OP in whole or in part -Revocation of approval of EMP, EMP-CP or EMP-OP in whole or in part
<p>Penalty Environmental Offences and Penalties</p>		
<p>Assistance (National, Local) The (national) government shall endeavour to provide technical advice, other assistance.</p>		
<p>Ability of local governments State and regional governments participate in public consultation, monitoring, inspection, and meeting with residents.</p>		
<p>Relation to local community The law does not appear to require periodical meetings with local community. Ministry and operator to hold a stakeholder meeting and public hearing with residents for explanation and discussion of the situation of coal-fired power plant.</p>		
<p>Independent inspector The law does not appear to require an independent inspector.</p>		

Detail of Emission Standards

(Relating to coal-fired power plants)

Myanmar

Parameter	Unit	Guideline value
Coal preparation plant		
Conveying, storage, and preparation, gas opacity	%	10
Pneumatic coal cleaning equipment opacity	%	10
Pneumatic coal cleaning equipment particulate	mg/Nm ^{3a}	40
Thermal dryer gas opacity	%	20
Thermal dryer gas particulate	mg/Nm ³	70
Ammonia	mg/Nm ³	30
Carbonyl sulfide + carbon disulfide	mg/Nm ³	3
Heavy metals(total)	mg/Nm ³	1.5
Hydrogen sulphide	mg/Nm ³	10
Mercury	mg/Nm ³	1
Nitrogen oxides	mg/Nm ³	200–400 ^b
Particulate matter PM ₁₀ ^c	mg/Nm ³	30–50 ^b
Sulfide dioxide	mg/Nm ³	150–200 ^b
Volatile organic compound	mg/Nm ³	150

^a Milligrams per normal cubic meter at specified temperature and pressure.

^b Lower value for plants of >100 MW thermal equivalent, higher value for plants of <100 MW thermal equivalent.

^c Particulate matter 10 micrometres or less in diameter.

Thailand

Regulation of Air Pollutants from Coal-fired Power Plants

(Blue letters: stipulated in law, green letters: actual situation)

Legislation

National (Federal, Central)

Environmental Act

Factory Act

There is no conflict between two acts.

Ministry of environment and Ministry of Industry work with collaboration usually.

Local (State, Municipality, District, City)

The law gives local governments power to establish own emission standard.

But no local government has set own emission standards to date.

Regulated pollutants (relating to coal-fired power plants)

PM, SO₂, NO_x

How can authorities recognize the existence of facilities that emit air pollutants?

Power plants with capacity between 10MW and 100MW are required to have an Environmental Impact Assessment (EIA)

Power plants with capacity 100MW and more are required to have an Environmental and Health Impact Assessment (EHIA)

Emission permit: not to exceed national standard

Authority to suspend operation

Ministry of Industry has power to order suspend CPP operation partially or fully.

20 years ago, Mae Moh CPP was ordered to reduce emissions.

Measurement of emission by operator

Licensed third party selected by operators check emission data twice a year.

Monitoring station: 5 km away from CPP, monitored pollutants: PM and SO₂

Operators should send emission monitoring data to Ministry of Industry with automatic method.

Monitoring

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 the power to check emission data, but this rarely occurs.

Reporting

Twice a year

Inspection

Department of Estate, Ministry of Industry inspects every industry plant.

In case of a large CPP, there is no site visit.

In case of severe accident, Ministry of Environment inspects.

Local government has the power to inspect, but there has been no case to date.

Archive Requirement

The law does not require keeping archives.

Public Announcements

Operators' annual report.

Local government does not publish emission data.

During coal transportation by truck, dust is emitted, which is more problematic than air pollution by CPP in Thailand.

Compensation for Damage and Losses

Central government requires CPP to pay compensation, but there is no case.

(It is difficult to find a responsibility of air pollution and evaluate damage and losses.)

Operators pay damages and losses voluntarily, i.e. hospital expense, medical examination, etc.

Penalty

Industry Act.

Ministry of Industry can pose fines, maximum B200,000.

Assistance (National, Local)

When a regulation is enhanced, the central government holds a meeting with stakeholders before amendment.

Ability of local governments

There is an expert at the local university.

Relation to local community

Regular meeting between CPP and residents is held every 3 months.

Independent inspector

Independent inspector is not required.

Detail of Emission Standards

(Relating to coal-fired power plants)

Thailand

Type and Size of Power Plant	Emission standard		
	(PM) (mg/m ³)	(SO ₂) (ppm)	(NO _x) (ppm)
New Power Plant (since 15 January 2010)			
1. Power Plant Size < 50 MW	80	360	200
2. Power Plant Size > 50MW	80	360	200
Power Plant (31 January 1996–15 January 2010)			
1. Power Plant Size > 500 MW	120	320	350
2. Power Plant Size 300–500 MW		450	
3. Power Plant Size < 300 MW		640	
Existing Power Plant (before 31 January 1996)			
1. Mae Moh			
Unit 1–3	180	1300	500
Unit 4–7	180	320	500
Unit 8–13			
Total SO ₂ Loading of Mae Moh Unit 1–13 shall not be more than 11 ton/hr			
2. Other Power Plant	320	700	400

Annex 4

SOx Regulations

1. Selected OECD countries

Australia

(A) National⁵

The current standards and goals for the Ambient Air Quality NEPM (National Environment Protection Measure)

Pollutant	Averaging period	Maximum concentration standard	Maximum allowable exceedances
SO ₂	1 hour	0.20 ppm	1 day a year
	1 day	0.08 ppm	1 day a year
	1 year	0.02 ppm	None

The National Guidelines for Control of Emission of Air Pollutants from New Stationary Sources 1985

Pollutant	Plant type	Emission limits (mg/m ³)
sulphuric acid mist and sulphur trioxide (as SO _x)	fuel-burning equipment sulphuric acid plants or plants producing sulphur trioxide	200 (expressed as SO ₃) 0.075 kg/t of 100% acid or equivalent

(B) (Example of State) New South Wales (NSW)⁶

Schedule 4 Standards of concentration for scheduled premises: general activities and plant

General standards of concentration

Air impurity	Activity or plant	Standard of concentration	
SO ₃	Any activity or plant	Group 1	200 mg/m ³
		Group 2, 3, 4, 5 or 6	100 mg/m ³

An activity carried out, or plant operated

Group 1: Before 1 January 1972

Group 2: After 1 January 1972 and before 1 July 1979

Group 3: After 1 July 1979 and before 1 July 1986

Group 4: After 1 July 1986 and before 1 August 1997

⁵ Source: IEA Clean Coal Centre.

