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POLICIES, REGULATORY FRAMEWORK AND ENFORCEMENT FOR AIR QUALITY MANAGEMENT: THE CASE OF JAPAN – ENVIRONMENT WORKING PAPER N°156

By Enrico Botta, Sho Yamasaki (1)

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Abstract

The pollution intensity of the Japanese economy, measured as emissions per dollar of GDP, is among the lowest within OECD countries. However, air pollution remains a significant issue. Almost 80% of the Japanese residents were exposed to an annual concentration of $PM_{2.5}$ above the WHO guideline while the attainment rate of the domestic air quality standard for photochemical oxidants is below 1%. The analysis of the regulatory and enforcement framework for air quality management in Japan identifies best practises and key remaining challenges, including a limited understanding of the generation mechanism of ozone pollution and the need to strengthen cooperation among Prefectures. This paper complements two case studies on air quality policies in China and Korea, and a third case study on international regulatory cooperation on air quality in North America, Europe and North-East Asia.

Keywords: air pollution, regulatory policy, monitoring and enforcement, Japan

JEL codes: Q52, Q53, Q58

Résumé

Exprimée en volume d'émissions pour 1 USD de PIB, l'intensité de la pollution est plus faible au Japon que dans la plupart des autres pays de l'OCDE. La pollution atmosphérique n'en reste pas moins un problème de taille. Près de 80 % des habitants de l'archipel sont exposés à une concentration annuelle de PM2.5 supérieure au niveau préconisé par l'OMS tandis que le taux de respect du niveau national fixé pour les oxydants photochimiques a été inférieur à 1 % en 2016. L'analyse du cadre réglementaire de la gestion de la pollution atmosphérique au Japon et du système d'application connexe permet de recenser les meilleures pratiques établies et les tâches essentielles qu'il reste à accomplir, telles que mieux comprendre le mécanisme de formation de la pollution à l'ozone et resserrer la coopération entre les préfectures. Ces travaux viennent compléter deux études de cas sur les politiques en faveur de la qualité de l'air poursuivies en Chine et en Corée, ainsi qu'une troisième sur la coopération internationale en matière de réglementation sur la qualité de l'air engagée en Amérique du Nord, en Europe et en Asie du Nord-Est.

Mots clés : pollution de l'air, politique réglementaire, surveillance et application, Japon

Classification JEL : Q52, Q53, Q58

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Executive summary

Key features of the environmental policy framework

In 1950-60s, Japan experienced a period of fast economic growth whose unchecked environmental externalities led to the diffusion of several pollution-related illnesses (Minamata disease, Itai-Itai disease, Yokkaichi asthma). Following public demands for improvement in the quality of the environment, Japan embarked on ambitious reforms and currently features one of the least pollution-intensive GDP among OECD countries. However, $PM_{2.5}$ and photochemical oxidants pollution remain significant issues. In 2017, almost 80% of the Japanese residents were exposed to an annual concentration of $PM_{2.5}$ above the WHO guideline while the attainment rate of the domestic Air Quality Standard for photochemical oxidants has been below 1% in 2016.

The management of air quality, as per other key environmental domains, is still largely based on the legal framework developed in the 1970s and in the Basic Environmental Act adopted in 1993. Its key features are:

- **Emission Limit Values - jointly with the Total Emission Standards for SO_x and NO_x in high risk areas - are the main tool to regulate air pollution from stationary sources**. Pricing instruments, such as taxes or trading scheme, are not included in the policy mix to regulate air pollution. Notably, a system based on Best Available Techniques is not employed in Japan with the exception of mercury.
- **A specific feature of the Japanese pollution control efforts is the large reliance on Voluntary Approaches.** Pollution Control Agreements (or PCAs), which started to proliferate in the early 1960s as a response of local governments to the citizens' demand for higher environmental quality, are nowadays common across Japan. Voluntary approaches are expected to continue to play an important role in controlling air pollution and, for instance, the recent review of Air Pollution Control Act explicitly refers to Voluntary Action Plans (or VAPs) as a tool to control emissions of Volatile Organic Compounds (VOCs).
- **Various incentives are in place to promote the purchase of low-emission vehicles while few target investment in pollution abatement technologies.** Since 2009 the purchase of eco-friendly vehicles is incentivised through a wide range of tax breaks (e.g. on the automotive acquisition and ownership taxes). The uptake of electric vehicles is further promoted through subsidies for the installation of chargers at private facilities. The main measure to incentivise firms' investment in environmental friendly technologies is a below-market rate loan program operated by the Japan Finance Corporation. In addition, certain local governments have introduced specific mechanisms (e.g. additional points in bids for public works) to support the adoption of Environmental Management Systems (EMSs), such as ECO Action 21.
- **As diesel cars are included in the group of vehicles that benefit from the eco-incentives, their sales have surged in recent years with potential negative impact on air quality**. This is particularly concerning given the improved

understanding on the link between air pollution and lung cancer that paved the way for the classification of diesel as a definite carcinogenic by the International Agency for Research on Cancer.

- **Most recent reforms focused on improving the procedures for the ex-ante assessment of projects (Environmental Impact Assessment - EIAs) and regulations (Regulatory Impact Assessment - RIAs).** In 2012, the Environmental Impact Assessment Law was revised to improve the level of "environmental democracy" through the introduction of various mechanisms that facilitate public participation (e.g. obligations to hold public sessions or to publish project documents online). In 2017, the Ministry of Internal Affairs and Communications, who is in charge of regulatory impact assessment, released new guidelines with the aim of increasing the application of quantitative evaluation methods. Given their recent release, it is too early to evaluate whether the guidelines led to a higher uptake of quantitative appraisals of the impact of regulations on air quality.
- **Not all ministerial manuals for Cost Benefits Analysis (CBA) provide clear guidance on how to evaluate the effects of projects on air quality.** This is particularly problematic since non-climate impacts that directly affect human health can have large importance for the outcome of a CBA.
- **The compliance monitoring and enforcement activities in Japan are geared towards guiding economic actors towards compliance with limited recourse to fines and penalties**. This is, for instance, clearly visible in the results of inspection activities that saw the issuance – on average during the past three years – of 8,087 guidance and only 5 administrative orders out of more 35,000 annual inspections. Notably, horizontal information sharing on compliance issues is limited, thus hindering synergies across Prefectures.

Key recommendations

- **Establish progressively more ambitious targets for the concentration of $PM_{2.5}$ and photochemical oxidants**. If these are carefully set, with the ultimate goal of meeting the national air quality standards within a realistic timeline, they can help to create momentum for further reforms. As an example, some Prefectures have already identified interim targets for the improvement of air quality (e.g., Tokyo Metropolitan Government set the goal of zero days with photochemical smog advisory alerts by FY2020).
- **Consider a broader application of economic instruments to control emissions.** Pricing instruments, such as taxes or trading scheme, are generally considered as the most efficient tool to promote green growth. A larger leverage of these instruments may allow to lower the social costs of meeting environmental quality objectives.
- **Strengthen horizontal cooperation to ensure a swifter response to violations and a better sharing of best practises.** A system that would allow prefectures to share data on malpractices may speed-up the identification of similar violations in other regions. Furthermore, given the autonomy granted to Prefectures in designing monitoring and enforcement procedures, a process of identification and collection of relative best-practise could promote their diffusion across regions. The seven regional coordination offices established by the Ministry of Environment may play an important role to this end.
- **Need to improve understanding of the generation mechanism of ozone pollution.** Notwithstanding decrease in the emissions of its main precursors, the concentration of Photochemical Oxidants remain well above the domestic air quality standards. Its generation mechanisms need to be better understood in order to design appropriate policy intervention.
- **Monitor the impact of the recently updated guidelines for the impact assessment of regulations and update CBA manuals.** The organization of "hands-on" seminars and the inclusion of more precise details on how to monetize the cost of air pollution may contribute to a faster diffusion of quantitative methodologies. Ministerial CBA manuals should also be reviewed to ensure they provide clear guidance on how the evaluate the effects of projects on air quality.

1. Introduction

This case study is part of a joint project of the OECD Environment Policy Committee and Regulatory Policy Committee focused on regulatory frameworks, enforcement and co-operation to address air pollution supported by the Ministry of Environment of Korea. The joint project comprises two pillars:

1. Country studies of policies, regulatory framework and enforcement for air quality management, covering China, Japan and Korea; and
2. Studies of international regulatory co-operation (IRC) initiatives to address air pollution, focusing on existing arrangements in North-East Asia, the Canada – United States Air Quality Agreement (Air Quality Agreement) and the Convention on Long-range Transboundary Air Pollution (CLRTAP).

This document complements two case studies that focus on policies, regulatory and enforcement frameworks for air quality management in China (ENV/WKP(2020)4), in Korea (ENV/WKP(2020)5) and third case study that analyses international regulatory cooperation on air quality in North America, Europe (the Convention on Long-Range Transboundary Air Pollution) and North-East Asia (COM/ENV/EPOC/GOV/RPC(2018)1)

These studies are carried out under Revised Output Proposal (ROP) for Intermediate Output 2.3.4.2.11. Environmental Policy Design and Evaluation- Regulatory quality and enforcement to address air pollution, under the 2017-2018 EPOC 2018 Programme of Work and Budget (ENV/EPOC(2017)1/ANN3). Overall, this joint project aims to support the broader ambition of countries in the region to improve their air quality policies by highlighting the challenges and possible solutions related to the design and enforcement of effective regulatory frameworks for air quality and the co-operation needs that transboundary air pollution generates.

This study builds on information collected by the Secretariat through deskwork, questionnaires, and interviews carried out during a fact-finding mission to China, Japan and Korea undertaken in May 2018. The case studies have also been revised based on comments received by EPOC and RPC Delegates as well as the participants at a project workshop in Beijing on 26-27 June 2019. The case study on Japan benefited from further comments and data provided by the Japanese Ministry of Environment and the Japanese Ministry of Internal Affairs and Communications. This paper was drafted by Enrico Botta (ENV/GGGR) and Sho Yamasaki (ENV/GGGR).

2. Historical and recent trends in air quality and emissions

During the 1950s-1960s, Japan experienced a period of fast economic growth that was accompanied by unprecedented environmental degradation. The unchecked pollution of numerous environmental media (e.g. air, water bodies) led to several pollution-related illnesses such as the Yokkaichi asthma, Minamata disease (mercury poisoning) – both named after the cities where they first appeared – and cadmium poisoning, known as *itai-itai* or "ouch-ouch" because of the severe bone pain it caused.

In response to the increasing public demand for pollution control measures, a number of reforms were undertaken during the 1960s-1970s. This process culminated in 1970 with an extraordinary session of the national Diet, which – often referred as the "green Diet" – introduced (or amended) over fourteen pollution control measures , and with the establishment of the Environmental Agency in 1971 (Imura and Schreurs, 2005[1]). After this first wave of measures, environmental policies and regulations were constantly updated in order to respond to new concerns and emerging challenges, a process that underlines the dynamic nature of environmental policy-making (Table 2.1).

Table 2.1. Timeline of key environmental policies in Japan

year	Law or action	Brief Description
1962	Establishment of the Smoke and Soot Law	Introduction of control of dust and smoke emission from factories in designated area
1967	Establishment of the Basic Environmental Pollution Control Law	Clarification of pollutants emission responsibility and introduction of environmental quality standards
1968	Establishment of the Air Pollution Control Act	(Amendment of the Smoke and Soot Regulation Law)
1970	Revision of the Air Pollution Control Act	Introduction of nationwide uniform emission control and direct penalty
1971	Establishment of the Environmental Agency	
1978	Revision of the Air Pollution Control Act	Introduction of control of automobile exhaust gas
1993	Establishment of the Basic Environmental Act	Introduction of concept of environmental pollution Prevention
2001	Establishment of the Ministry of the Environment & Establishment of the Automotive NO_x/PM Law	Upgrade of the Agency & Amendment of the Automotive NO_x Law
2006	Revision of the Air Pollution Control Act	Introduction of control of VOC emission
2009	Introduction of Air quality standard for PM2.5	Establishment of AQS for PM 2.5 in addition to the standard for PM7
2018	Revision of the Air Pollution Control Act	Introduction of BAT control of mercury emission

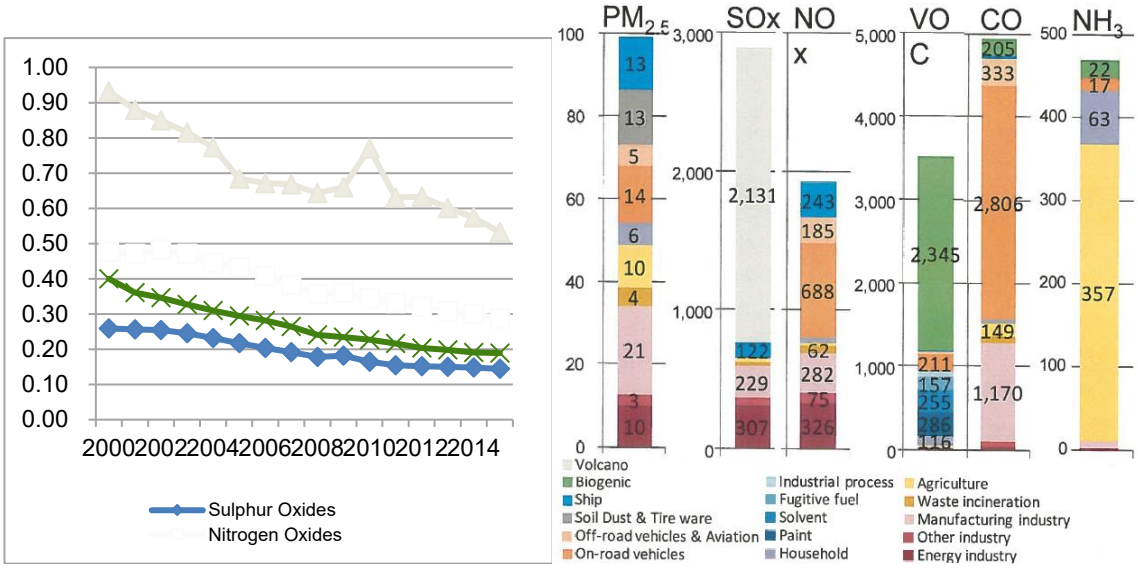
Source: Authors' elaboration.

