An Effective Measure for Environmental Control

-The Integrated Environment Management System-


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1. Introduction

The manufacturing sector has been one of the key economic growth drivers across Asia, which makes the region recognized as the manufacturing hub of the world. However, at the same time, it means that there are many sources discharging pollutants into the environmental medium(air, water, and land). In order to protect the environment and human health against those pollutants, most countries have environmental permitting regulations in place that impose legally-binding requirements on industrial activities with significant environmental impacts. Within this context and given the Republic of Korea's (ROK) experience with rapid industrialization, the ROK offers a valuable case study in introducing and applying the new system for environmental control. This could be a useful reference for countries in the region facing similar pathways of industrialization like the ROK and seeking more advanced environmental control tools. This policy brief outlines the analysis of the ROK's new strategy – Integrated Environment Management System, and provides recommendations based on lessons from the ROK's experience. The purpose of this policy brief is to contribute knowledge tools on implementing effective policies for protecting the environment as a whole from industrial sectors.

2. Environmental Permitting in Asia and the Pacific

Single-medium permitting - the traditional regulatory approach – was developed to address specific environmental problems such as air pollution, water contamination, and waste management, etc. Under this system, it is required to obtain numerous environmental permits from a variety of separate authorities for operating industrial facilities. Based on those permits, each facility is allowed to discharge a specific amount of pollutants, set by the environmental quality standard, into each environmental medium.

However, this measure does not address environmental problems as a whole. In terms of a holistic approach to the environment, polluting substances may be transferred from one environmental medium into another. Also, an effort to solve a local environmental problem may lead to harm at a greater distance, like balloon effect. As a result, *an integrated approach to environmental regulation* has emerged, viewing the environment as a whole and minimizing the environmental impact more efficiently through optimal design and operation of an industrial facility.

With an integrated permitting system, emissions into the environmental mediums are considered all together, not separately. It means that an operator of industrial facilities should comply with the permit condition set to achieve a high level of protection for the environment overall. Integrated permitting is based on the concept of “Best Available Techniques” (BAT), which balances the benefits to the environment against the costs to the operator, and emphasizes pollution prevention rather than end-of-pipe control.

Traditional regulatory techniques and mechanisms, including single-medium permitting, remain the most widely adopted legal tools for environmental pollution control because they require less effort in terms of monitoring and enforcement and are frequently applied to Asia and the Pacific. However, as environmental problems become more complicated than in the past and socio-economic and ecological factors change, the new measures to minimize environmental pollution in a more effective way are being used to complement the traditional regulatory mechanisms. In this regard, several countries in Asia and the Pacific are moving forward to the integrated environmental permitting. For example, the Philippines government has begun issuing an environmental compliance certificate, an integrated approach that obligates the project proponent to comply with all environmental requirements and conditions set out in environmental laws and regulations. The Chinese government also adopted a new regulation to introduce integrated permitting gradually. Also, some states of India issue consolidated consent for air and water pollution and hazardous waste based on Common Consent Applications. There are significant efforts underway in Asia and the Pacific to apply new and innovative enforcements aimed at minimizing the environmental impact.

Box 1.Global Trend

Since an integrated environmental permit system was first introduced in 1969 by the Swedish government, a host of countries in the world have adopted a similar policy to control industrial facilities in a more effective and coordinated way.

The European Union (EU) devised the Integrated Pollution Prevention Control (IPPC) Directive in 1996 and mandated that its member countries establish an integrated environmental management system. In 2010, the EU adopted the Industrial Emission Directive (IED), and the IED entered into force in January 2011 and had to be transposed by the Member States by January 2013. The IED regulates the environmental impacts of more than 50,000 of the largest industrial installations in the EU. The IED is operated based on several features; (1) The permits must consider the whole environmental performance of the facility with the perspective of the integrated approach. (2) The BAT, which is defined in consultation with the Member States, industry, and environmental organizations, serves the reference for setting permit conditions. (3) Competent authorities have some flexibility in setting emission limit values depending on the surrounding condition of the facility. (4) The IED requires regular environmental inspections every 1 to 3 years. (5) The IED ensures public participation in the decision-making process by having access to permit applications, permits, and the results of the monitoring of releases. Through the IED, the EU has dramatically reduced industrial pollution of air and water since the 1980s, for example, industrial emissions of sulfur dioxide (SO_2) and dust particles have halved since 2007. Also, the EU reported that the IED has helped avoid waste and promotes resource efficiency.