⁶ Source: Outline of Protection of the Environment Operations (Clean Air) Regulation 2010.

Group 5: After 1 August 1997 and before 1 September 2005

Group 6: After 1 September 2005

Germany⁷

Emission limit values for coal combustion plants in German legislation: TA-Luft 2002

Applicable to plants with a thermal input of less than 50 MW

Pollutant	Plant size (MWth)	Daily emission limit value (mg/m ₃)
SO ₂ (SO ₂ + SO ₃)	All	1300 (for hard coal)
	All	1000 (other fuels)
	All	3501 (fluidised bed combustion)

Applicable to new plants (in operation after 7 January 2014) with a thermal input of 50 MW or more.

Pollutant	Plant size (MWth)	Emission limit value (mg/m ³)		
		Daily mean value	Half-hourly mean value	Annual mean value
SO _x (SO ₂ + SO ₃)	50-100	400	800	
		350 (fluidised bed)	700 (fluidised bed)	
	>100-300	200	400	
	>300	150	300	
		200 (circulating or pressurised fluidised bed)	400 (circulating or pressurised fluidised bed)	

Applicable to existing plants (in operation before 7 January 2014) with a thermal input of 50 MW or more.

Pollutant	Plant size (MWth)	Emission limit value (mg/m ³)		
		Daily mean value	Half-hourly mean value	Annual mean value
SO _x (SO ₂ + SO ₃)	50-100	400	800	
		350 (fluidised bed)	700 (fluidised bed)	
	>100-300	200	400	
	>300	150	300	
		200	400	

⁷ Source: IEA Clean Coal Centre.

Japan

(A) Air Pollution Control Act

$$q = K * 10^{-3} * He^2$$

q: Maximum permissible limit of SO_x (m³N/h)

He: Adjusted height of the Outlet (m)

K: Area of classification

General regulation K: from 3.0 to 17.5

Special regulation (new construction, specified area) K: from 1.17 to 2.34

$$He = Ho + 0.65 (Hm + Ht)$$

$$Hm = 0.795V(Q*V) / \{1 + (2.58/V)\}$$

$$Ht = 2.01 * 10^{-3} * Q * (T - 288) * \{2.30 \log J + (1/J) - 1\}$$

$$J = (1/V(Q*V)) [1460 - 296 * \{V/(T - 288)\}] + 1$$

He Adjusted height of the Outlet (m)

Ho Actual height of the Outlet (m)

Q Quantity of emission at 15°C (m³/s)

V Discharge rate of emission (m/s)

T Temperature of emission (absolute temperature)

(B) Life environment relevant ordinance (Yokohama City)

Sulphur content in emissions: 4 SO₂ equivalent grams/1 fuel oil equivalent kg combustion

Republic of Korea

Air Pollution Control Act

- Established before 1996: 100ppm (O₂: 6%)
- Established before 2014: 80ppm (O₂: 6%)
- Established after 2015: 50ppm (O₂: 6%)

Voluntary (Operators of new CPP)

- In-cheon: 20 to 25ppm (O₂: 6%)
- Dang-gin: 40ppm (O₂: 6%)
- Yeou-su: 30 ppm (O₂: 6%)

United States

(A) 40 CFR part 50 (air quality)

Pollutant	Primary/ Secondary	Averaging time	Level	Form
SO ₂	primary	1 hour	75 ppb	99th percentile of 1-hour daily maximum concentrations, averaged over 3 years
	secondary	3 hours	0.5 ppm	Not to be exceeded more than once per year

Primary standards provide public health protection, including protecting the health of "sensitive" populations such as asthmatics, children, and the elderly. **Secondary standards** provide public welfare protection, including protection against decreased visibility and damage to animals, crops, vegetation, and buildings.

(B) 40 CFR part 60 subpart Da (stationary source)

Applicability:

That is capable of combusting more than 73 MW (250 MMBtu/hr) heat input of fossil fuel.

	SO ₂
1971–1978	520 ng/J heat input
Sep 1978–1997	520 ng/J heat input and 90% reduction (or 70% reduction where <260 ng/J)
1978 Mar 2005	180 ng/J gross output 65 ng/J heat input
Commenced construction: Mar 2005–May 2011	180 ng/J gross output 95% reduction
Commenced reconstruction: Mar 2005–May 2011	180 ng/J gross output 65 ng/J heat input 95% reduction
Modified: Mar 2005–May 2011	180 ng/J gross output 65 ng/J heat input 90% reduction
Construction or reconstruction after: 3 May 2011	130 ng/J gross energy output 140 ng/J net energy output 97% reduction
Modified after: 3 May 2011	180 ng/J gross output 90% reduction

2. ASEAN countries, China, and India

Cambodia⁸

<u>Emission</u>	Unit	Cambodian standard	World Bank standard
Sulphur Dioxide (SO ₂) Dry, 0 °C, 1atm, 6% O ₂	mg/Nm ³	500	2000

China⁹

Emission standards for air pollutants from coal-fired power plants (GB13223-2011)

GB13223-2011 came into force on 1 January 2012, replacing GB13223-2003

Pollutant	Application	Emission limit value	Location of monitoring and emission control
SO ₂ , mg/m ³	New boilers	100	Stack and flue
		200 ^a	
	Existing boilers	200	
		400 ^a	

^a Emission limits apply to plants in Guangxi Zhuang Autonomous Region, Chongqing Municipality, Sichuan Province, and Guizhou Province.