Nowadays, Japan enjoys relatively good levels of air quality. The country features one the least pollution intensive GDP among the OECD members and the emission levels of major pollutants have been decoupled from economic activity (Figure 2.1). Per capita levels are also among the lowest among OECD Countries. For instance, Japan recorded the lowest per capita emission of carbon monoxide and volatile

organic compounds (VOCs) while NO_x per capita emissions are the third lowest among OECD countries (OECD data, 2018[2]).

Figure 2.1. Emissions in Japan – trends and sectoral decomposition

Panel a. Total emissions per unit of GDP (Kg per 1000 USD). **Panel b**. Total Emission by sector, 2012 (kt/y)



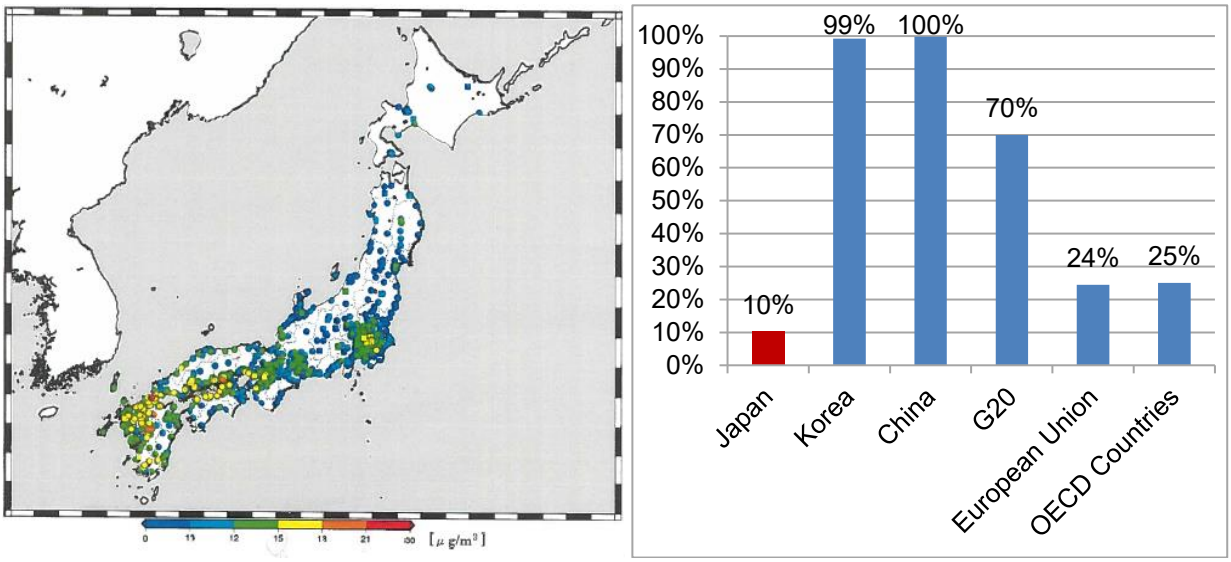
Source: Panel a, OECD stats, 2018. Panel b, (MoE, 2018[3]).

However, aggregated national data hide specific pollution hotspots. Indeed, according to latest available data (2017) almost 10% of Japanese residents are exposed to annual concentration levels of fine particulate matter (PM)[1] above the objective set by the domestic Air Quality Standards (i.e. 15 micrograms/m^3) (Figure 2.1). In addition, it should be noted that $PM_{2.5}$ concentration in almost the whole country is above the safest level identified by the WHO (10µg/m^3). The main sources of PM emissions are the manufacturing sector, on-road vehicles and "soil dust & tire ware" (Figure 2.1).

[2] Once inhaled, particulate matter can affect the heart and lungs and cause serious health effects. Fine particles smaller than 10 micrometres in diameter (PM10) can enter deep into the lungs, while PM2.5 are those smaller than 2.5 micrometres, and can thus go beyond in the lungs into bloodstream.

Figure 2.2. Regional distribution map of PM 2.5

Panel a. Regional distribution map of PM 2.5. **Panel b**. Share of population exposed to more than 15 µg/m3



Note: data for left panel are the yearly average values for FY2016. Data for the right panel refers to 2017.
Source: Left panel: (MoE, 2018[3]). Right panel: OECD (2018), "Air quality and health: Exposure to PM2.5 fine particles - countries and regions", OECD Environment Statistics (database).

Also, the concentration of photochemical oxidants[2] remains particularly high. Urban areas - specially in the region of Kanto and Kansai – are characterised by lower air quality (Figure 2.3) but, at the same time, the air quality standard for photochemical oxidants such as ozone has not been met in any Prefectures. Furthermore, in 2017 there have been eighty-seven days were the concentration of ozone reached levels almost double those prescribed by WHO guidelines, thus triggering the release of warnings to the populations. Importantly, and as opposed to PM pollution, photochemical oxidants are a secondary pollutant and their generation mechanisms are still not well understood (see Box 2.1).

[2] Photochemical oxidants pollution such as ozone has the greatest impact on the respiratory system. Symptoms associated with exposure include cough, chest pain, and throat and eye irritation.

Box 2.1. Primary and Secondary pollutants

Pollutants can be classified according to their generation mechanisms. Primary pollutants (e.g. sulfur dioxide (SO_2), volatile organic compounds (VOCs) or nitrogen oxides (NO_X) are those emitted directly as a result of human activity or natural processes, while secondary pollutants are created from primary pollutants through reactions with sunlight and other components in the atmosphere.

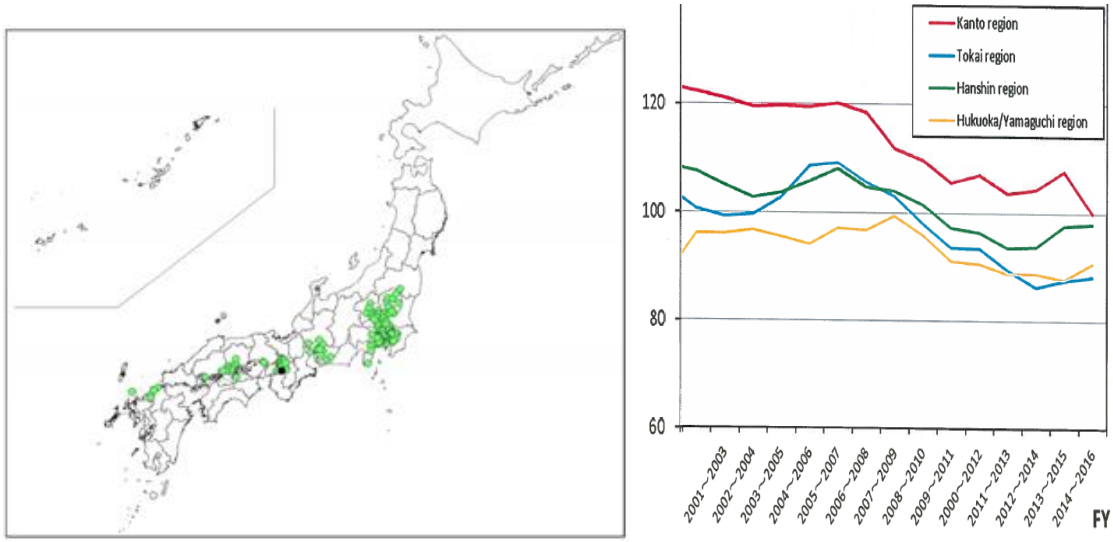
Photochemical oxidants, such as ground-level ozone, are often classified as a secondary pollutant. In fact, ozone is not emitted directly into the air and it is mostly generated by chemical reactions between nitrogen oxides (NO_x) and volatile organic compounds (VOCs) in the presence of sunlight. Emissions from industrial facilities and electric utilities, motor vehicle exhaust, gasoline vapours, and chemical solvents are some of the major sources of NO_x and VOCs (US EPA, n.d.[4]).

Given its secondary nature, policies aiming at controlling ozone concentration focus on its main precursors, namely VOCs and NO_x. In Japan, numerous instruments have been introduced to control the emission of these pollutants precursors, such as emission standards for fixed sources of VOCs and more stringent regulation for mobile-sources in specific regions. However, notwithstanding improvement in the concentration of these precursors, concentration levels of photochemical oxidants have remained relatively constant and further research on its generation mechanism is considered as necessary.

Source: (EEA, 2018[5]), (National Institute for Environmental Studies, 2018[6])

Figure 2.3. Trends in photochemical oxidants (OX) pollution

Panel a. Regional distribution map of Monitoring stations with OX pollution alerts. **Panel b**. Trends in OX concentration levels (ppb)



Note: Panel A: Black dot stands for "monitoring stations experiencing photochemical ox alerts more than 10 days in 2016". Light green dot stands for "monitoring stations experiencing photochemical ox alerts 1-9 days in 2016". Condition for OX pollution alerts: 0.12ppm for hourly average).
Source: (MoE, 2018[7]).

There is limited understanding of the role of transboundary sources, with the available evidence suggesting Japan's downwind location increases its susceptibility to foreign emissions of PM and dust. Modelling

simulation led by JAMSTEC, a research centre within jurisdiction of the Ministry of Education, estimated that emissions originating on mainland China may account up to 50-60% of $PM_{2.5}$ annual mean concentration in Western Japan and 40% in the Kanto area (Ikeda et al., 2015[8]). A joint study by Japanese and Chinese researchers who focused on SNA (Sulphur, Nitrate, and Ammonia), which contributes to PM formation, confirmed the importance – specially in the case of Nitrate (NO3) - of transboundary air movements (Itahashi et al., 2017[9]). Similarly to PM2.5, the concentration of photochemical oxidants is affected by transboundary sources as well. For instance, JAMSTEC (2007[10]) concluded that NO_x sources in East Asia contributed to increase ozone concentration across Japan, specially during warmer months. Also, modelling simulation by "Photochemical Oxidants Research and Review Committee" within the MoE (2017[11]) shows that the increased emission of OX precursors (VOC and NOx) in the eastern Asian continent are likely to lead to increase in daily maximum 8-hour average concentration in a broader area of Japan, with particularly negative impact on the Kyushu area (southern-western) than Kanto area (eastern). Cuesta et al. (2018[12]) also find evidence of ozone pollution plumes transported from the North China Plain to Northern China, Korea and Japan.

3. The environmental policy-making framework

3.1. Main policy actors

Following the relatively centralised structure of the Japanese government, most of the responsibilities for environmental policy making are retained at the central level. The Ministry of Environment (MoE) has exclusive jurisdiction over several matters involving air pollution. These include the setting of both ambient air quality standards and emission limits values, the formulation of the total emissions reduction policies and the determination of the facilities to regulate.

The responsibilities for some air quality policies are fragmented across multiple ministries with no formal horizontal coordination mechanism in place. This is the case, for instance, of the automotive sectors where the MoE is in charge of the "Automobile NO_x Emission Act" while the Ministry of Economy, Trade and Industry (METI) elaborates the Basic Energy Plan that sets the targets for clean vehicles penetration as well as for renewable energy generation (METI, 2014[13]). Given this lack of formal structures, horizontal cooperation often builds on established practises, such as formal and informal meetings with different stakeholders. An additional implicit mechanisms to improve coordination is provided by the Central Environment Council (中央環境審議会 or CEC) that reviews all laws and programs that are likely to have an environmental impact (Figure 3.1). This is an advisory body[3] to MoE and other ministries (OECD, 2002) and it is composed of non-governmental experts appointed for a period of two years by the Prime Minister following recommendations by the MoE. The CEC is mainly tasked with providing opinions and expert judgement on themes established in the Basic Environment Plan (Article 15 Paragraph 3) and other important matters with regard to environmental conservation (MoE, 2018[14]). Currently, the CEC has numerous subcommittees working on issues connected to air quality, including the Technical Committee on Atmospheric Emission Standards, the Special Committee for Fine Particulate Matter and Automobile Exhaust Gas Comprehensive Measures subcommittee (MoE, 2018[15]).

The annual budget of the MoE almost tripled during the last decade without – however – any large impact on the resources dedicated to air quality issues. Financial resources increased from 356 billion yen in 2000 to 1061 billion yen in 2017 (MoE, 2018[3]) while total staff followed a similar trajectory and grew from 882 to 3,042 persons during the same period . However, this increase – which is mainly driven by the environmental concerns following the Fukushima nuclear accident in 2011 and climate change – is coupled with a constant (or slightly decreasing) pool of resources available for air quality matters (MoE, 2018[3]). Table 3.1 provides a break-down of staffing at the subnational level.

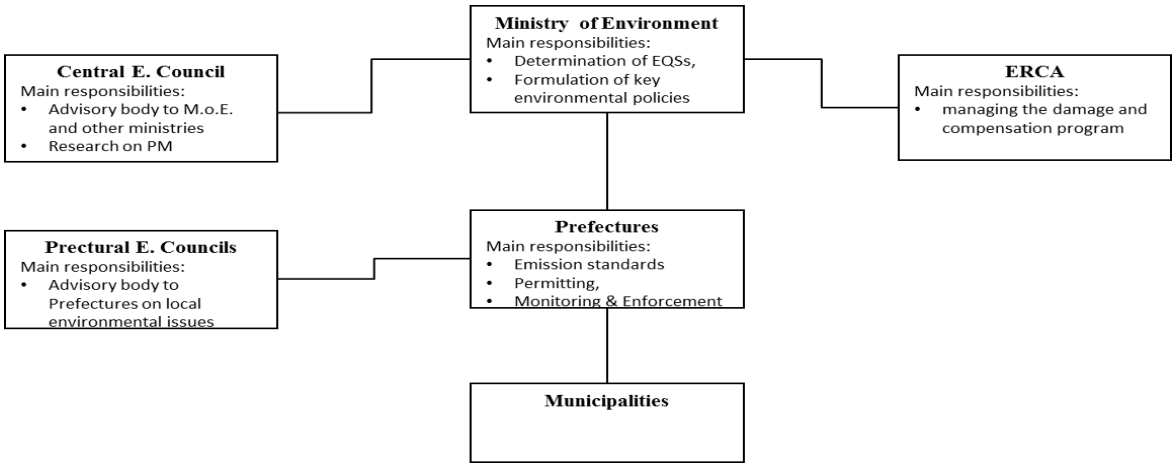
A particular institution is Environmental Restoration and Conservation Agency (ERCA) that manages the programs for pollution prevention and compensation of the sufferers of pollution-related illnesses. This agency inherited the pollution compensation programs established during the

[3] CEC decisions are purely advisory (i.e. not binding) but there is a consolidated practise of acting upon them (MoE, 2018[3]).