The Russian Federation amended the Federal Law on Environmental Protection and introduced a gradual transition to a technological regulation system, based on the BAT in 2014. The amended Law classified industrial facilities into four categories depending on the level of adverse environmental impacts. 7,000 industrial installations have to apply for permits by the end of 2020. 300 pilot facilities with a contribution to the total pollutant emission of more than 60% must obtain an integrated environmental permit, and apply the BAT. The permit is subject to review every seven years and prescribes the maximum permissible level of emissions of pollutants.

The Republic of Turkey introduced an integrated environmental permitting regime with the legislation of Environmental Permits and Licenses Regulation, effective as of 1 April 2010. In order to clarify the processes and procedures to be used in the applications for certificates, permits, and licenses of the project, the Ministry of Environment and Urban Planning (the MoE) announced a new regulation regarding the Environmental Permit and Licenses, effective as of 1 November 2014. Under the Permit and License Regulation, it is required to obtain a single consolidated permit, which is valid for five years, instead of obtaining separate environment permits (e.g., emission permit and water discharge permit). The new regulation classified the facilities into two groups depending on their environmental impacts, and let them obtain a Permit and License from the MoE or the Provincial Directorates of the Environment and Urban Planning agency. According to the OECD Environmental Performance Review of Turkey released in 2019, even though the Turkey government introduced a single environmental permit, this consolidated permit was not yet based on the BAT, and the Turkey government plans to introduce BAT-based permitting in 2024.

China “The Plan for Implementation of the Pollution Control Permit System” was issued by China’s State Council in November 2016. Its policy goal was for the pollution permitting system to be designed and implemented by the Ministry of Environmental Protection. The Ministry adopted a new regulation for moving gradually toward an integrated permitting, which moves away from the traditional single medium permitting. This new integrated permit system applies to specific industrial sectors which the Ministry announces.

3. The Relevance of Environmental Permitting for the Implementation of the 2030 Agenda

The integrated permitting system approaches the environment as a whole, which leads to reduce the harmful impact of industrial activities on the entire ecosystem. It also encourages operators of facilities to adopt effective technology, which benefits saving resources, and as well, preserving the environment. As a result, efforts to implement the integrated permitting system in each country would contribute to achieving some targets of Sustainable Development Goals(SDGs) of 2030 Agenda. Achievable SDGs are introduced below.

SDG target 3.9: By 2030 substantially reduce the number of deaths and illnesses from hazardous chemicals and air, water, and soil pollution and contamination.

Integrated permitting emphasizes a comprehensive approach, taking into account the transfer effects of pollutants from each environmental medium. It can contribute to mitigating the types and amount of emitted pollutants as a whole, which can reduce related diseases caused by severe contamination.

SDG target 6.3: By 2030, improve water quality by reducing pollution, eliminating dumping and minimizing release of hazardous chemicals and materials, halving the proportion of untreated wastewater and substantially increasing recycling and safe reuse globally.

Practice in the EU shows that integrated permitting based on the BAT can reduce a magnitude of released pollutants into all environmental medium and also help reduce waste and increase resource efficiency. So, it can contribute to improving water quality by decreasing emitted materials, including chemicals and wastewater, and by promoting recycling and reuse.

SDG target 9.4: By 2030, upgrade infrastructure and retrofit industries to make them sustainable, with increased resource-use efficiency and greater adoption of clean and environmentally sound technologies and industrial processes, with all countries taking action in accordance with their respective capabilities.

An integrated permitting system is usually operated based on the BAT, which is regularly discussed and updated in consideration of the development of technology. It encourages each industrial facility to introduce new efficient technologies that can mitigate the emission of pollutants with fewer costs. This practice can guarantee sustainable management of industrial facilities by installing cost-effective and environmentally sound technologies.

SDG target 11.6: By 2030, reduce the adverse per capita environmental impact of cities, including by paying special attention to air quality and municipal and other waste management.

According to data from the UN, an estimated 54.5 percent of the world's population lived in urban settlements as of 2016. These areas are full of small and medium-scale factories, which account for a substantial proportion of industry in most countries. However, due to the lack of relevant resources available for them, the operators often fail to abide by environmental regulations, resulting in related pollutions in densely populated areas. In this regard, an integrated environmental permitting encourages a government to provide an industrial facility with effective guidelines for reducing pollutants, aiming to minimize harmful environmental influences on urban dwellers.

SDG target 12.4: By 2020, achieve environmentally sound management of chemicals and all wastes throughout their life cycle in accordance with agreed international frameworks and significantly reduce their release to air, water and soil in order to minimize their adverse impacts on human health and the environment.