Special air pollutant emission control requirements for key regions

Coal-fired power plants located within the key regions should meet the special emission limit values in the following table. The key regions include Beijing City, Tianjin City, Hebei Province, Yangzi River Delta, Pearl River Delta, Central Liaoning Province, Shandong Province, Wuhan City and surrounding areas, Changsha City, Zhuzhou City, Xiangtan City, Chengdu and Chongqing City, coastal areas of Fujian Province, Central and Northern Shanxi Province, Guanzhong Region of Shaanxi Province, Gansu Province, Ningxia Province, and Wulumuqi (Ürümqi, Xinjiang Uyghur Autonomous Region).

Pollutant	Application	Emission limit value	Location of monitoring and emission control
SO ₂ , mg/m ³	all	50	Stack and flue

⁸ Source: WG member

⁹ Source: IEA Clean Coal Centre

India¹⁰

(A) Stack heights for thermal power plants

Power generation capacity (MW)	Height (m)
<200/210	$H=14(Q)^{0.3}$ where Q is the emission rate of SO ₂ in kg/h and H is the stack height in metres
≥200/210–<500	220
≥500	275
Steam generating capacity, t/h	Height, m
<2	half times the neighbouring building height or 9 m (whichever is more)
>2–5	12
>5–10	15
>10–15	18
>15–20	21
>20–25	24
>25–30	27
>30	30 or $H = 14(Q)^{0.3}$ where Q is the emission rate of SO ₂ in kg/h and H is the stack height in metres (whichever is more)

(B) National Ambient Air Quality Standards

Pollutant	Time weighted average	Concentration in ambient air		Measurement method
		Industrial, residential, rural and other areas	Ecologically sensitive area (notified by central government)	
SO ₂ , µg/m ³	Annual	50	20	improved West and Gaeke ultraviolet fluorescence
	24 hours	80	80	

¹⁰ Source: IEA Clean Coal Centre

Indonesia¹¹

Static Emission Sources Quality Standard for CPP

Parameter	Maximum level (mg/Nm ³)	
	A	B
Sulphur Dioxide (SO ₂)	750	750

A. For CPP in operation before 1 December 2008.

B. For CPP in operation after 1 December 2008.

Notes:

- Gas volume is measured under standard condition (25°C and 1 atm).
- Opacity is used as a practical indicator for monitoring.
- All parameters corrected by O₂: 7 %
- For CPP with CEMS installed, the imposition of emission quality standard is for 95% of normal operation time for 3 months.

Lao PDR¹²

(A) Ambient Air Quality Standard

Pollutant	Average time unit: mg/m ³					Method of measurement
	Hours			1 month	1 year	
	1 hr	8 hr	24 hr			
SO ₂	0.78	-	0.30	-	0.10	UV Fluorescence (1 hr, 24 hr, 1 yr) or Pararosaniline (1 hr, 4 hr)

(B) Air Emission Standard for Power Plants

Pollutant	Source	Permitted emission value	
		ppm	mg/m ³
SO ₂	Coal or Gas Power Plant		
	1. With the capacity of not more than 300 MW	640	
	2. With the capacity above 300 MW, not more than 500 MW	450	
	3. With the capacity above 500 MW	320	

¹¹ Source: WG Member.

¹² Source: WG Member.

Malaysia¹³

Environmental Quality (Clean Air) Regulations 2014

Pollutant	Capacity	Limit value
SO _x	>10 MW _e	500 mg/m ³

Myanmar¹⁴

Air Emission Level

Pollutant	Unit	Guideline value
SO ₂	Mg/Nm ³	150-200

Lower value for plants of > 100 MW thermal equivalent, higher value for plants of <100 MW thermal equivalent.

Philippines¹⁵

National Emission Standards for Sulphur Oxides for Stationary Sources (DENR Administrative Order No. 2000 - 81, 7 Nov 2000)

	Existing source		New source	
	fuel burning equipment	other source	fuel burning equipment	other source
emission limit, mg/m ³	1500 as SO ₂	1000 as SO ₃	700 as SO ₂	200 as SO ₃

Singapore¹⁶

Environmental Protection and Management (Air Impurities) Regulations (effective from 1 Jan 2001, as revised in 2002 and 2008)

Standards for air pollutants emissions from stationary sources

Pollutant	Plant type	Emission limit value, mg/m ³
SO ₂	any trade, industry or process (non-combustion sources)	500

The emissions of sulphur dioxide into the air from fuel combustion are controlled by limiting the sulphur content in fuels used by industries to not more than 1% by weight. Industries sited near urban areas are required to use fuel with a lower sulphur content.

¹³ Source: WG Member.

¹⁴ Source: WG Member.

¹⁵ Source: IEA Clean Coal Centre.

¹⁶ Source: IEA Clean Coal Centre.

Thailand¹⁷

(1) Emission standard from coal-fired power plants

(A) New Power Plant (since 15 January 2010)

Pollutant	Power plant size	Unit	Emission standard
SO ₂	<50 MW	ppm	360
	>50 MW	ppm	180

Notification of the Ministry of Natural Resources and Environment published in the Royal Government Gazette, Vol.127 Part 7, 15 January 2553 (2010).