1970s-1980s to pay certified victims of air pollution. The agency saw its responsibilities broadening over time to include, among other things, supporting the implementation of measures developed at the central and local level to reduce air pollution (Box 3.1). The funding of these activities is generated by a mix of sources, including: the pollution load levy – which is earmarked to pay health compensation benefits –, 20% of the total revenues from the automobile tonnage tax and the funds collected though the so-called "specified" levy that is imposed on polluters in the areas where the causal relationship between certain diseases and air pollution is well established, such as the regions of Kumamoto and Kagoshima for the Minamata and Toyama for Itai-Itai disease (ERCA, 2014[16]).

Prefectures, the lower level of government, have limited policy-making power in relation to air quality and are mainly in charge of monitoring and enforcement. They can establish stricter emission standards than those set by the central government and can "*formulate a plan for reducing the total quantity of [pollution]"* in areas where it "*is difficult to attain the standards for environmental conditions related to air pollution [..]"* (APCA, 2006[17]). As in several other OECD countries, they are also responsible for the monitoring and enforcement of air quality regulations and for operating the permitting system (Figure 3.1). Within this context, they also have the responsibility to warn the public when the concentration of selected pollutants (SOx, SPM, CO, NOx, OX) reach levels considered as dangerous for human health (see section 2.2). It should be noted that the MoE can recommend prefectures to implement stricter emission standards *(APCA, art 5)* but the use of this power has been very limited. Importantly, the central government retains monitoring responsibilities in relation to nuclear matters.

Figure 3.1. Main governmental actors and key responsivities in relation to air quality



Source: Authors' elaboration.

To improve vertical coordination, seven Regional Environmental Offices have been established by the MoE in 2005 but their focus is mainly on activities related to waste management and nature conservation (OECD, 2010[18]). These offices are also responsible for cross-cutting activities, including the development of environmental awareness and education initiatives (OECD, 2010[18]). Moreover, they take a role of liaisons between MoE and local governments in case of national disaster by, for instance, informing the MoE on the results on the samplings of air pollution conducted by local offices (MoE, 2018[19]).

Table 3.1. Employees of Ministry of Environment at sub-national level (2017)

(Units: persons, %)

	Total	Prefectures	Municipalities
Pollution	7,041	3,525	3,516
Environmental conservation	6,894	2,493	4,401
Collection and disposal of waste and sewage	45,140	152	44,988
Total of the above 3 items (a)	59,075	6,170	52,905
(a) as a percentage of (b)	2.5	0.5	4.9
General administrative department (b)	2,383,778	1,308,744	1,075,034

Note: "General administrative department" denotes the total of employees in local governments, excluding employees covered by the accounts of publicly managed firms
Source: (Ministry of Internal Affairs and Communications, 2018[20]) .

Box 3.1. The Environmental Restoration and Conservation Agency (ERCA)

Following numerous lawsuits both against companies for polluting the environment and the State for failing to enforce relevant regulations, several programs were established to support victims of pollution and to promote prevention activities during the 1960s-1970s. One of the first measures introduced has been the Japan Environment Corporation or "JEC" (1965) that offered firms discounted loans for investment in pollution prevention activities. Later in 1974, the Law Concerning Pollution-related Health Damage Compensation established the Pollution-related Health Damage Compensation System (or PHDCS). Its objectives were to provide compensation benefits, such as medical insurance and disability allowance, to the certified sufferers of air pollution-related illnesses (such as chronic bronchitis, bronchial asthma, asthmatic bronchitis and pulmonary emphysema) and Minamata and Itai-Itai diseases. In order to qualify for benefits, applicants had to pass a medical examination and prove to have lived or worked in specific regions for more than a certain period of time. In 1984, there were around 100 000 certified patients suffering from air pollution-related illnesses and over 2 000 suffering from Minamata and Itai-Itai diseases. The certification of new victims of air pollution was terminated in 1987 but payments to certified suffers continued. Finally in 1988, the "Pollution-related Health Damage Compensation and Promotion Association" (PHDCPA) was established to operate both the PHCDS and the newly established "Pollution-related Health Damage Prevention Programme" (PHDPP), which focused mainly on prevention activities in 47 heavy polluted areas.

The ERCA, established in 2004, inherited the operations of PHDCPA (i.e. PHDCS and PHDPP) as well as selected roles of JEC. Moreover, ERCA also manages the operation of the Asbestos-related Health Damage Relief program which was created in 2006 to cover the cost of medical care for people exposed to asbestos under the Asbestos Health Damage Relief Act. Through these numerous programs, the ERCA also supports measures carried out by the central, local governments and private organisations to reduce air pollution, improve nature conservation and the management of waste disposal**s.**

Each program is financed through specific mechanisms. The pollution load levy, (part of) the automobile tonnage tax, and a so-called "specific levy" imposed on polluting facilities operating in certain areas are used to cover the expenses of the PHDCS (ERCA, 2014[16]). The PHDPP is financed by the Pollution Health Damage Prevention Fund investment, a JPY 50 billion (about USD 500 million)

endowment fund established by polluting enterprises and the national government. Finally, the activities connected to asbestos pollution are financed by transfers from both central and local governments as well as contributions – computed according to the amount of asbestos used – from enterprises who meet certain conditions.

Source: (ERCA, 2018[21]), (ERCA, 2014[16]), (Hashimoto, 1989[22])

3.2. Environmental impact assessment of projects and regulations

Environmental Impact Assessment (EIA) and Regulatory Impact Analysis (RIA) can be effective instruments to promote policy coherence and the consideration of air quality issues in different policy areas (Wiener and Ribeiro, 2016[23]; Jacob et al., 2011[24]). These can be broadly defined as analytical tools available to government to evaluate the environmental impacts of individual construction projects (EIA) and the benefits and costs - also in terms of the environment - of regulations (RIA).

There is a long-standing practise with Environmental Impact Assessments (EIA) in Japan, whose process has been revised in 2012. Currently, the EIA Law identifies 13 types of project that are classified as "Class-1 projects" or "Class -2" according to their size. All projects that fall within the first category have to go through an environmental impact assessment before construction while the competent Ministers are required to determine – considering the opinions of prefectural governors – the need for an environmental impact assessment for smaller "Class-2 projects" (Table 3.3). All assessments need to compare the proposed project with alternative solutions. Importantly, the Minister of the Environment can advise on items to be included in the assessment (MoE, 2012[25]). The collection of feedbacks from lower levels of government can be particularly important for air pollution where multiple, small-scale projects may collectively severely affect overall air quality. Examples may include a thermoelectric power plant localised where numerous factories are already in operation or a road passing through an area where the concentration of nitrogen dioxide (NO_2) already exceeds the ambient environmental quality standard (MoE, 2012[25]).

The Revised EIA Law introduced two additional steps in the assessment procedures. Also before the amendment, there was an requirement to compare the proposed project with alternative solutions. However, the framework of the project (location, scale, etc.) was determined prior to the beginning of the EIA process and therefore it was sometime complex to consider alternative solutions along these dimensions. For this reason, the reform has introduced an additional step prior to the detailed IEA assessment where all proponents of Class-1 project[4] have to prepare a document on "Primary Environmental Impact Consideration" that has to consider alternative plans on specific features of the projects, such as location and scale. Stakeholders are invited to provide comments that should be reflected in the subsequent steps of the EIA. The second newly introduced step is denominated "Impact Mitigation Reporting" and it is performed once the project is under construction in order to monitor environmental conditions during its development and operational stage (MoE, 2012[25]).

The Japanese environmental impact assessment (EIA) law and relative guidelines do not mandate to consider transboundary impacts. Furthermore, Japan is not a signatory part of the Espoo (EIA) Convention that establishes an obligation for States to notify and consult each other on all major projects that are likely to have a significant adverse environmental impact across national boundaries.

[4] This step is voluntary to class-2 projects.

In addition, as of March 2012, all major cities and prefectures developed their own EIA ordinance[5]. These are meant to ensure that also smaller projects, which may have a specific relevance to environmental quality due to local circumstances, undergo an EIA process. *Takao* (2016[26]) reports that these ordinances require the creation of independent review commissions (shinsakai), which provide "expert opinions", and often stipulate a power for the local administrative chief to call public hearings (kochokai) whenever this is considered as necessary.

A Regulatory Impact Analysis (RIA) process was formally adopted in 2007 but has only been partially applied. The Implementation Guidelines for Policy Evaluation of Regulations state that all new or revised regulations should be evaluated considering their expected costs and benefits – including in relation to the environment – in comparison with a baseline and alternative scenarios (Ministry of Internal Affairs and Communications, 2017[27]). However, as noted by the recently concluded analysis of the Policy Evaluation Council (2017[28]), the assessments are afflicted by two main issues. First of all, RIAs are mainly performed at an advanced stage of the regulatory process (while it should be used to improve the regulation during its formation process and decision making). Secondly, they mostly included only qualitative considerations. For instance, Yashiro (2016[29]) reports that only five RIAs out of a total of 128 published in 2013 included a quantitative impact assessment. The limited application of quantitative assessment seems to characterise both RIAs performed by the Ministry of Environment and those performed by other Ministries (MoE, 2018[19]).

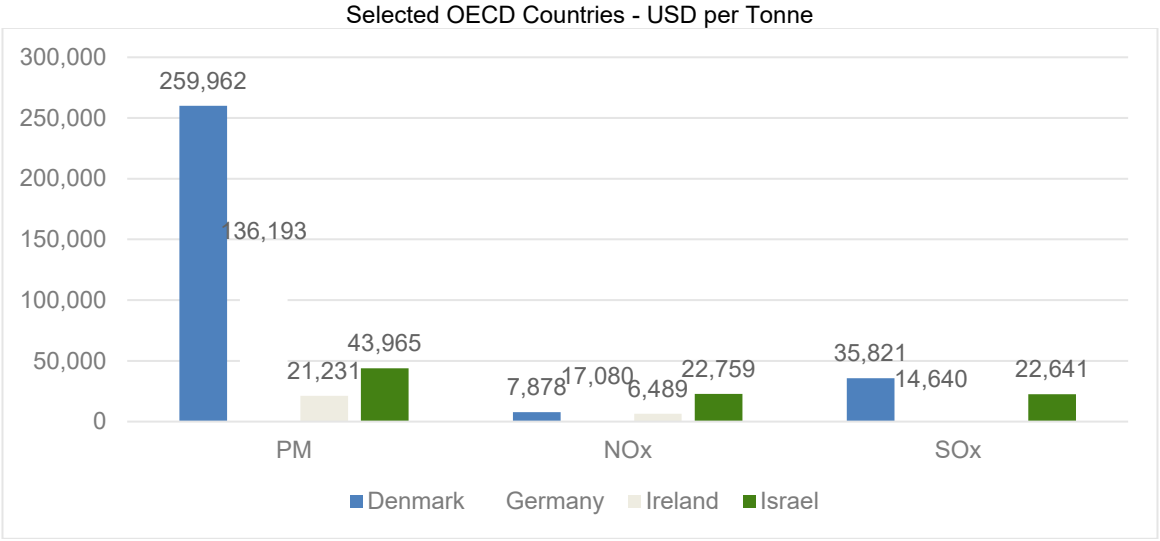
In order to streamline the procedure, the regulatory impact assessment guidelines have been recently revised while a manual and calculation templates have been developed as well. The revised guidelines further elaborate on the information and criteria in relation to quantifying and qualifying impacts and costs, including the various techniques and processes that ministries can adopt under specific circumstances (e.g. contingent valuation and hedonic pricing). Since these have been published in mid-2017, it is too early to evaluate their impact. In this regard, the inclusion of predefined values of the social cost of each additional tonne of emitted pollutant in RIAs manuals or the development of dedicated training sessions – to be delivered online or offline – may facilitate an higher (and standardised) recourse to quantitative assessments of the impacts of regulations on air quality (Box 3.3).

Furthermore[6], the Ministry of Land, Infrastructure, Transport and Tourism (MLIT) publishes the "Technical Guideline of Cost-benefit Analysis for Public Project Evaluation" (or "TG"), which presents the general recommendations for the drafting of Manuals for the CBA of transport projects. These TG include a wide range of environmental impacts (e.g. air quality, water quality) and several costing methods. However, the CBA Manuals – which are developed by the various Ministries and are not required to follow all the TG recommendations - do not always consider all environmental benefits and costs (ITF, 2015[30]). For instance, the manual for "road CBA" does not consider air pollution impact while these are included within the manual dedicated to "railway CBA". This limited focus is particularly problematic since non-climate impacts that directly affect human health and mortality can especially have large importance for the outcome of a CBA (OECD, 2018[31]). From this standpoint, it should be considered that the estimates of the total welfare loss associated to exposure to all air pollution, which includes ambient PM2.5 exposure as well as ambient ozone exposure and indoor air pollution, range between 5.3% of GDP in Japan, 4.3% in Korea and 9.92% in China (World Bank and IHME, 2016[32]). In this regard, it should be noted that some OECD countries include economic values of the impacts of major pollutants for use in the investment assessments (see Figure 3.2 and Box 3.2).

[5] Examples of EIA ordinance by cities and prefectures; Tokyo (Tokyo Bureau of Environment, 2013[158]), Osaka (Osaka Prefectural Government, 2013[159]), Kanagawa (Kanagawa Prefectural Government, 2014[160]), Chiba (Chiba Prefectural Government, 2014[161]), Yokohama (City of Yokohama, 2012[162]).

[6] This section benefited from the expert advice of Professor K.Hayashi (Nagoya University).