Since an integrated permitting features reassessment of the permits regularly, it enables us to achieve life-long management of pollutants generated by industrial facilities. This is to reflect any changes in industrial processes caused by new equipment or modification of the existing ones, which might be inconsistent with the details of previously granted permits. This constant post-review procedure, consequently, can minimize the harmful influences of pollution materials on human health and the environment in the long perspective.

SDG target 13.2: Integrate climate change measures into national policies, strategies and planning

As mentioned, integrated permitting can control the emitted pollutant, including greenhouse gas, and promote resource efficiency. It can also contribute to decreasing the use of raw materials and reducing greenhouse gases, so it can be considered as one of the effective measures to tackle climate change.

4. The Korean Experience: Lessons from the "Environmental Pollution Prevention Act"

The Korean GDP has increased by around 860 times between 1960 (1.9 billion USD) to 2019 (1.72 trillion USD). In particular, the manufacturing sector accounts for 29.2% of the Korean GDP as of 2018. This fast and intensive growth has caused severe environmental issues. This led to the implementation of a variety of legislation to prohibit industry facilities from deteriorating the environment and human health, starting with the "Environmental Pollution Prevention Act" in 1963. Since then, the specific legislation on each environmental medium had been enforced, respectively, which set the emission limit values of each

pollutant. As a result, an operator of industrial facilities had to install and operate them by obtaining permissions or reporting to a relevant authority based on each Act and complying with all emission limit values for all environmental mediums. Even though this legal framework, to some extent, contributed to protecting the environment and human health, it also had inefficiency and limitations hampering comprehensive environmental improvement.

Multiple permitting for each medium Most of the industrial facilities don't discharge pollutants into only one environmental medium. They emit harmful materials into every environmental medium at the same time. It means that every single permission should be obtained from all individual Acts in installing and operating an industrial facility. In Korea, an operator of the industrial facility must secure up to 11 permits by submitting similar documents to different authorities. The process was complicated and caused unnecessary administration costs. It also posed undue burdens on operators.

Box 2.An example of permit types and authorities for a waste disposal facility

The table below shows an example of permit types and authorities of each permit in installing and operating a waste disposal facility in Ansan City, Gyeonggi Province. There are different authorities in charge of permitting, depending on the medium and permit type.

	Wastes				Air			Malodor	Water
Type of permit	Designated-waste incineration installation permit	General-waste incineration Installation permit	Designated-waste disposal plan reporting	Industrial waste discharge reporting	Air pollutants discharge facility installation permit	Floating dust emission reporting	VOCs discharge reporting	Malodor discharge facility reporting	Waste water Discharge facility permit
Authority	Agency of Environment	City government	Agency of Environment	City government	Province government	City government			Province government

Emission limit values without variation Every industrial facility discharges different amounts of pollutants depending on its attributes, such as raw materials, chemical and physical processes, and the technical level of emission control equipment. However, the existing Acts applied uniformed emission limit values to all facilities without consideration of its features. As a result, the emission limit values acted like stricter regulation to some facilities, which led to unnecessary social costs with limited environmental improvement.

Box 3. Examples of uniformed emission limit values for different facilities

1) Each facility discharges wastewater with different levels of Chemical Oxygen Demand (COD). For example, in general, the level of COD of wastewater discharged from a tofu manufacturing factory is around 200ppm. On the other hand, the one from a plating factory and a dyeing factory are 3,500ppm and 500ppm, respectively. However, the appropriate Act regulates a COD level of wastewater from all facilities up to 70ppm, but not considering the features of each facility.

2) Emission limit values of pollutants in the air, such as Cu, Ni, Zn, HCN, Benzene, Phenol, and Formaldehyde, are set in the range of 2 and 10ppm regardless of the type of facilities.

A lack of technical information and expertise Under the existing legal system, the permitting must be released within 10 days[1] after an official receipt of application documents. Even though the documents include technical matters, such as raw materials, pollutants after the process, and applied technology, the official had to issue the permit without any supports from experts. According to a survey, an official review around 95 permits a year, and it takes merely 2.5 days, on average, for dealing with one permission. The inappropriate permitting can be issued because of the lack of expertise and the rapid process, which can lead operators of facilities to be punished against the Law despite compliance with the permit.