(B) Power Plant (31 January 1996 – 15 January 2010)

Pollutant	Power Plant Size	Unit	Emission standard
SO ₂	>500 MW	ppm	320
	300-500 MW	ppm	450
	<300 MW	ppm	640

Notification of the Ministry of Science, Technology and Environment published in the Royal Government Gazette, Vol.113 Part 9, page 220, 30 January 2539 (1996).

(C) Mae Moh Power Plant

Pollutant	Power Unit	Unit	Emission Standard
SO ₂	Unit 1–3	ppm	1300
	Unit 4–7	ppm	320
	Unit 8–13	ppm	300
	Unit 1–13	Total SO ₂ Loading not exceed 11 tons/hour	

Notification of the Ministry of Science, Technology and Environment No.3, B.E.2544 (2001), 29 January B.E.2544 (2001), published in the Royal Government Gazette, Vol.118 special Part 24, 16 March B.E.2544 (2001).

(2) Ambient Air Standards

Pollutant	Average	Emission Standard
SO ₂	1 year	Not exceed 0.04 ppm (0.10 mg/m ³)
	24 hr	Not exceed 0.12 ppm (0.30 mg/m ³)
	1 hr	Not exceed 0.3 ppm (780 µg /m ³)

Notification of National Environmental Board No.10, B.E.2538 (1995) under the Enhancement and Conservation of National Environmental Quality Act B.E.2535 (1992), published in the Royal Gazette No.112 Part 52, 25 May B.E.2538 (1995).

Notification of National Environmental Board No.24, B.E.2547 (2004) under the Enhancement and Conservation of National Environmental Quality Act B.E.2535 (1992), published in the Royal Gazette No.121 Part 104 D, 22 September B.E.2547 (2004).

¹⁷ Source: WG Member.

Viet Nam

Emission standards for thermal power plants were released on 16 November 2009

Vietnam's standards are based on the size of operation and location of the facility. The relevant emission standard for a pollutant is calculated using the following formula:

$$\text{Emission limit in mg/m}^3 = C \times K_p \times K_v$$

where C is the concentration parameter

K_p is the power plant size coefficient

K_v is the region coefficient.

Pollutant	Concentration parameter, mg/Nm ³	
	Existing plants operating before 17 October 2007 and valid until 31 December 2014	Plants operating since 17 October 2007 and all plants after 1 January 2015
SO ₂	1500	500

Power plant size, MW	K_p coefficient
$P \leq 300$	1.0
$300 < P \leq 1200$	0.85
$P > 1200$	0.7

Zoning area	K_v coefficient
cities, historic, cultural or natural heritage	0.6
inner city and urban suburbs	0.8
industrial zones, suburbs, and outskirts	1.0
rural	1.2
rural mountains	1.4

Annex 5

NO_x Regulations

1. Selected OECD countries

Australia

(A) National¹⁸

The current standards and goals for the Ambient Air Quality NEPM (National Environment Protection Measure)

Pollutant	Averaging period	Maximum concentration standard	Maximum allowable exceedances
NO ₂	1 hour	0.12 ppm	1 day a year
	1 year	0.03 ppm	None

The National Guidelines for Control of Emission of Air Pollutants from New Stationary Sources 1985

Pollutant	Plant type	Emission limits, mg/m ³
Nitrogen oxides (as NO ₂)	power generating boiler >30 MWe	800
	power generating boiler <30 MWe	500
	industrial steam boiler	500

(B) (Example of State) New South Wales (NSW)¹⁹

Schedule 3 Standards of concentration for scheduled premises: activities and plant used for specific purposes

Emission standards for NO_x

Industry	Activity or plant	Standard of concentration	
		Group	Standard
Power generation	boiler, operating on fuel other than gas, including one used in connection with an electricity generating system with a capacity of ≥30 MW	Group 1, 2, 3, or 4	2500 mg/m ³
		Group 5	800 mg/m ³
		Group 6	500 mg/m ³

¹⁸ Source: IEA Clean Coal Centre.

¹⁹ Source: Outline of Protection of the Environment Operations (Clean Air) Regulation 2010.

An activity carried out, or plant operated

Group 1: Before 1 January 1972

Group 2: After 1 January 1972 and before 1 July 1979

Group 3: After 1 July 1979 and before 1 July 1986

Group 4: After 1 July 1986 and before 1 August 1997

Group 5: After 1 August 1997 and before 1 September 2005

Group 6: After 1 September 2005

Germany²⁰

Emission limit values for coal combustion plants in German legislation: TA-Luft 2002

Applicable to plants with a thermal input of less than 50 MW

Pollutant	Plant size, MWth	Daily emission limit value, mg/m ₃
NO _x (NO + NO ₂)	≥10	400
	<10	500
	all	300 (fluidised bed combustion)

Applicable to new plants (in operation after 7 January 2014) with a thermal input of 50 MW or more.

Pollutant	Plant size MWth	Emission limit value (ELV), mg/m ³		
		Daily mean value	Half-hourly mean value	Annual mean value
NO _x (NO + NO ₂)	50–100	300	600	250
		400 (pulverised lignite)	800 (pulverised lignite)	250
	>100–300	200	400	100
		150	400	100
	>300	200 (pulverised lignite)	300	100
		400 (pulverised lignite)	400 (pulverised lignite)	

²⁰ Source: IEA Clean Coal Centre.

Applicable to existing plants (in operation before 7 January 2014) with a thermal input of 50 MW or more.