Figure 3.2. Examples of economic values of pollutants used in CBAs for transport



Source: Based on the survey for (OECD, 2018[31]).

Box 3.2. DEFRA guidelines on emission costing

According the UK Department for Environment and Rural Affairs (DEFRA) guidelines, the recommended method to value changes in air quality is the impact pathway approach (I-PA). This methodology allows to estimates the consequences of changes in the ambient concentrations of air pollutants for a range of health and environmental outcomes.

However, since the a full I-PA modelling is relatively resource and time intensive, estimates of "damage costs" per tonne of emissions have been developed for the use by analysts. For instance, the estimates of the impacts of NO_2 exposure are reported in table below. Importantly, the guidelines recommend different values according to where the emissions take place and provide a range of estimated costs due to the uncertainty on the link between NO_2, and consequently emissions of NO_X, and mortality.

Table 3.2. NO_X damage costs (per tonne, 2015 prices)

	Estimated cost
Transport average	£25,252 (£10,101 - £40,404)
Transport Central london	£115,405 (£46,162 - £184,648)
Transport inner london	£118,688 (£47,475 - £189,901)
Transport	£118,688 (£47,475 - £189,901)
Transport outer london	£77,526 (£31,010 - £124,041)
Transport inner conurbation	£61,365 (£24,546 - £98,184)
Transport outer conurbation	£38,131 (£15,253 - £61,010)
Rural	£7,829 (£3,131 - £12,526)

Note: A key uncertainty around the impact of NO2, and consequently emissions of NO_X, is the link to mortality. Specifically, mortality is estimated to be reduced by 2.5% (with a range of ± 1.5%) for each 10 µg/m3 change in exposure to NO_2. . Values (range and central estimates) only for selected geographic areas are reported.
Source: (Defra, 2015[33]).

Box 3.3. Online regulatory reform training programmes – the Example of Korea

A number of OECD member countries leverage online trainings when regulatory reforms are introduced. Their advantage lies in their higher flexibility in delivery and limited cost. In addition, they allow to broaden the target audience to a larger number of officials than what traditional approaches would permit. However, the limited interaction that often characterises such courses has sometime been considered as reason to carefully consider their application for advanced trainings.

A recent example of the development of online trainings is provided by the Government of Korea that introduced an online program to train official on the recent regulatory reform that affected regulatory impact analysis as well. This program is managed by the Central Officials Training Institute (COTI) and target central public officials who can access the COTI website using their identification number and password.

The online tool allows officials to progress at their own speed but with an obligation to complete the programme with the one calendar month. The course is successfully concluded if the trainee has completed at least 90% of the course sections and scored at least 70% in an online test. Upon completion, a certificate is recorded in the official's performance assessment.

Source: (OECD, 2015[34]).

Table 3.3. List of projects subject to environmental impact assessment

	Class-1 project (EIA is always required)	Class-2 project (The necessity of EIA is judged by project)
1. Road		
national expressway	all	–
metropolitan expressway	4 lanes or more	–
national roads	4 lanes or more,10km or longer	4 lanes or more, 7.5km–10km
large-scale forest road	width: 6.5m or wider, 20km or longer	width: 6.5m or wider,15km–20km
2. River		
dam, weir	reservoir area:100ha or larger	reservoir area:75ha–100ha
diversion channnel, lake-related development	area of land alteration:100ha or larger	area of land alteration:75ha–100ha
3. Railway		
shinkansen(super express train) railway, track	all length:10km or longer	– length:7.5km–10km
4. Airport	runway:2,500m or longer	runway:1,875m–2,500m
5. Power plant		
hydraulic power plant	output:30,000kw or over	output:22,500kw–30,000kw
thermal power plant	output:150,000kw or over	output:112,500kw–150,000kw
geothermal power plant	output:10,000kw or over	output:7,500kw–10,000kw
nuclear power plant	all	–
wind power plant	output:10,000kw or over	output:7,500kw–10,000kw
6. Waste disposal site	area:30ha or larger	area:25ha–30ha
7. Landfill and reclamation	area:exceeding 50ha	area:40ha–50ha
8. Land readjustment project	area:100ha or larger	area:75ha–100ha
9. New Residential area development project	area:100ha or larger	area:75ha–100ha
10. Industrial estate development project	area:100ha or larger	area:75ha–100ha
11. New town infrastructure development project	area:100ha or larger	area:75ha–100ha
12. Distribution center complex development project	area:100ha or larger	area:75ha–100ha
13. Residential or industrial land development by specific organizations	area:100ha or larger	area:75ha–100ha
Port and harbor plannning	Total reclaimed and excavated land: 300ha or larger	

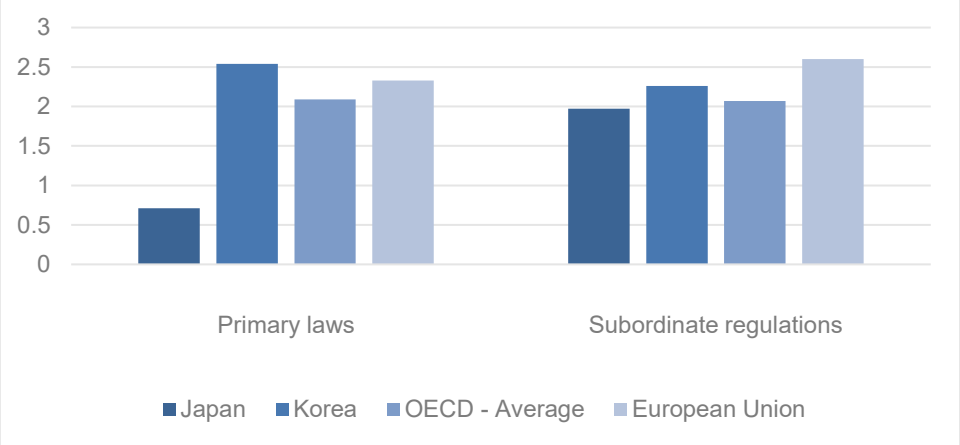
Source: (MoE, 2012[25]).

3.3. Stakeholders' participation

The mechanisms to promote a working environmental democracy are – in general – not specific to air pollution. For this reason, a brief overview of the tools in place to ensure that the public can contribute to the environmental policy making process is provided below.

A first layer of public participation is provided by a systematic practise to consult citizens on primary and secondary laws. The OECD Indicators of Regulatory Policy and Governance (IRPG) focus on this aspect of the legislative process that is particularly complex to measure. Importantly, the indicators, which are based on a survey of OECD member countries, target exclusively the processes and practices for developing national regulations in the executive branch of government[7]. The results underline how the extent of stakeholders' engagement in relation to subordinate regulation in Japan is in line with other OECD countries (Figure 3.3). However, the country would benefit from extending existing efforts to engage with stakeholders in the process of developing primary laws, for example through public online consultations on the interactive government website.

Figure 3.3. Indicators of Regulatory Policy and Governance – stakeholders' engagement



Source: OECD Stat - Dataset: Government at a Glance - 2017 edition.

The 2012 revision of the Environmental Impact Assessment introduced numerous mechanisms to promote public participation during the EIA process but similar provisions are lacking for RIAs. Examples connected to the EIA process include obligations to hold a public session at the stage of the determination of the assessment method and to publish the documents prepared by the project proponents via internet. Instead, measures to improve environmental democracy within the RIA process are limited to the obligation of disclosing the results on the website of the Ministry in charge of the RIA. As such, within this latter case, the public can only scrutinize the assessments once they have been drafted but cannot provide inputs to their preparation. Importantly, the OECD Recommendations on Regulatory Policy and Governance underline how governments should consult stakeholders on all aspects of impact assessment analysis.

Currently, only a limited number of NGOs that focus on air quality operate on a national scale. According to several scholars, this is a common feature of Japanese citizens' environmental engagement that is mainly local (Mason, 2014[35]). A clear symptom of this lack of engagement on the national level is that no

[7] In most countries the majority of their national primary laws originate from initiatives of the executive and are hence covered by the survey. In Japan, around 26% of all national primary laws are initiated by the Parliament.

NGOs have been recently invited to participate in the discussions with the various working groups of the Central Environment Council that focus on issues related to air quality (MoE, 2018[3]).

Furthermore, limited funding – due to the small membership base – and the absence of a single national-level co-ordinating body weakens the ability of NGOs to influence national and long-term policy objectives and solutions (OECD, 2010[18]). This is a feature of Japanese system that is not shared in neighbouring countries. For instance, the Korean Federation for Environmental Movement (KFEM), which is the biggest and the most influential NGO in South Korea, counts 85,000 members. In comparison, membership of Japanese NGOs is usually less than 10,000 (Hasegawa, 2010[36]) while "The Wild Bird Society of Japan" - which is the largest Japanese environmental NGO - counts less than 51,000 members (as of April 2017) (The Wild Bird Society of Japan, 2018[37]). Furthermore, while Green Peace counts 600,000 members (or 4% of the domestic population) in the Netherlands and more than 550,000 (less than 1% of population) in Germany (Hasegawa, 2010[36]), its membership base hovers at only 7,000 members out of a 127 million strong population in Japan (Greenpeace Japan, 2017[38]).

A specific national mechanism to provide financial assistance to non-governmental and non-profit organizations is the Japan Fund for Global Environment (JFGE). This manages an endowment fund established by the Japanese government whose accrued interest are leveraged to finance initiative of NGOs and NPOs aimed at environmental conservation. The fund targets projects in nine key areas that include, among the most relevant for air quality, the following: air, water and soil conservation; nature protection, conservation and restoration; Forest conservation and tree/grass planting; Anti-desertification; Prevention of global warming; Comprehensive environmental education and Comprehensive environmental conservation activities (ERCA, 2014[16]). Examples of recent supported projects include investigations on the health impact of chemical air pollutants and awareness-raising initiatives (ERCA, 2018[39]); international cooperation on monitoring of migratory land birds in the North-East Asia region, including China (ERCA, 2018[40]); development of social businesses to support protected forest areas (ERCA, 2018[41]) and creation of teaching materials on Environmental Sustainable Development for young students (ERCA, 2018[42]).

4. Key policies and regulations for air quality management

4.1. The objectives: Ambient Air Quality Standards

Air quality is monitored in Japan according to the Basic Environment law (art. 16) which introduced the first standards for several air pollutants in 1973. Importantly, while suspended particulate matter (SPM, equivalent to PM_7)[8] is included among the monitored substances since the promulgation of the law, standards for fine particulate matters ($PM_{2.5}$) were established only by the end of 2009. The standards are set by the central government and lower levels of governments do not have the authority to introduce other (more or less stringent) air quality standards (AQSs). Furthermore, it should be noted that the law stipulates only an obligation to endeavour to attain the environmental standards but does not require their actual attainment (Matsuno, 2010[43]).

The concentration levels of major pollutants are in line with the domestically set standards with the exception of photochemical oxidants and fine particulate matter (Table 4.1). Since attainment is measured considering compliance at the level of the monitoring station, the results highlight how the air quality is still below the nationally set objectives in several areas of the country for fine particulate matters. Instead, virtually all regions are affected by a concentration of photochemical oxidants above the nationally set standards. However, it should be noted that several AQSs, when comparable, are set at concentration levels higher than those suggested by the WHO.

[8] SPM is defined as a set of particular matters that are all smaller than 10 μm and it is equivalent to PM7. Japan began using SPM as a standard in 1973 when the medical knowledge regarded particles smaller than 10 μm as dangerous to human hurting health. (MoE, 2013[147]). Once PM10 has become the global standard, Japan has continued monitoring SPM since it is more stringent than PM10.

Table 4.1. Air quality standards in selected countries and regions

Substance	Air quality standards in Japan		Air quality standards per WHO guidelines	Yearly average value in 2016	Attainment rate in 2016	JPN rules for issuing alerts
PM2.5	Hourly	n.a.	n.a	11.9 µg/m³	88.7%	Prefectures broadcast an alert when a level of 85 µg/m³ is recorded early in the morning
	Daily	35 µg/m³ *	25 µg/m³			
	Yearly	15 µg/m³	10 µg/m³			
Suspended Particulate Matter (Corresponds to PM7) ***	Hourly	0.20 mg/m³ **	n.a.	0.017 mg/m³	99.6%	Advisory: 2 mg/m³ lasts 2 hours Warning: 3 mg/m³ lasts 3 hours
	Daily	0.10 mg/m³ *	n.a.			
	Yearly	n.a.	n.a.			
PM 10 ***	Hourly	n.a.	n.a.	Not measured	n.a.	n.a.
	Daily	n.a.	50 µg/m³			
	Yearly	n.a.	20 µg/m³			
Sulphur dioxide	Hourly	0.1 ppm (=262.3 µg/m³) **	500 µg/m³ ****	0.002 ppm (=5.24 µg/m³)	100%	Advisory: 0.2 ppm lasts 3 hours, or 0.3 ppm lasts 2 hours, or more than 0.5 ppm, 48 hours average exceeds 0.15 ppm Warning: 0.5 ppm lasts 3 hours or 0.7 ppm lasts 2 hours
	Daily	0.04 ppm (=104.8 µg/m³) *	20 µg/m³			
	Yearly	n.a.	n.a.			
Nitrogen dioxide	Hourly	n.a.	200 µg/m³	0.009 ppm (=16.9 µg/m³)	100%	Advisory: Hourly average exceeds 0.5 ppm Warning: Hourly average exceeds 1.0 ppm
	Daily	0.04-0.06 ppm (=75 - 113 µg/m³) *	n.a.			
	Yearly	n.a.	40 µg/m³			
Carbon Monoxide	Hourly	n.a.	30 mg/m³	0.3 ppm (=0.34 mg/m³)	100%	Advisory: Hourly average exceeds 30 ppm Warning: Hourly average exceeds 50 ppm
	8 hours average	20 ppm (= 22.9 mg/m³) **	10 mg/m³			
	Daily	10 ppm (= 11.5 mg/m³) *	n.a.			
Photochemical Oxidants	Hourly	0.06 ppm (=117.8 µg/m³) **	n.a.	0.047 ppm****** (=92.3 µg/m³)	0.1%	Advisory: Hourly average exceeds 0.12 ppm Warning: Hourly average exceeds 0.40 ppm (Some prefectures set the threshold uniquely for the middle value around 0.24 ppm)
	Daily maximum 8 hours average	n.a.	100 µg/m³*****			
	Yearly	n.a.	n.a.			

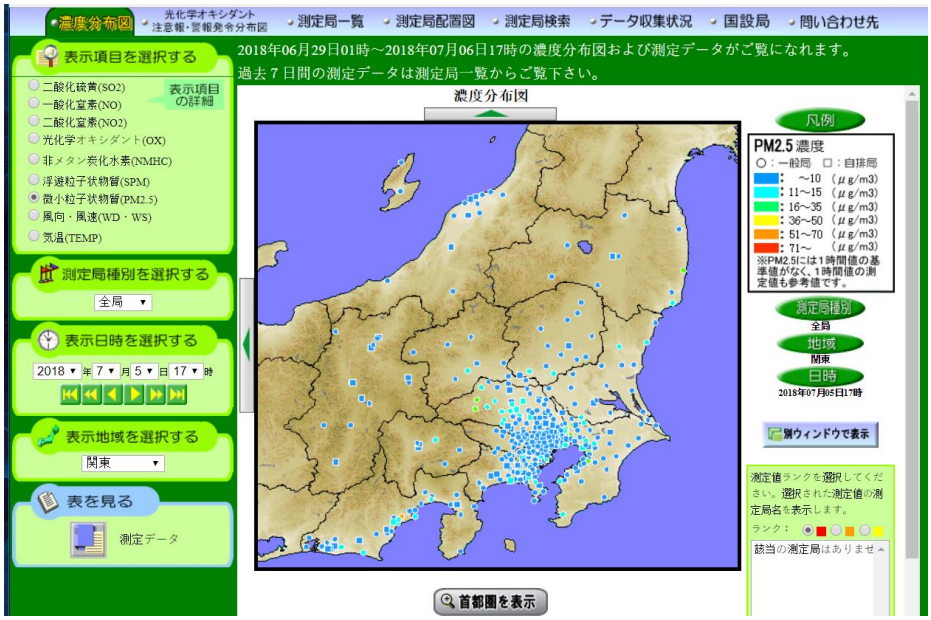
Note: The conversion from µg/m³ to ppm in case of photochemical oxidants is based on the molecular weight of ozone (48 g/mol) since this is the pollutant covered by the WHO daily quality standard. Achievement rate is computed considering monitoring stations that jointly compliance with all the AQSs for a given pollutant (e.g. Daily and yearly concentration for PM2.5) .
"*" marks AQSs that measured as the annual 98th percentile values
"**" marks AQSs that are measured as the annual maximum value
"***" marks that Suspended Particular Matter (PM7) is employed instead of PM10 in Japan
"****" marks AQs that are measures as average of 10-minute
"*****" marks AQs for ozone
"******" marks that this value is yearly average of daytime maximum 1-hour values
Source: (MoE, 2018[44]), (APCA, 2017[45]), (WHO, 2006[46]), (WHO, 2000[47]), (MoE, 2013[48]).

4.2. Air quality monitoring

A continuous monitoring system for 11 air pollutants[9], the atmospheric Environmental Regional Observation System or "Soramame-kun", has been established (Figure 4.1). There are two types of monitoring stations: those for the general atmospheric environment (1,581 stations in 2016), and those for roadside air monitoring (451 stations in 2016). The Soramame-kun website discloses the observed information almost in real time[10] on a distribution map, where concentration values are reported using a colour coding system. Moreover, it discloses the status of photochemical oxidants advisory and warning alerts during the past seven days.

Figure 4.1. Soramame-kun's distribution map

(example of PM2.5 in Kanto region, at 5 p.m. on 5th July, 2018)



When observed concentration values exceed predetermined thresholds, an advisory (注意報) or warning (警) alert is issued (APCA, 2006[17]). In the former case, the prefectural governor informs the population about the worsening air quality and asks for the cooperation of firms to reduce the emissions of soot smoke and VOC as well as for the voluntary restraint of citizens in the use of automobiles. In case of "warning alerts", which are issued for heavier pollution levels, the prefectural governor can request necessary measures to reduce the soot and smoke concentration as well as prohibiting the circulation of vehicles if these are judged to be contributing to the peak in emissions. Warnings are announced to local citizens through a number of media, including TV/Radio, local government website, pre-registered e-mailing service, and smartphone application. (MoE, 2018[3]) (Saitama Prefecture, 2018[49]). Local governments usually have contact points where citizens can report critical air quality events (MoE, 2018[19]). In 2017, advisory alerts for photochemical oxidant pollution were issued in eighty-seven days while only twice for $PM_{2.5}$. No other advisory or warming alert was issued.

[9] Sulfur dioxide (SO_2), Nitric oxide (NO), Nitrogen dioxide (NO_2), nitrogen oxides (NO_x), Carbon monoxide (CO), Photochemical oxidant (OX), Non-methane hydrocarbon (NMHC), Methane (CH4), total hydrocarbon emissions (THC), Suspended particulate matter (SPM), Micro particulate matter ($PM_{2.5}$).

[10] Data are published with a two hours delay.

4.3. Policies and regulatory tools to improve air quality

4.3.1. Setting long-term objectives

The Basic Environmental Plan (BEP) is a multi-annual framework that sets the long-term objectives for environmental policy. The plans, whose implementation is assessed by the Central Environmental Council and the Ministry of Environment, are drafted in coordination with multiple ministries and provide guidance for budget allocation (OECD, 2010[18]).

The latest BEP (2018) does not include air pollution among its main cross-disciplinary strategic objectives, thus underlining the current lower priority of this topic. This is partially contradictory since the final review of the previous basic plan highlighted the low attainment rate of air quality standards for both photochemical oxidants (0% for both stationary and mobile measures) and PM2.5 (74.5% for stationary measurement, and 58.4% for mobility measurement) (MoE, 2015[50]). However, regardless of this lack of an explicit focus on air pollution, numerous measures of the current BEP are likely to support better air quality (e.g. promotion of renewable energy, compact city, higher usage of public transport and bicycle, and efficient EIA). (MoE, 2018[51]). Furthermore, the plan highlights the importance of PM2.5, photochemical oxidants and asbestos for the "overall environmental risk management", which is among the six main strategic objectives identified.

Prefectures often develop multi-year environmental plans as well. These, while adapting to local characteristics, follow a similar structure to the BEPs and provide an overview on the prioritised policy objectives and planned measures (see Box 4.1) (Ogata, 2006[52]). However, there is no evidence that these reviews influence the annual planning and budgeting processes (OECD, 2010[18]).

Box 4.1. The Tokyo Environmental Master Plan

While air quality in Tokyo has significantly improved during the past decade, PM2.5 and photochemical oxidants remain key challenges. For instance, PM2.5 concentrations decreased by approximately 55% in the past 10 years but neither the 24-hour nor the annual environmental standard have been recently met. Similarly, while the concentration of photochemical oxidants has diminished, the relative environmental standards have not been met at any monitoring stations (and 14 photochemical smog advisory alerts were issued) in 2015.

In light of these challenges, the Tokyo Metropolitan Government (TMG) adopted a new master plan with progressive milestones in 2016. The city has introduced a short-term target of zero days with photochemical smog advisory alerts by FY2020 and a long-term target to reduce the concentration of photochemical oxidant to 0.07 ppm or less at all monitoring stations by FY2030 (a level still higher than the current domestic AQS). In addition, the plan aims at an achievement rate for the national PM2.5 air quality standard equal to 100% by FY2024. Planned measures include promotion for the purchase of certified domestic appliances and low-emission vehicles, technical support for business with facilities that emit soot and smoke, increased cooperation with surrounding local governments and research on the generation mechanism of photochemical oxidants.

Furthermore, the city is putting in place a number of measures to improve the sustainability of the 2020 Olympics Games. The "Tokyo 2020" Sustainability Plan, which aims at ensuring that the SDGs are incorporated in the planning of the Games, is articulated around five main sustainability themes: Climate Change; Resource Management; Natural Environment and Biodiversity; Consideration of Human Rights, Labour, Fair Business Practices and Involvement, Cooperation and Communications. A number of actions to be implemented along themes are likely to contribute to improve air quality as well. Examples include:

development of green areas, promotion of the use of public transport and the development of eco-driving awareness-raising campaigns.

Source: (Tokyo Metropolitan Government, 2016[53]) (Tokyo 2020, 2018[54]).

4.3.2. Industry

Emission Limit values

The SO_x emission limit value regulations are relatively more complex than those enforced in other OECD countries, partially due to historical reasons. Spurred by the severe air pollution problem during the middle of last century, the *Air Pollution Control Law* (1968) introduced two main provisions to control the emission of this pollutant: the so called "K-Value" Regulation and the Regulation on Total Emissions.

The K-Value Regulation mainly aims at decreasing the concentration of SO_2 at the ground level. To this end, the allowable emission limit for each facility is determined according to the following formula:

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

where q is the permissible hourly emission volume of sulphur oxides (m^3/h); He is the effective height that is equal to the sum of the actual height of the stack and the exhaust gas ascent height; and K is a constant whose value varies according to the region where the plant is located. As such, while being a national regulation, the emission limit values are inherently *geographically differentiated.* The K values are listed on the MOE website[11].

Whereas the K-Value Regulation is applied at the facility level, the *Regulation on SO_x Total Emissions* is set at plant-level and targets large-scale installations. This was introduced to avoid an expansion of the polluted area due to firms building higher stacks in order to comply with the K-value regulation (Matsuno, 2010[43]). To this end, the regulation introduces a cap – which varies according to plant vintages – on total facility emission in certain designated areas. The permitted amount of emissions "Q" is calculated using a formula that takes into consideration the fuel consumption of heavy oil equivalent (kl/h) of both existing (W) and new facilities (Wi). The other two variables included in the formula, namely "a" and "b", are set by local governments, given a range established by law, taking into account air quality in the area and the target set in their emission reduction plan.

New plant	Existing plant
$Q = aW^b + ra\{(W+Wi)^b - W^b\}$	$Q = aW^b$

Similarly, NO_x emissions are also regulated though both standards, which vary according to the technology employed, and caps on total emissions, which are enforced only in selected regions.

Instead, the approach to PM standard setting is similar to those developed in other countries. In fact, soot and dust standards vary according to the technology employed and the geographic location of the plant (Table 4.2).

Both emission limit and total emission values are vintage-differentiated, thus imposing more stringent requirements on new firms than on existing firms. Vintage differentiation regulations are relatively common across OECD countries and are often justified on political economic grounds since they reduce the impact of new regulations on existing assets. However, at the same time, they create an uneven playing field for new entrants since they face stricter regulations. The possibly resulting lower rate of entry of new firms may slowdown the upgrade of the capital stock and therefore lead to slower penetration of less emissions-intensive technology. For some Japanese regulations, the cut-off date to distinguish new and old plants is

[11] https://www.env.go.jp/en/air/aq/air/air3_table.html.

set as the year of the entry into force of the law (e.g. 1965 or 1974), therefore the pool of ("old") facilities subject to less stringent standards is likely to be small but potentially very polluting. However, the number and the impact that these facilities are not well understood and should be subject of further investigation.

Best available techniques- (or BATs-) based emission standards have been recently adopted but only for mercury emissions in selected sectors. Following the entry into force of the "Minamata Convention on Mercury" on August 2017, Japan has modified its air pollution control act to establish the obligation to consider best-available technologies for emission standards for new facilities emitting mercury in selected sectors (MoE, 2016[55]). These include: coal-fired power plants; coal-fired industrial boilers; smelting and roasting processes used in the production of non-ferrous metals; waste incineration facilities; cement clinker production facilities.

Table 4.2. Summary table - standards for stationary sources

	Pollutant	Vintage differentiation (existing / new plant)	Geographic differentiation	Responsible for setting Emission Limit Value (ELVs)
Standards	PM	No differentiation (see geographic diff.)	Special limits for new plants in specified areas (9 areas)	Central GOVs but Prefectures can introduce stricter standards
	NO_x	No differentiation	No differentiation	Central GOVs but Prefectures can introduce stricter standards
	SO_x	No differentiation (see geographic diff.)	Lower (more stringent) K-values for new plants in specified areas (28 areas)	Government sets the K-value
Total emission limits	SO_x	Yes	Applicable only to plants in specified areas (24 areas)	Prefectures based on emission reduction plans
	NO_x	No differentiation	Applicable only to plants in specified areas (3 areas)	Prefectures based on emission reduction plans

Source: (MoE, 2012[56]) , (MoE, 2018[57]).

Permitting

New facilities regulated under the Air Pollution Control Law are required to submit a notification to the Prefectural governor before starting operations. Information to be submitted by the permit applicant include the location and map of the soot and smoke equipment, size and capacity of the facility, amount of discharged air pollutant, air pollutant *treatment and discharge method* and fuels used (MoE, 2018[58]). If the new facilities are located in the special areas designated for the total emission regulation for SO_x or NO_x, an additional document needs to be submitted to the prefecture governor or city mayor in order to ensure that the expected emissions do not exceed the total limits.

Business operations cannot start until 60 days have elapsed from the date when the notification to the governor was accepted. Local governments verify whether the facility can comply with enforced emission standards considering facilities equipment, operating procedures and disposal method of soot and smoke (MoE, 2018[19]). Any change to the structure of the facility, its use and technology to dispose soot and smoke needs also to be communicated to the prefectural governor (APCA, 2006[17]). There is no other formal condition imposed on the operators as part of the permitting procedure, which is the same for large and small factories even if emission limit values vary according to the size of the plant.

Pollution control manager

Large companies are required to establish the positions of a "Pollution Prevention General Manager" and of "Pollution Control Managers" (Box 4.2). These are open only to candidates that have passed a national examination managed by the JEMAI, an independent association financed by the companies' membership and candidates' examination fees. At the present, there are 13 types of pollution control managers, whose qualifications vary according to the type of factory, its scale and relevant pollutants (JEMAI, 2018[59]). They are responsible for the maintenance and management of pollution prevention equipment as well as for the implementation of the necessary measures in case of an incident. The association also plays a role in facilitating compliance and updating the skills of its members (see section 4.3).