Pollutant	Plant size MWth	Emission limit value (mg/m ³)		
		Daily mean value	Half-hourly mean value	Annual mean value
NO _x (NO + NO ₂)	50–100	300	600	
		400 (pulverised lignite)	800 (pulverised lignite)	
	>100–300	200		
	>300	200	400 400	

Japan

(A) Air Pollution Control Act

200ppm (O₂: 6%)

(B) Life environment relevant ordinance (Yokohama City)

NO₂: 100ppm

NO_x: 200ppm

Republic of Korea

Air Pollution Control Act

- Established before 1996: 140ppm (O₂: 6%)
- Established after 1996: 70ppm (O₂: 6%)
- Established after 2015: 50ppm (O₂: 6%)

Voluntary (Operators of new CPP)

- In-cheon: 15ppm (O₂: 6%)
- Dang-gin: 50ppm (O₂: 6%)
- Yeou-su: 30 ppm (O₂: 6%)

United States

(A) 40 CFR part 50 (air quality)

Pollutant	Primary/ secondary	Averaging time	Level	Form
NO ₂	primary	1 hour	100 ppb	98th percentile of 1-hour daily maximum concentrations, averaged over 3 years
	primary and secondary	1 year	53 ppb	Annual Mean

Primary standards provide public health protection, including protecting the health of ‘sensitive’ populations such as asthmatics, children, and the elderly. **Secondary standards** provide public welfare protection, including protection against decreased visibility and damage to animals, crops, vegetation, and buildings.

(B) 40 CFR part 60 subpart Da (stationary source)

Applicability:

That is capable of combusting more than 73 MW (250 MMBtu/hr) heat input of fossil fuel.

	NO _x
1971–1978	300 ng/J heat input
Sep 1978–1997	subbituminous: 210 ng/J heat input; other coal types: 260 ng/J heat input
1978–Mar 2005	New plant: 200 ng/J gross output; Reconstructed: 65 ng/J heat input
Commenced construction: Mar 2005–May 2011	130 ng/J gross output
Commenced reconstruction: Mar 2005–May 2011	130 ng/J gross output; 47 ng/J heat input
Modified: Mar 2005–May 2011	180 ng/J gross output; 65 ng/J heat input
Construction or reconstruction after: 3 May 2011	88 ng/J gross output; 95 ng/J net output
Modified after: 3 May 2011	140 ng/J gross output

2. ASEAN countries, China, and India

Cambodia²¹

Emission	Unit	Cambodian standard	World Bank standard
Nitrogen Oxide (NO ₂) Dry, 0 °C, 1atm, 6% O ₂	mg/Nm ³	1000	750

China²²

Emission standards for air pollutants from coal-fired power plants (GB13223-2011)

GB13223-2011 came into force on 1 January 2012, replacing GB13223-2003

Pollutant	Application	Emission limit value	Location of monitoring and emission control
NO _x (as NO ₂), mg/m ³	all	100	stack and flue
		200 ^a	

^a Emission limit applies to arch fired furnaces, existing Circulating Fluidized Bed (CFB) power generating boilers, and power generating boilers commissioned or which received approval for construction before 31 December 2003.

Special air pollutant emission control requirements for key regions

Coal-fired power plants located within the key regions should meet the special emission limit values in the following table. The key regions include Beijing City, Tianjin City, Hebei Province, Yangzi River Delta, Pearl River Delta, Central Liaoning Province, Shandong Province, Wuhan City and surrounding areas, Changsha City, Zhuzhou City, Xiangtan City, Chengdu and Chongqing City, coastal areas of Fujian Province, Central and Northern Shanxi Province, Guanzhong Region of Shaanxi Province, Gansu Province, Ningxia Province, and Wulumuqi (Ürümqi, Xinjiang Uyghur Autonomous Region).

Pollutant	Application	Emission limit value	Location of monitoring and emission control
NO _x (as NO ₂), mg/m ³	all	100	Stack and flue

²¹ Source: WG member.

²² Source: IEA Clean Coal Centre.

India²³

(A) National Ambient Air Quality Standards

Pollutant	Time-weighted average	Concentration in ambient air		Measurement method
		Industrial, residential, rural, and other areas	Ecologically sensitive area (notified by Central Government)	
NO ₂ , µg/m ³	Annual	40	30	modified Jacob & Hochheiser (Na-Arsenite) chemiluminescence
	24 hours	80	80	

Indonesia²⁴

Static Emission Sources Quality Standard for CPP

Parameter	Maximum level (mg/Nm ³)	
	A	B
Nitrogen oxide (NO _x) stated as NO ₂	850	750

A. For CPP that have been operated before 1 December 2008;

B. For CPP that have been operated after 1 December 2008.

Notes:

- a. Gas volume is measured under standard condition (25°C and 1 atm).
- b. Opacity is used as a practical indicator for monitoring.
- c. All parameters corrected by O₂: 7 %
- d. For CPP with CEMS installed, the imposition of emission quality standard is for 95% of normal operation time for 3 months.

²³ Source: IEA Clean Coal Centre.

²⁴ Source: WG Member.

Lao PDR²⁵

(A) Ambient Air Quality Standard

Pollutant	Average time unit: mg/m ³					Method of measurement
	Hours			1 month	1 year	
	1 hr	8 hr	24 hr			
NO ₂	0.32	-	-	-	-	chemiluminescence method

(B) Air Emission Standard for Power Plants

Pollutant	Source	Permitted emission value	
Oxide of Nitrogen	Power plant generating electricity from:	ppm	mg/m ³
	1. Coal	350	

Malaysia²⁶

Environmental Quality (Clean Air) Regulations 2014

Pollutant	Capacity	Limit value
NO _x	>10 MW _e	500 mg/m ³

Myanmar²⁷

Air Emission Level

Pollutant	Unit	Guideline Value
Nitrogen oxides	Mg/Nm ³	200-400

Lower value for plants of > 100 MW thermal equivalent, higher value for plants of <100 MW thermal equivalent.