Box 4.2. Pollution Control Manager

The 1971 law on "improvement of pollution prevention systems" established an obligation to create several positions in charge of pollution control for firms operating in certain sectors. These sectors include electric power supply, gas supply, heat supply, and manufacturing.

The type and complexity of the required organisational structure varies according to the size of the facilities. Firms with less than 20 full-time employees are mandated to hire "Pollution Control Managers" who both oversee the operation and maintenance of the facilities and control the quality of fuel and raw materials. An additional layer of control, namely a "Supervisor of Pollution Control" is required for firms with more than 20 full-time employees. Finally, larger firms, which are defined as factories generating more than 40,000m3 of soot per hour and discharging an average of more than 10,000m3 of wastewater per day, are mandated to hire also a "Chief Manager of Pollution Control". Importantly, this personnel perform these functions alongside other duties within the organisation.

Source: (JEMAI, 2018[59])

Taxes

The only form of environmental taxation concerning air pollution is a levy on SO_x emissions which, however, is often considered more as an "environmental liability instrument". The main purpose of this levy is to secure funding to compensate the sufferers – certified by 1987 – of diseases due to air pollution. In order to set the levy rate, the costs to cover health expenditures for certified patients is estimated each year and then apportioned to emitters proportionally to their 1982-86 emissions (48% of the cost) and current annual emissions (32% of the cost). The remaining 20% is financed through the automobile tonnage tax (see Box 3.1 on ERCA). Therefore, companies that had emitting facilities operating until the 1st April 1987 remain liable even if these plants are (or will be) closed. Instead, newly established firms are not required to contribute to the fund unless they install a soot- and smoke-producing equipment in an existing plant (i.e. they start emitting air pollutants from an existing facility).

This structure affects incentives to abate emission for both new and existing firms. The exclusion of new firms – while due to the objective underpinning this policy, namely the introduction of an environmental liability instrument rather than an emission tax – is particularly problematic from the point of view of ensuring that polluters internalise the environmental externalities of their production choices. At the same time, existing firms may face lower incentives to abate emission since lower pollution would lead only to a limited decrease of the payments because these depend on the health costs of patients.

Subsidies

Currently, few incentives are available to firms for the installation of pollution abatement equipment. The main instrument consists in subsidised loans provided by Japan Finance Corporation (JFC). These are offered to enterprise undertaking environmental and energy related investments, with a specific focus on SMEs that emit precise substances that cause air pollution such as smoke, volatile organic compounds or asbestos (Table 4.3). Examples of equipment purchasable through this scheme include: dust collection / dust removal equipment; cleaning, neutralisation, adsorption and reduction equipment and/or measurement and analysis equipment (JFC, 2018[60]). However, loans disbursed for environmental and energy investments accounted only for 3.2% (50.4 billion yen) of the total loan operations in 2016 (JFC, 2017[61]).

Table 4.3. Air pollution-related low interest loan by JFC as of 2018

	Small and Medium sized Entities	Micro businesses and individuals	**Agriculture**
Loan Purpose	Environment and energy related investments such as initiatives for non-fossil fuels, energy saving, asbestos, PCB-waste, and low pollution vehicles		Investments for appropriate disposal of domesticated animals' excrement
Maximum amount of loan	JPY 720 million	JPY 72 million	Lower of either 80% of actual cost or the following; (Individual) JPY 35 million, (Corporation) JPY 70 million
Interest rate (depends on condition)	0.3 % - 2.75%	0.3% - 1.45%	0.3%
Loan period	20 years	20 years	20 years

Source: (JFC, 2018[62]).

Furthermore, incentives are in place to support the installation of renewable energy technologies, which indirectly contributes to the promotion of air quality. Feed-in tariffs are in place since 2012 (IEA, 2018[63]) while a subsidy covering half of the investment cost for local governments and one third for private industries has been established for off-grid self-consumption renewable energy generation (Agency for Natural Resources and Energy, 2018[64]).

Following the 2004 Law Concerning Promotion of Business Activities with Environmental Consideration, several measures encourage the adoption of environmental management systems (EMS). These often focus on ECO Action 21 that is an EMS developed by the Ministry of Environment and currently managed by the Institute for Global Environmental Strategies (IGES). To favour its diffusion, some local governments offer subsidies to cover certification-related expenses (e.g. consulting fees) while ECO-21 compliant firms often benefit from additional qualification points in bidding procedures for public construction works. More precisely, several prefectures have adopted qualitative criteria for bids evaluation, such as whether the business is rooted in the local community or whether the rate of employees with disabilities is higher than the target rate set by the promotional act. Compliance with Eco Action 21 is also included even if it provides limited additional points compared to the other qualitative criteria considered (e.g., 4 points in a case of Osaka) (IPSuS, 2018[65]) (Industrial Waste Management Foundation, 2013[66]). In addition, Development Bank of Japan considers compliance with ECO Action 21 as a condition for investment and lending activities (DBJ, 2018[67]) while several banks offer special loan programs to certified firms (IPSuS, 2011[68]).

Voluntary approaches

The wide use of Voluntary approaches is a unique feature of Japanese pollution control measures. Two different types of voluntary approaches are common in Japan. The first is an approach where local

governments negotiate "pollution control agreements" (or PCAs) with firms. These proliferated in the late 1960s when local governments, which had limitedly authority to regulate emissions, started resorting to this instrument in order to respond to the increasing demand for pollution control measures by local citizens. Their development is de facto encouraged by the national government that collects signed PCAs as references for new agreements (Matsuno, 2010[43]). However, there is no updated estimations of the total number of PCAs currently in effect. The second type of VAs commonly used in Japan are unilateral commitments by industrial organisations (or "voluntary action plans - VAPs"), which are a more recent development and became more common in the mid 1990s (Börkey et al., 1999[69]).

The development of PCAs has attracted both criticisms and praises. On the one hand, supporting authors underline how the higher flexibility of these instruments can allow to both better match the pollution control measures to local conditions and to respond faster to local issues. On the other hand, critics have often highlighted how the legal ground of PCAs is often not clear, thus their enforceability can be questioned. Furthermore, a risk of redundancy between the laws and the PCAs and the sometime limited transparency that characterise the negotiations between public authorities and firms have also been highlighted as problematic (OECD, 2003[70]). Finally, some authors question the extent to which firms voluntarily enter PCAs (Matsuno, 2007[71]). The difficulties to empirically test their impact add to the ongoing debate on the pros and cons of this approach (Elliott and Okubo, 2016[72]).

Nevertheless, the extent to which this approach can be replicated in other countries is highly debated. In fact, the Japanese culture of "co-operative regulation" has often been considered as cornerstone for the efficacy of PCAs to pollution control. Within this context, a bureaucracy that is perceived as relatively efficient and "not prone to scandals" has allowed to build the necessary mutual trust between public authorities and regulated companies for the system to thrive (OECD, 2003[70]). In this regard, it should be noted that the recourse to voluntary approaches is much less common in other OECD countries. For instance, the latest available estimates put the number of PCAs in Japan at around 30.000 (1999) while in similarly dated surveys the EA (1996) counted approximately 300 national-level approach in Europe[12] (1996) and Brouhle et al. (2005) noted that "*negotiated agreements […] are relatively rare in the U.S*" (2005) (Brouhle, Griffiths and Wolverton, 2005[73]).

Voluntary approaches are expected to continue to play an important role in controlling air pollution through a "best mix approach". This is generally defined as controlling emission through a combination of regulatory and voluntary measures (MoE, 2018[74]) and it is explicitly mentioned by the Air on Pollution Control Act (APCA). More precisely, the Act has been revised in 2006 with the objective to decrease volatile organic compounds (VOCs) emission by 30% compared to levels recorded in 2000 (APCA, 2006[17]). To this end, the APCA was amended to introduce new VOCs emission standard and an obligation for facilities to both measure VOCs emission at least twice a year and to report establishment or any modification to existing emitting facilities (METI, 2010[75]). At the same time, the Act mentions how voluntary initiatives are expected to further contribute to reduction in pollution. In this context, numerous industry-wide initiatives were lunched (Box 4.3). The approach is considered as successful since VOCs emission were reduced by more than 40% compared to FY 2000 in 2010 and almost halved since the entry into force of the VOC regulation (from 1,065,791 tonnes in 2006 to 671,567 tonnes in 2016) (MoE, 2018[76])

Box 4.3. Voluntary approaches and VOCs

In 2006, a revision of Air Pollution Control Act targeted a 30% reduction of VOCs emission by 2010 compared to levels observed in 2000. The revision mandated businesses over a certain size to comply

[12] The 1996 review focused only on "..those commitments undertaken by firms and sector associations, which are the result of negotiations with public authorities and/or explicitly recognised by the authorities" (European Environment Agency, 1997).

with newly set VOCs emission standards and mentioned how emission reductions should be achieved through an appropriate combination of legal tools and voluntary initiatives by businesses (APCA, 2006[17]).

To this end, numerous industry wide initiatives (so called voluntary action plans) were lunched. The participation to these programs is voluntary but a relative high number of firms joins due to multiple reasons. Businesses often consider these initiatives as a useful tool to pursue their companies' own Corporate Social Responsibility (CSR) objective. Furthermore, there is a general understanding that these initiatives need to be successful in order to avoid that the government introduces new regulations. In addition, there is often informal peer pressure within the industry to join. Recent data (2015) report more than 40 industry associations with program on VOCs reduction (METI, 2017[77]).

A particularly successful example is provided by the printing sector where over 90% of the industry (base on shipment value) joined the voluntary initiatives as of 2015 (METI, 2017[77]). Participants are required to independently establish their own reduction targets and submit a voluntary action plan to the industry association. Then, their progress against their own targets are reviewed yearly by the Association (METI, 2010[75]). In addition, labelling schemes, such as the Green Printing Certifications, incentivise firms' participation (JFPI, 2018[78]).

4.3.3. Mobile sources

Japanese vehicle emission standards, as well as fuel efficiency targets, are jointly developed by a number of Ministries (MoE, MLIT and METI) **in cooperation with the Central Environment Council.** Importantly, emission standards are adopted under the authority of the "Air Pollution Control Act", while fuel efficiency targets are established under the "Law Concerning the Rational Use of Energy". In addition to emission standards (Table 4.5 and Table 4.6), also efficiency standards have been introduced and, while targets were established with a timeframe up to 2020, they were met by industry already in 2013 (Yang and Bandivadekar, 2017[79])

The Worldwide Harmonized Light Vehicles Test Procedure (WLTP) has been recently introduced to test vehicles emissions. The adoption of the worldwide UN standards is expected to increase the adherence of vehicles emission on road to those observed in laboratory tests thanks to the introduction of more realistic and a wider variety of driving conditions (urban, suburban, main road, motorway) in the testing procedure (Box 4.4) (ACEA, 2018[80]).

Box 4.4. Measuring vehicle emissions

The Worldwide Harmonized Light Vehicles Test Procedure (WLTP) – approved by UNECE in 2014 and adopted by several countries (Europe and Japan in 2018, China, India and South Korea in 2021) – is expected to reduce the gap between emissions measured during the testing phase and in real-world conditions (UNECE, 2017[81]) (Alphabet, 2018[82]). The studies analysing how measured pollutant emissions vary when domestic testing procedures and the WLTP procedure is adopted seems to confirm the higher stringency of this approach. For instance, as far as local pollutants are considered (NO_x, CO, PM, THCs), evidence seems to suggest that the WLTP will lead to an increase (and more realistic) measurement of emission compared to the New European Driving Cycle (NEDC), which is the test-procedure used in Europe until 2017 (Pavlovic et al., 2018[83]), and to the JC08, which is the test-procedure used in Japan until October 2018 (Kühlwein, German and Bandivadekar, 2014[84]).

However, the WLTP is still a laboratory test and does not accurately represent real-world emissions. For instance, the ICCT and Element Energy (2015[85]) estimate that real-world CO2 emission will be still 23% higher than those observed during the testing phase. For this reason, several countries – including Japan – are planning to complement laboratory test with emissions measurement in Real Driving Conditions

(RDE). Within these procedures, emissions are measured by portable emission measuring systems (PEMS) that are attached to the car while driving on the road according to random variations of parameters such as acceleration, deceleration, ambient temperature, and payloads. RDE is expected to be introduced in Japan for diesel vehicles in Japan in 2022 (MLIT, 2018[86]).

In order to improve air quality in congested areas, the NO_x/PM Act was introduced in 2002. The Act originally required the government to develop a national basic policy to bring NO_x and SPM concentration levels more closely in line with the relative AQSs by 2010 in the major cities of 8 prefectures (e.g., Tokyo, Osaka, etc.). The measures introduced to this end included a ban on the registration of older and polluting vehicles within these cities (un-registered vehicles cannot circulate) and a mandate for businesses to submit (and annually report on) "vehicle usage plan" to reduce NO_x and PM emission (e.g. shift to less polluting vehicles, reduce vehicle usage via modal shift, etc.). After an evaluation in 2011, the target was revised to the complete compliance with the NO_x and SPM AQSs by 2020. A 2015 interim review concluded that 1 city and 3 prefectures had the met the 2020 target of NO_x and SPM by 2015. (MoE, 2017[87]).

In order to reduce information asymmetries for consumers, numerous vehicle labelling tools have been introduced. This labelling scheme reports whether a vehicle is compliant – for instance – with the 2018 standards or whether it over-performs it by a certain percentage (e.g. emissions are 25%, 50% and 75% lower than the 2018 standard) (JAMA, 2017[88]). In 2018, a certification system for refuelling stations equipped with devices that reduce emissions due to fuel evaporation, which is one of the causative substances of photochemical oxidants and PM 2.5, has been established (MOE, 2018).

With the introduction of dedicated tax incentives in 2009, the registration of eco-friendly vehicles dramatically increased in recent years. JAMA (2017[88]) estimates that the (so-called) next-generation vehicles – which includes hybrid, plug-in hybrid, electric, fuel cell, clean diesel, and other new-energy vehicles – accounted for almost 35% of new passenger car registrations in 2016 . The tax breaks for these vehicles focus on three main automotive taxes: tonnage, acquisition, and ownership (Table 4.4) (Kuramochi, 2014[89]). In addition, since the tonnage tax is levied according to the type and the weight of the vehicle, this provides a general but indirect effect to reduce emissions of pollutants across all engine technologies. The uptake of electric vehicles is further promoted through subsidies for the installation of chargers at private facilities (NGVPC, 2018[90]).