Philippines²⁸

National Emission Standards for Nitrogen Oxides for Stationary Sources (DENR

Administrative Order No. 2000 - 81, 7 Nov 2000)

	Existing source		New source	
	fuel burning equipment	other source	fuel burning equipment	other source
Emission limit, mg/m ³	1500 as NO ₂	1000 as NO ₂	1000 as NO ₂	500 as SO ₂

²⁵ Source: WG Member.

²⁶ Source: WG Member.

²⁷ Source: WG Member.

²⁸ Source: IEA Clean Coal Centre.

Singapore²⁹

Environmental Protection and Management (Air Impurities) Regulations (effective 1 Jan 2001, as revised in 2002 and 2008)

Standards for air pollutants emissions from stationary sources

Pollutant	Plant type	Emission limit value, mg/m ³
NOx as NO ₂	any trade, industry, process, or fuel burning equipment	700

Thailand³⁰

(1) Emission standard from coal-fired power plants

(A) New Power Plant (since 15 January 2010)

Pollutant	Power Plant Size	Unit	Emission standard
NOx as NO ₂	<50 MW	ppm	200
	>50 MW	ppm	200

Notification of the Ministry of Natural Resources and Environment published in the Royal Government Gazette, Vol.127 Part 7, 15 January B.E.2553 (2010).

(B) Power Plant (31 January 1996–15 January 2010)

Pollutant	Unit	Emission standard
NOx as NO ₂	ppm	350

Notification of the Ministry of Science, Technology and Environment published in the Royal Government Gazette, Vol.113 Part 9, page 220, 30 January B.E.2539 (1996).

(C) Mae Moh Power Plant

Pollutant	Power Unit	Unit	Emission standard
NO ₂	Unit 1-3	ppm	500
	Unit 4-7	ppm	500
	Unit 8-13	ppm	500

Notification of the Ministry of Science, Technology and Environment No.3, B.E.2544 (2001) 29 January B.E.2544 (2001), published in the Royal Government Gazette, Vol.118 special Part 24, 16 March B.E.2544 (2001).

²⁹ Source: IEA Clean Coal Centre.

³⁰ Source: WG Member.

(2) Ambient Air Standards

Pollutant	Average	Emission standard
NO ₂	1 year	Not exceed 0.17 ppm (0.32 mg/m ³)
	1 hr	Not exceed 0.03 ppm (0.057 mg/m ³)

Notification of National Environmental Board No.10, B.E.2538 (1995) under the Enhancement and Conservation of National Environmental Quality Act B.E.2535 (1992), published in the Royal Gazette No.112 Part 52, 25 May B.E.2538 (1995).

Notification of National Environmental Board No.24, B.E.2547 (2004) under the Enhancement and Conservation of National Environmental Quality Act B.E.2535 (1992), published in the Royal Gazette No.121 Part 104 D, 22 September B.E.2547 (2004).

Viet Nam

Emission standards for thermal power plants were released on 16 November 2009. Viet Nam's standards are based on the size of operation and location of the facility. The relevant emission standard for a pollutant is calculated using the following formula:

$$\text{Emission limit in mg/m}^3 = C \times K_p \times K_v$$

where C is the concentration parameter

K_p is the power plant size coefficient

K_v is the region coefficient.

Pollutant	Concentration parameter, mg/Nm ³	
	Existing plants operating before 17 October 2007 and valid until 31 December 2014	Plants operating since 17 October 2007 and all plants after 1 January 2015
NO _x (as NO ₂)	1000	650 with coal volatile content >10% 1000 with coal volatile content ≤10%

Power plant size, MW	K _p coefficient
P ≤ 300	1.0
300 < P ≤ 1200	0.85
P > 1200	0.7

Zoning area	Kv coefficient
cities, historic, cultural, or natural heritage	0.6
inner city and urban suburbs	0.8
industrial zones, suburbs, and outskirts	1.0
rural	1.2
rural mountains	1.4

Annex 6

PM Regulations

1. Selected OECD countries

Australia

(A) National³¹

The current standards and goals for the Ambient Air Quality National Environment Protection Measure (NEPM)

Pollutant	Averaging period	Maximum concentration standard	Maximum allowable exceedances
PM ₁₀	1 day	50 µg /m ³	None
	1 year	25 µg /m ³	None
PM _{2.5}	1 day	25 µg /m ³	None
	1 year	8 µg /m ³	None

The advisory reporting standards and goals for PM_{2.5} are:

Pollutant	Averaging period	Maximum concentration
NO _{2.5}	1 day	20 µg/m ³ by 2025
	1 year	7 µg /m ³ by 2025

The review was completed in 2011.

The National Guidelines for Control of Emission of Air Pollutants from New Stationary Sources 1985

Pollutant	Plant type	Emission limits, mg/m ³
Particulate	power plant boiler	80
	other coal-burning boiler	250
	any other trade, industry process, industrial plant, or fuel-burning equipment	250

³¹ Source: IEA Clean Coal Centre.

(B) (Example of State) New South Wales (NSW)³²

Schedule 3 Standards of concentration for scheduled premises: activities and plant used for specific purposes

Emission standards for particulates

Air impurity	Activity or plant	Standard of concentration	
PM	Any activity or plant using a liquid or solid standard fuel or a non-standard fuel	Group 1	400 mg/m ³
		Group 2, 3, or 4	250 mg/m ³
		Group 5	100 mg/m ³
		Group 6	50 mg/m ³

An activity carried out, or plant operated

Group 1: Before 1 January 1972

Group 2: After 1 January 1972 and before 1 July 1979

Group 3: After 1 July 1979 and before 1 July 1986

Group 4: After 1 July 1986 and before 1 August 1997

Group 5: After 1 August 1997 and before 1 September 2005

Group 6: After 1 September 2005

Germany³³

Emission limit values for coal combustion plants in German legislation: TA-Luft 2002

Applicable to plants with a thermal input of less than 50 MW

Pollutant	Plant size, MWth	Daily emission limit value, mg/m ³
Dust	≥5	20
	<5	50

Applicable to new plants (in operation after 7 January 2014) with a thermal input of 50 MW or more.

Pollutant	Plant size, MWth	Emission limit value (ELV), mg/m ³		
		Daily mean value	Half-hourly mean value	Annual mean value
Dust	all >300	10	20	10

³² Source: Outline of Protection of the Environment Operations (Clean Air) Regulation 2010.

³³ Source: IEA Clean Coal Centre.

Applicable to existing plants (in operation before 7 January 2014) with a thermal input of 50 MW or more.

Pollutant	Plant size, MWth	Emission limit value (ELV), mg/m ³		
		Daily mean value	Half-hourly mean value	Annual mean value
Dust	all >300	20	40	10

Japan

(A) Air Pollution Control Act

100mg/m³_N (O₂: 6%)

(B) Life environment relevant ordinance (Yokohama City)

0.05g/m³_N

Republic of Korea

Air Pollution Control Act

- Established before 2001: 25mg/Sm³ (O₂: 6%)
- Established after 2001: 20mg/Sm³ (O₂: 6%)
- Established after 2015: 10mg/Sm³ (O₂: 6%)

Voluntary (operators of new CPP)

- In-cheon: 5mg/Sm³ (O₂: 6%)
- Yeou-su: 8mg/Sm³ ppm (O₂: 6%)

United States

(A) 40 CFR part 50 (air quality)

Pollutant		Primary/ Secondary	Averaging time	Level	Form
PM	PM _{2.5}	primary	1 year	12.0 µg/m ³	annual mean, averaged over 3 years
		secondary	1 year	15.0 µg/m ³	annual mean, averaged over 3 years
		primary and secondary	24 hours	35 µg/m ³	98th percentile, averaged over 3 years
	PM ₁₀	primary and secondary	24 hours	150 µg/m ³	Not to be exceeded more than once per year on average over 3 years

Primary standards provide public health protection, including protecting the health of ‘sensitive’ populations such as asthmatics, children, and the elderly. **Secondary standards** provide public welfare protection, including protection against decreased visibility and damage to animals, crops, vegetation, and buildings.

(B) 40 CFR part 60 subpart Da (stationary source)

Applicability:

That is capable of combusting more than 73 MW (250 MMBtu/hr) heat input of fossil fuel.

	PM
1971–1978	43 ng/J heat input
Sep 1978–1997	13 ng/J heat input
1978–Mar 2005	
Commenced construction: Mar 2005–May 2011	18 ng/J gross output 6.4 ng/J heat input
Commenced reconstruction: Mar 2005–May 2011	Or: 13 ng/J input and 99.9% reduction
Modified: Mar 2005–May 2011	18 ng/J gross output 6.4 ng/J heat input Or: 13 ng/J input and 99.8% reduction
Construction or reconstruction after: 3 May 2011	11 ng/J gross output 12 ng/J net output
Modified after: 3 May 2011	18 ng/J gross output 6.4 ng/J heat input Or: 13 ng/J input and 99.8% reduction

2. ASEAN countries, China, and India

Cambodia³⁴

Emission	Unit	Cambodian standard	World Bank standard
Particulates Dry, 0 ⁰ c, 1atm, 6% O ₂	mg/Nm ³	400	50

China³⁵

Emission standards for air pollutants from coal-fired power plants (GB13223-2011)

GB13223-2011 came into force on 1 January 2012, replacing GB13223-2003

Pollutant	Application	Emission limit value	Location of monitoring and emission control
Particulate, mg/m ³	all	30	stack and flue

Special air pollutant emission control requirements for key regions

Coal-fired power plants located within the key regions should meet the special emission limit values in the following table. The key regions include Beijing City, Tianjin City, Hebei Province, Yangzi River Delta, Pearl River Delta, Central Liaoning Province, Shandong Province, Wuhan City and surrounding areas, Changsha City, Zhuzhou City, Xiangtan City, Chengdu and Chongqing City, coastal areas of Fujian Province, Central and Northern Shanxi Province, Guanzhong Region of Shaanxi Province, Gansu Province, Ningxia Province, and Wulumuqi (Ürümqi, Xinjiang Uyghur Autonomous Region).

Pollutant	Application	Emission limit value	Location of monitoring and emission control
Particulate, mg/m ³	all	20	Stack and flue

India³⁶

(A) Emission limits for particulate matter (PM) from thermal power plants

Plant size, MW	Emission limit, mg/Nm ³
<210	350
≥210	150

³⁴ Source: WG member.

³⁵ Source: IEA Clean Coal Centre.

³⁶ Source: IEA Clean Coal Centre.

(B) National Ambient Air Quality Standards

Pollutant	Time weighted average	Concentration in ambient air		Measurement method
		Industrial, residential, rural, and other areas	Ecologically sensitive area (notified by central government)	
PM ₁₀ , µg/m ³	Annual	60	60	gravimetric TEOM beta attenuation
	24 hours	100	100	
PM _{2.5} , µg/m ³	Annual	40	40	gravimetric TEOM beta attenuation
	24 hours	60	60	

Indonesia³⁷

Static Emission Sources Quality Standard for CPP

Parameter	Maximum level (mg/Nm ³)	
	A	B
Total Particulate	150	100
Opacity	20%	20%

A. For CPP that have been operated before 1 December 2008.

B. For CPP that have been operated after 1 December 2008.

Notes:

- Gas volume is measured under standard condition (25°C and 1 atm).
- Opacity is used as a practical indicator for monitoring.
- All parameters corrected by O₂ : 7 %
- For CPP with CEMS installed, the imposition of emission quality standard is for 95 % of normal operation time for 3 months.