Table 4.4. Tax reduction for Eco-friendly vehicles

(Example of passenger cars, as of August 2018)

		Alternative Energy Vehicles*	Conventional vehicles						
			Emission level:	Emission down by 75% from 2005 standards or Emission down by 50% from 2018 standards					
			Fuel Efficiency:	+50% from 2020 standard	+40% from 2020 standard	+30% from 2020 standard	+20% from 2020 standard	+10% from 2020 standard	+0% from 2020 standard	+10% from 2015 standard
Acquisition Tax	New vehicles	Exempt				80% reduction	60% reduction	40% reduction	20% reduction	N.A.
	Used vehicles	¥450,000 deduction				¥350,000 deduction	¥250,000 deduction	¥150,000 deduction	¥50,000 deduction	N.A.
Tonnage Tax		Exempt**		Exempt		75% reduction		50% reduction	25% reduction	N.A.***
Automotive Tax		75% reduction**					50% reduction		N.A.	N.A.

Note:
"*" New Alternative Energy Vehicles (AEV) include Electric vehicles, Fuel cell vehicles, Plug-in hybrid vehicles, Clean diesel vehicles (only vehicles complying with 2009 or 2018 emission standards), Natural gas vehicles (with NO_x emissions down by 10% from 2009 emission standards, or complying with 2018 emission standards).
"**" marks that exemption applies on first inspection mandated for new vehicle and for the 1st vehicle inspection post-purchase
"***" marks that when they undergo the initial inspection from May 2018 to April 2019, they will be eligible for a 25% reduction for tonnage tax .
Source: (JAMA, 2017[88]).

As diesel cars are included in the group of vehicles that benefit from the eco incentives, their sales have surged in recent years with potential negative impact on air quality (Figure 4.2). The eco-incentives have been established mainly as a tool to achieve the long-term carbon reduction targets of Japan and therefore diesel-powered vehicles were included due to their lower CO_2 emissions. However, this type of engines pose particular issues for air quality because of their higher emissions of traditional pollutants. While the penetration rates of diesel passenger cars in Japan is almost nil, the rapid growth rate of sales promoted by the incentives suggest that potential issues may emerge in the short-medium term. This is particularly important given also the improved understanding on the link between air pollution and lung cancer that paved the way for the classification of diesel as a definite carcinogenic by the International Agency for Research on Cancer (IARC, 2012[91]; Roy and Braathen, 2017[92]).

In addition, as in most OECD countries, petrol is taxed more heavily than diesel. Environmental considerations call for the removal of the diesel differential since there is no environmental reason to attach a tax preference to diesel. However, as the recent experiences of environmental tax reforms show, appropriate measures need to be introduced to mitigate the potential distributive implications of such changes (Arlinghaus and Van Dender, 2017[93]).

Table 4.5. Tax on diesel and gasoline

USD/Litre

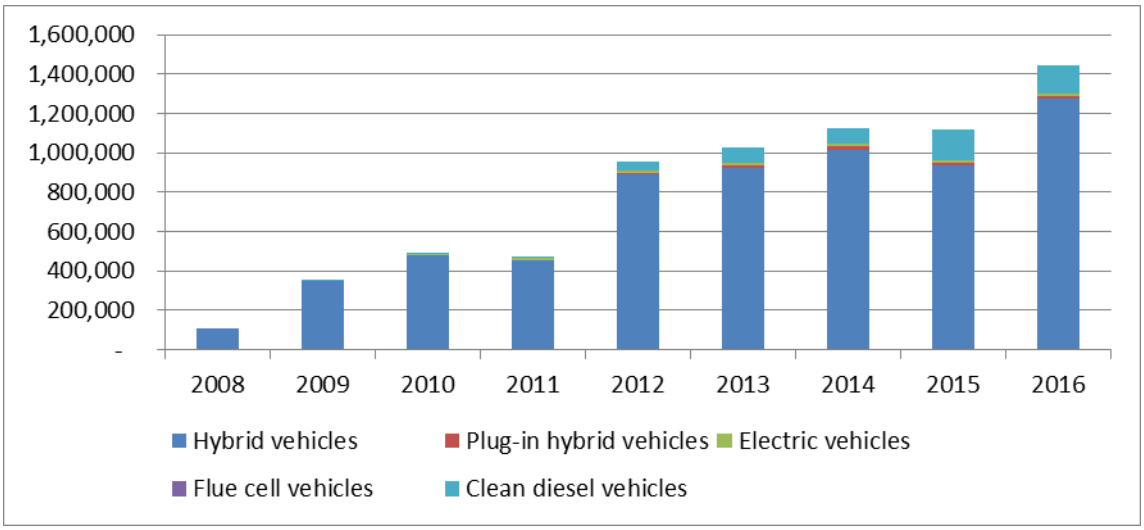
	Diesel	Gasoline
Japan	0.49	0.3
Korea	0.82	0.57
OECD Average	0.54	0.71

Source: OECD Green growth indicators.

Another potential issue lies in the road pricing schemes that often encourage long-distance driving, including over routes that are very well served by fast train. Currently there is a 30% midnight discount on motorway tolls for all types of automobiles in order to mitigate the daytime peak traffic. If this is combined with the long-distance use discount, which provides an additional 10% reduction on road toll for trips over 100km and a 20% discount for trips over 200km, then total discounts is in the 30% to 50% range. A similar situation applies to urban motorways where specific discounts (named as "environmental road pricing") are offered to divert large-size vehicles from congested roads within residential areas in certain cities (e.g. it ranges between 10% to 20% discount in Kanto and around 30% on Hanshin Expressway in Kinki) (MLIT, 2014[94]). Nevertheless, some interesting reforms are being undertaken. For instance, the Japan Express Holding re-organised the toll rates of expressways in Tokyo in order to reflect distance-travelled (MLIT, 2018[95]).

Figure 4.2. Next generation passenger car – new registrations

Vehicle units, 2017



Source: (JAMA, 2017[88]).

Table 4.6. Emission standards for passenger cars

	Panel A. Emission standards for Diesel cars					
Vehicle weight	Type of test	Year of introduction	Unit	PM	NOx	CO
All cars	WLTP	2018	g/km	0.005	0.15	0.63
	Panel B. Emission standards for Gasoline cars					
All cars	WLTP	2018	g/km	0.005	0.05	1.15

Source: (DieselNet, 2015[96]) (MLIT, 2018[97]).

Table 4.7. Emission standards for Commercial vehicles

	Panel A. Emission standards for diesel light commercial vehicles					
Vehicle weight	Type of test	Year of introduction	Unit	PM	NOx	CO
> 1700 kg	WLTP	2019	g/km	0.007	0.24	0.63
≤ 1700 kg	WLTP	2018	g/km	0.005	0.15	0.63
	Panel B. Emission standards for gasoline light commercial vehicles					
Mini	JC08	2009	g/km	0.005	0.05	4.02
≤ 1700 kg	JC08	2009	g/km	0.005	0.05	1.15
> 1700 kg	JC08	2009	g/km	0.007	0.07	2.55
Mini	WLTP	2019	g/km	0.005	0.05	4.02
≤ 1700 kg	WLTP	2019	g/km	0.005	0.05	1.15
> 1700 kg	WLTP	2019	g/km	0.007	0.07	2.55
	Panel C. Emission standards for diesel heavy commercial vehicles					
All weights	WHTC	2016	g/km	0.010	0.40	2.22

Source: Panels A and B: (DieselNet, 2015[96]) (MLIT, 2018[97]). Panel C: (MLIT, 2018[98]) (MLIT, 2018[97]).

5. Monitoring & enforcement of regulations

The monitoring and enforcement activities in Japan are geared towards guiding economic actors towards compliance with limited recourse to fines and penalties. This is, for instance, clearly visible in the ratio between administrative guidances issued after inspection and the quasi-absence of sanctions. Several authors point out how the success of this approach seems to be based on very specific features of the Japanese system where regulations are devised and introduced via a co-operative process with the various stakeholders (OECD, 2003[70]) (MoE, 2018[3]) and where the reputational consequences of non-compliance can be large (OECD, 2009[99]). There have been no major reforms to the regulatory monitoring and enforcement practises in the past years. As such, the following pages will only briefly summarise the key features. Greater attention is paid to mobile sources, given the role that these play in PM emissions.

5.1. Monitoring

Box 5.1. OECD Best Practice Principles Regulatory Enforcement and Inspections

The OECD "Best Practice Principles for Regulatory Enforcement and Inspection" address the design of the policies, institutions and tools to promote effective compliance. These are based on extensive review of practices in OECD and non-OECD countries and are intended to represent an overarching framework to support initiatives to improve regulatory enforcement (OECD, 2014[100]). The principles are:

1. Evidence based enforcement. Regulatory enforcement and inspections should be evidence-based and measurement-based: deciding what to inspect and how should be grounded on data and evidence, and results should be evaluated regularly.
2. Selectivity. Promoting compliance and enforcing rules should be left to market forces, private sector and civil society actions wherever possible: inspections and enforcement cannot be everywhere and address everything, and there are many other ways to achieve regulations' objectives.
3. Risk focus and proportionality. Enforcement needs to be risk-based and proportionate: the frequency of inspections and the resources employed should be proportional to the level of risk and enforcement actions should be aiming at reducing the actual risk posed by infractions.
4. Responsive regulation. Enforcement should be based on "responsive regulation" principles: inspection enforcement actions should be modulated depending on the profile and behaviour of specific businesses.
5. Long term vision. Governments should adopt policies on regulatory enforcement and inspections: clear objectives should be set and institutional mechanisms set up with clear objectives and a long-term road-map.
6. Co-ordination and consolidation. Inspection functions should be co-ordinated and, where needed, consolidated: less duplication and overlaps will ensure better use of public resources, minimise burden on regulated subjects, and maximise effectiveness.
7. Transparent governance. Governance structures and human resources policies for regulatory enforcement should support transparency, professionalism, and results-oriented management. Execution of regulatory enforcement should be independent from political influence, and compliance promotion efforts should be rewarded.
8. Information integration. Information and communication technologies should be used to maximise risk-focus, co-ordination and information-sharing – as well as optimal use of resources.
9. Clear and fair process. Governments should ensure clarity of rules and process for enforcement and inspections: coherent legislation to organise inspections and enforcement needs to be adopted and published, and clearly articulate rights and obligations of officials and of businesses.
10. Compliance promotion. Transparency and compliance should be promoted through the use of appropriate instruments such as guidance, toolkits and checklists.
11. Professionalism. Inspectors should be trained and managed to ensure professionalism, integrity, consistency and transparency: this requires substantial training focusing not only on technical but also on generic inspection skills, and official guidelines for inspectors to help ensure consistency and fairness.

5.1.1. Stationary Sources

Self-monitoring and inspections

Self-monitoring requirements for firms increase in relation to their environmental impact (Table 5.1). The regulations require measurements to be performed either directly by the regulated firm or by third parties (i.e. accredited laboratories) following specific procedures and techniques (e.g. for NO_x, the measurement methods should follow Japanese Industrial Standard k0104). Emitters are also required to store the results of their analysis for at least three years (The Regulations for the enforcement of Air Pollution Control Act, as amended in 2016).

Table 5.1. Obligation of pollutants emission measurement

		Emission gas volume	Minimum frequency	Note
Soot and Smoke	SO_x	>= 10Nm^3 / hour	Every two months	24 hours monitoring required for those subject to total emission regulations
	NO_x	>= 40,000 m^3 / hour	Every two months	24 hours monitoring required for those subject to total emission regulations
		< 40,000 m^3 / hour	Every six months	
	Others (e.g., Soot and Dust, other pollutants such as Cadmium, etc.)	>= 40,000 m^3 / hour	Every two months	
	< 40,000 m^3 / hour	< 40,000 m^3 / hour	Every six months	
VOCs			Every one year	
Asbestos			Every six months	Concentration standard is 10 fibres per 1 L air
Mercury		>= 40,000 m^3 / hour	Every four months	
		< 40,000 m^3 / hour	Every six months	

Note: Emission gas volume criteria applied for SO_x (10Nm^3 / hour) is based on SO_x emission. Criteria applied for pollutants other than SO_x (40,000 m^3/hour) is based on overall gas emission of facility.
Source: (APCA, 2016[101]).

While the MoE has released guidelines for the organisation and design of inspections, the ultimate responsibility lies with local governments. The guidelines encourage to schedule inspections so that all facilities are regularly checked but local governments have the autonomy to develop their own prioritisation criteria (MoE, 2008[102]). These usually include the total volume of pollution emission, kinds of hazardous pollutants released, and compliance record, thus allowing for a prioritisation of inspections for higher-risk facilities in line with the OECD Best Practice Principles Regulatory Enforcement and Inspections (Box 5.1) (OECD, 2009[99]) (MoE, 2018[19]). The MoE also issues guidelines on how to draft inspection manuals but, since these are non-mandatory as well, local authorities have adopted different approaches ranging from releasing detailed manuals to developing simple checklists. Overall, the presence of guidelines and manuals are likely to ensure that regulated agents are not confronted with excessive variations depending on the inspectors they are in contact with. Importantly, while this approach based on non-mandatory guidelines is likely to provide Prefectures with the necessary autonomy to cater inspection strategies to the local needs, the extent to which implemented procedures ensure sufficiently uniform standards across regions is not monitored.

The result of inspection is summarised in a form of written reports. In addition, some local governments have developed their own local database to store and manage inspection results. (MoE, 2018[19]). Most prefectures did not introduce a system of inspectors' rotation, thus the same staff is likely to monitor the

same facility over a long time period. This is often considered as a bad practise since it can facilitate corruption.

During the past three years approximately 15% of factories emitting soot and smoke and 60% of those emitting VOCs have been inspected annually (Table 5.2). The number of inspections has also remained relatively stable during this period with the exception of those related to asbestos. In fact, these increased by 35% between 2015 and 2016 due to an earthquake in Kumamoto that damaged numerous old buildings that were built using asbestos, thus requiring an extensive monitoring of emissions from buildings demolition activities (MoE, 2018[103]).

Table 5.2. Number of facilities / factories checked by local governments in 2016

	Total number (by facility)	Total number (by factory)	Inspections (by factory)	Administrative Guidance (by facility)	Administrative Orders (by facility)	Litigation (by facility)
Soot and Smoke	217,673	87,727	14,427	4,422	1	0
VOCs	3,445	1,091	604	76	2	0
Asbestos	12,474	n.a.	23,703	4,971	4	0

Note: Counting for asbestos is based on number of dismantling or demolition of building using materials including asbestos. Direct emitters of asbestos were abolished by the end of 2007.
Source: (MoE, 2018[103]).

5.1.2. Mobile sources

Self-monitoring and inspections

Under the Road Transport Vehicles Act, Japan introduced the "type designation system" (型式指定制度) for mass-produced vehicles (RTVA, 2017[104]). Within this framework, the MLIT is responsible to verify that vehicles to be introduced in the market comply with emission (and safety) standards. Once a new vehicle is approved, the manufacturer is required to ensure that each produced unit meets these standards through a so-called "completion test" (完成検査) (Task-force to ensure the appropriate completion testing, 2018[105]).

Following the recent international scandals surrounding vehicle emission tests, the national government is reviewing the inspection procedure on manufacturers' vehicle "completion tests". These inspections are commonly announced so that companies can prepare the necessary documents and equipment, thus shortening the overall time for the assessment. However, since in recent investigations it emerged that unqualified personnel performed these tests, a task-force has been established to evaluate both the current inspecting and testing procedures. After a four month-long review, the Task-force released a number of recommendations to improve both procedures, including a shift to unexpected inspection and a requirement for companies to record and report the content of the trainings completed by testers (see also section 4.3) (Task-force to ensure the appropriate completion testing, 2018[105]).

Once vehicles are in-use, owners are required to perform periodic inspections. The National Agency for Automobile and Land Transport Technology (NALTEC) operates and manages the inspection system that comprises both periodic and roadside assessments (Table 5.3). The former, whose frequency depends on the vehicle type, are carried out at inspection stations of the national agency or designated maintenance garages (NALTEC, 2016[106]). The latter are instead carried out on the roads in cooperation with the police.

Table 5.3. Valid term of vehicle inspection certificate

		Initial inspection	From the 2nd inspection
Trucks	>= 8 ton	1 year	1 year
	< 8 ton	2 years	1 year
Buses / Taxis		1 year	1 year
Rental cars (Passenger cars only)		2 years	1 year
Mini-sized Trucks Small-sized Motorcycles Large-sized Special Motor Vehicles		2 years	2 years
Private Passenger Motor Vehicles Mini-sized Passenger Motor Vehicles		3 years	2 years

Source: (NALTEC, 2016[107]).

Moreover, the MLIT can conduct sampling-based inspection of in-use vehicles. For instance, following the diesel emissions scandal in 2015, MLIT and MoE jointly conducted emission inspection on 8 existing models of diesel vehicles (6 domestic and 2 imported models) (MLIT, 2015[108]) with the aim of verifying the presence of any discrepancy in emission levels between real driving conditions and in-house tests. Furthermore, the MLIT leverages different channels to collect information on vehicles nonconformities that can potentially require a recall. Information from users is collected through a vehicle malfunction information hotline and a dedicated website. From 2001 to 2015, the MLIT collected annually, on average, 6,000 consumers' reports and it is estimated that between 45% and 80% of these provided complete and reasonable information. On average, emission-related cases accounted for 2% to 3% of effective reports (ICCT, 2017[109]). These data are analysed and integrated with the information on malfunctions reported by manufacturers, police and other relevant agencies to identify potential issues (MLIT, 2018[110]).

5.2. Enforcement

5.2.1. Administrative enforcement

Based on the inspection results, authorities can issue either administrative guidance or administrative orders. Administrative guidance are not legally-binding acts that recommend and provide advice on how to improve pollution control measures. Lack of compliance with these acts does not lead to penalties (Ministry of Justice, 2005[111]). Instead, administrative orders are legal acts that require firms to improve or to suspend operations (Ministry of Justice, 2005[111]) These administrative acts are imposed if a major corrective action is required or if the administrative guidance has been insufficient to ensure corrective actions (APCA, 2006[17]), (OECD, 2009[99]).

Administrative enforcement can start on the basis of either self-disclosed reports or samplings taken by certified inspectors. Once a firm has received a guidance or an order, it is required to submit an "improvement plan" that has to include a timeline for ameliorating interventions. Based on this timeline, the local governments schedule the date of next follow-up inspection (MoE, 2018[19]).

Administrative orders are very rarely issued since the intervention of the authority is already regarded as a sanction due to potentially high reputational damages. A strong culture of compliance results in a very low ratio between the numbers of guidances and orders issued. For instance, during the past three years - on average - 35,555 inspections have been conducted leading to the issuance of 8,087 guidances and only 5 orders (MoE, 2018[103]). Importantly, the details of enforcement decisions (e.g. names of businesses, reasons, etc.) are not publicly disclosed but aggregated data are available on the

MoE website. In addition, corporations are encouraged to publish environmental reports along the guidelines developed by the MoE. These explicitly require to describe the compliance with environmental regulations, including "the status of the compliance with environmental regulations and of the performance of other obligations related to the environment". This information can be disclosed in the section dedicated to "Environmental risk management system" (MoE, 2012[112]).

In case of incidents, the local government can also order to take the necessary measure to prevent the worsening of the environmental consequences. While the facility is responsible for reporting any incident, the MoE and local governments can conduct additional inspections if deemed necessary (APCA, 2006[17]).

There is limited horizontal information sharing on compliance issues. In fact, no specific mechanism has been established to ensure that prefectures share with each other data on violation and inspections results. These information are first reported to the National government that can then decide whether to initiate further investigations and/or inform other prefectures. Within this context, the creation of stronger horizontal coordination mechanisms that would allow Prefectures to directly share information on non-compliance issues may reduce the time to identify similar violations in other regions (OECD, 2018[113]).

For mobile sources, the MLIT can recommend manufactures to recall vehicles that are found in violation of enforced standards. If the manufacturer does not follow this recommendation, then MLIT will publicly announce its noncompliance. If the manufacturer still refuses to act after the public announcement, MLIT will order a recall (MLIT, 2018[110]).

Violation of vehicle emission standards also lead to civil and criminal penalties. For instance, providing a false notification on potentially nonconforming or nonconforming vehicles/devices, failing to take the corrective actions ordered by the MLIT or to collaborate during on-site can result in one year of penal servitude or/ and in fines up to 3 million yen for each person, in addition to a fine up to 200 million yen for each group for each violation (Yang, Muncrief and Bandivadekaricct, 2017[114]). Moreover, considering the scandal of cheating on fuel economy tests in 2016, the Road Transport Vehicle Act was amended in 2017 so that the MLIT can suspend type designation approval for vehicles if it is determined that the manufacturer provided false information in type designation applications (MLIT, 2017[115]).

It is particularly complex to compare the extent to which countries rely on guidance and other enforcement actions. The main reasons are the difference in the tools available to domestic agencies (i.e. the gradation of enforcement response) and the statistical issues due to the non-randomness of inspections. In fact, several countries deliberately target higher risk facilities and therefore the sample of the inspected facilities is not random. As such, a higher (or lower) rate of both violations discovery and/or of recourse to heavier enforcement actions may be the result of a higher (or lower) ability to identify potential violators (Mazur, 2010[116]). Also for these reasons, there is a limited availability of cross-country data on this topic. Keeping these caveats in mind, it should be noted that OECD countries exhibit a large variation in terms of their reliance on fines to correct to violations. For instance, formal enforcement actions (either through civil judicial and administrative enforcement) were initiated for approximately 16% of the federal inspections and evaluations in 2017 in USA while French authorities conducted 20,000 inspections in 2014 leading to 2,300 compliance notices (mise en demeure) and only 950 more formal actions (« sanctions administratives » et « procès-verbaux d'infraction ») (MEDDE, 2015[117]; US EPA, 2018[118]).

5.2.2. Legal liability

The Air Pollution Control Act introduced strict liability for environmental damages. This principle establishes that whenever any air pollutant injures human health, the entity that released such pollutant is liable for any resulting damage. For instance, the PHDCS program operated by the ERCA (Box 3.1) has been considered as a form of administrative damage compensation system whereby victims of pollution can obtain compensations through non-judicial procedures. Victims who are not included in such administrative compensation systems can sue the polluters in court.

There have also been cases in which compensation was demanded from the government for failing to regulate harmful substances. This obligation was first recognised in the landmark decision on the Minamata disease lawsuit where the Japanese Supreme Court (2004) ruled that the failure of the national and prefectural government to exercise their power to control pollution and to enforce regulations was an unlawful act. After this decision, several courts admitted the State liability in other pollution cases. For instance, in 2013 the Osaka High Court held that the national government was liable for failing to regulate asbestos based on the Labour Standards Act and on the Industrial Safety and Health Act (Okubo, 2014[119]) (Osaka Asbestos defense lawyers, 2018[120]).

The penal code establishes several environment-related criminal offences. These include violation of improvement orders or provision of false information (Table 5.4). The decision to initiate prosecution is at the discretion of the local government. When criminal penalties are issued against a company, usually its employees are also convicted of violation.

Table 5.4. Penalties for Soot and Smoke facilities

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	Penalties
Violate order to change a plan or order for improvement	1 year of penal servitude or fine up to 1 million yen
Violate restrictions on Soot and Smoke emissions Violate order of measures on the event of an accident	6 months of penal servitude or fine up to 0.5 million yen
Failure or false notification of setting in place facilities Failure or false notification of changes to the structured of facilities	3 months pf penal servitude or fine up to 0.3 million yen
Failure or false notification of existing facilities Violate restrictions on implementation of facilities False report of emissions, or refuse, obstruct or evade an inspection Failure or false recording, failure in keeping record	Fine up to 0.2 million yen
Failure or false notification of name change, discontinue, or succession	Fine up to 0.1 million yen

Source: (APCA, 2006[17]).

5.3. Promotion of compliance

The main objective of compliance promotion activities is to ensure that regulated entities are aware of their environmental responsibilities and possess the capacity to comply. To this end, countries often leverage a variegated toolbox that includes training or guidance provided during the inspections. In this respect, the practise of relying significantly on administrative guidance rather than sanctions can be regarded as an effective part of the compliance promotion toolkit leveraged in Japan (see section 4.2.1).

In addition, numerous actors contribute to information dissemination activities. The MoE plays an important role in disseminating information about new regulations, often jointly with METI, by developing information and educational materials for the regulated industries and by holding seminars at industrial associations' meetings. However, these initiatives are introduced ad-hoc and on-going training programs, which can be useful to newly established firms, are not offered. Furthermore, a lack of formal evaluation of these initiatives hinder the identification of best-practises. Other actors that promote information dissemination includes the METI that has also developed environment management guidelines for pollution prevention activities (METI, 2007[121]). Furthermore, the Japan Environmental Association for Industry (JEMAI) also

plays a role in disseminating information by organising trainings open to its associates and other interested parties. The initiatives aims at providing pollution control managers with continuous education as well as skilling-up those who engage in environmental work including environmental management system and environmental audit (JEMAI, 2018[122]). JEMAI also shares the latest information regarding environmental laws and pollution control technologies by publishing books and updating its website. Finally, local governments also provide their own regulatory information to businesses by delivering trainings, developing explanatory materials, and attending industrial associations' meetings to disseminate information as needed (OECD, 2009[99]).

Furthermore, the introduction of measures to control the qualifications of personnel in charge of "completion tests" for mobile sources is currently under consideration. In fact, the training of employees responsible for completion tests is currently at the discretion of the manufactures. Following the completion test scandal in 2016, the "Taskforce for appropriate completion test" suggested to introduce a requirement for companies to both record and report the content of trainings completed by testers and to establish programs for continuous skills update. The document also included a recommendation to check if the training and education are conducted in line with the submitted reports during on-site inspections (Task-force to ensure the appropriate completion testing, 2018[105]).

Disclosing non-compliance is a useful approach to promoting adherence to environmental laws both within firms and governments. To this end, several mechanisms contribute to ensure that the general public is informed on the quality of the environment and has access to the results of the monitoring and enforcement activities. For instance, the MoE surveys regional emissions of key pollutants (e.g. soot and dust, SO_x and NO_x) and discloses the results on the attainment rate of the various air quality standards while Soramamekun's system provides almost real time information on the concentration of certain pollutants (MoE, 2018[7]). Information on inspection and enforcement activities is also collected at the national level. To this end, yearly report are released with aggregated data on number of total facilities/factories emitting specific pollutants (soot and smoke, VOCs, and asbestos), the number of (i) facilities/factories inspected, (ii) administrative guidance and administrative orders issued, and (iii) initiated litigation. The report also has some breakdown of numbers by type of administrative guidance and administrative orders[13] (MoE, 2018[103]). Importantly, the details of enforcement decisions (e.g., names of businesses, reasons, etc.) are not publicly disclosed but the guidelines for environmental reports require corporations to describe the status of compliance with environmental regulations. The MLIT also discloses information about automotive recalls on its web site while, on a dedicated online database, users can search information on recall reports, remedial actions taken, and malfunctions by vehicle type (MLIT, 2018[123]).

The Act on Promotion of Business Activities mandates certain corporations to publish annual environmental reports. However, this duty is limited to "specified business operators", which are defined as corporations established under special laws or under government order (e.g. the national university corporations or incorporated administrative agencies under the Act on General Rules for Incorporated Administrative Agencies) (Thomson Reuters, n.d.[124]). Instead, larger corporations, defined as corporations other than small and medium-sized enterprises, must make efforts to publish environmental reports. As detailed by the reporting guidelines developed by the MoE, "air pollution and its environmental impacts on the living environment" should be included among the topics assessed in these publications (MoE, 2012[112]).

[13] The main categories are: 1) failure to measure emission 2) failure to record the measurement result 3) failure to store measurement records and 4) providing false record

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