³⁷ Source: WG Member.

Lao PDR³⁸

(A) Ambient Air Quality Standard

Pollutant	Average Time Unit: mg/m ³					Method of Measurement
	Hours			1 month	1 year	
	1 hr	8 hr	24 hr			
Total Suspended Particulate	-	-	0.33	-	0.10	gravimetric
PM ₁₀	.05	-	0.12	-	0	gravimetric or beta ray or taper element oscillating microbalance or dichotomous

(B) Air Emission Standard for Power Plants

Pollutant	Source	Permitted emission value	
Particulate Substances	Power Plant Generating Electricity From:	ppm	mg/m ³
	1. Coal	-	120

Malaysia³⁹

Environmental Quality (Clean Air) Regulations 2014

Pollutant	Capacity	Limit value
PM	>10 MW _e	50 mg/m ³

Myanmar⁴⁰

Air Emission Level

Pollutant	Unit	Guideline value
PM ₁₀	mg/Nm ³	30-50

Lower value for plants of > 100 MW thermal equivalent, higher value for plants of <100 MW thermal equivalent.

³⁸ Source: WG Member.

³⁹ Source: WG Member.

⁴⁰ Source: WG Member.

Philippines⁴¹

National Emission Standards for Particulate Matter for Stationary Sources (DENR Administrative Order No. 2000 - 81, 7 Nov 2000)

	Emission source		
	Fuel burning equipment		Other stationary sources
	Urban and industrial area	Other area	
Emission limit, mg/m ³	150	200	200

Singapore⁴²

Environmental Protection and Management (Air Impurities) Regulations (effective 1 January 2001, as revised in 2002 and 2008)

Standards for air pollutants emissions from stationary sources

Pollutant	Plant type	Emission limit value, mg/m ³
Particulate matter	any trade, industry, process, fuel burning equipment or industrial plant (except for any cold blast foundry cupolas)	100

where there is more than one flue, duct or chimney in any scheduled premises, the total mass of the particulate emissions from all such flues, ducts, or chimneys divided by the total volume of such emissions shall not exceed 100 mg/m³ and the particulate emissions from each of such flue, duct or chimney shall not exceed 200 mg/m³ at any point of time.

Thailand⁴³

(1) Emission standards from coal-fired power plants

(A) New Power Plant (since 15 January 2010)

Pollutant	Power plant size	Unit	Emission standard
Particulate	<50 MW	mg/m ³	80
	>50 MW	mg/m ³	80

Notification of the Ministry of Natural Resources and Environment published in the Royal Government Gazette, Vol.127 Part 7, 15 January B.E.2553 (2010).

⁴¹ Source: IEA Clean Coal Centre.

⁴² Source: IEA Clean Coal Centre.

⁴³ Source: WG Member.

(B) Power Plant (31 January 1996–15 January 2010)

Pollutant	Unit	Emission standard
Particulate	mg/m ³	120

Notification of the Ministry of Science, Technology and Environment published in the Royal Government Gazette, Vol.113 Part 9, page 220, 30 January (1996).

(C) Mae Moh Power Plant

Pollutant	Power unit	Unit	Emission standard
NO ₂	Unit 1-3	mg/m ³	180
	Unit 4-7	mg/m ³	180
	Unit 8-13	mg/m ³	180

Notification of the Ministry of Science, Technology and Environment No.3, B.E.2544 (2001) 29 January B.E.2544 (2001), published in the Royal Government Gazette, Vol.118 special Part 24, 16 March B.E.2544 (2001).

(2) Ambient Air Standards

Pollutant	Average	Emission standard
Total Suspended Particulate	24 hr	Not exceed 0.33 mg/m ³
	1 hr	Not exceed 0.10 mg/m ³
PM ₁₀	24 hr	Not exceed 0.12 mg/m ³
	1 hr	Not exceed 0.05 mg/m ³
PM _{2.5}	24 hr	Not exceed 0.05 mg/m ³
	1 hr	Not exceed 0.025 mg/m ³

Notification of National Environmental Board No.10, B.E.2538 (1995) under the Enhancement and Conservation of National Environmental Quality Act B.E.2535 (1992), published in the Royal Gazette No.112 Part 52, 25 May B.E.2538 (1995).

Notification of National Environmental Board No.24, B.E.2547 (2004) under the Enhancement and Conservation of National Environmental Quality Act B.E.2535 (1992), published in the Royal Gazette No.121 Part 104 D, 22 September B.E.2547 (2004).

Notification of National Environmental Board No.36, B.E.2553 (2010) under the Enhancement and Conservation of National Environmental Quality Act B.E.2535 (1992), published in the Royal Gazette No.127 Part 37, 24 March B.E.2553 (2010).

Viet Nam

Emission standards for thermal power plants were released on 16 November 2009

Viet Nam's standards are based on the size of operation and location of the facility. The relevant emission standard for a pollutant is calculated using the following formula:

$$\text{Emission limit in mg/m}^3 = C \times K_p \times K_v$$

where C is the concentration parameter

K_p is the power plant size coefficient

K_v is the region coefficient.

Pollutant	Concentration parameter, mg/Nm ³	
	Existing plants operating before 17 October 2007 and valid until 31 December 2014	Plants operating since 17 October 2007 and all plants after 1 January 2015
Particulate matter	400	200

Power plant size, MW	K_p coefficient
$P \leq 300$	1.0
$300 < P \leq 1200$	0.85
$P > 1200$	0.7

Zoning area	K_v coefficient
cities, historic, cultural, or natural heritage	0.6
inner city and urban suburbs	0.8
industrial zones, suburbs, and outskirts	1.0
rural	1.2
rural mountains	1.4