Box 4. Loopholes of the process of permitting

1) The rate of identifying pollutants discharged as wastewater, but not shown in the permit: 54.6% [2]
2) The rate of identifying pollutants emitted into the air, but not shown in the permit: 50%[3]
3) The incidence of inappropriate operation, unlike the permit: 9 cases[4]

Permanent permission Once the permission for the facility was obtained, it was permanently in effect. This is because, under the previous system, there were no regulatory provisions to revoke the permit itself or close the facility, except where the license is granted in a false or otherwise fraudulent way. This permanent permission made it difficult to review the changes caused by new pollutants discharged from the newly introduced process or deterioration of pollution control equipment. Also, it did not encourage operators to embrace new technology for whittling down the emission of pollutants during the industrial process. As a result, it became harder to carry out a comprehensive pollutant management scheme.

Box 5. The cases of inappropriate measure due to the absence of relevant procedure

The examples below show that a new procedure should be introduced to reflect the change of raw materials or the addition of a new process for operating the permitting system more flexibly.

	Pollutants	Cause of emission	Emitted amount	Emission limited value	Measure
A smelter	Selenium	Change of raw materials	0.4ppm	0.01ppm	Enforcement notice
B textile company	Phenol	Addition of a new process	0.311ppm	0.005ppm	Suspension of use (accusation)

For example, facilities permitted from the 1970s to 1990s were exempt from installing pollution control equipment due to the absence of the process to review the context of the permit after allowing the operation.

Limitations of managing the end-of-pipe Pollutants can be produced and discharged at every stage of the industrial process. However, the existing legislation has made it difficult to conduct comprehensive pollutant emissions management because permitting and reporting of each pollution media was governed by different authorities. It means that harmful pollutants can be discharged in the middle of the process

[1] The period is different depending on the type of permitting : permitting or reporting for installation of the facility - 10days: permitting of revision of the facility – 7days : reporting of revision of the facility – 5 days
[2] The annual survey of the specific hazardous water pollutant (Jan. 2013),
[3] The annual survey of the specific hazardous air pollutant(Mar.2013)
[4] The annual survey of the specific hazardous air pollutant(Mar.2013)

without any regulations and surveillance. For example, a survey on the emissions of chemicals shows that 61.3% of emitted pollutants into the air are scattered from sources such as valves and flanges, not just from smokestacks.

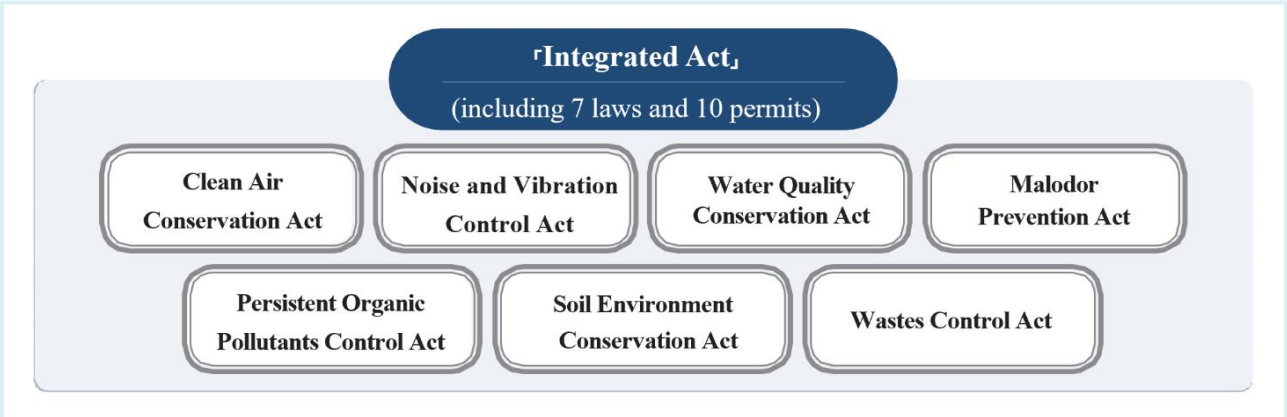
The traditional system - single-medium permitting – had contributed to controlling the industry sector to minimize its harmful effects on the environment and human health for several decades despite its loopholes. However, these problems led to adopt a new regulation – integrated environmental management system - for managing industry facilities more efficiently and flexibly. The mentioned problems would be similar to those of member States that have adopted the traditional regulatory approach for environmental control. It would be meaningful to understand how the transformation has occurred in the ROK to overcome those limitations of the existing system.

5. The Integrated Control of Pollutant-Discharging Facilities Act

The ROK enforced the "Act on the Integrated Control of Pollutant-Discharging Facilities" (hereinafter referred to as the 'Integrated Act') in 2017 to address the drawbacks of the traditional measure to control the industrial sector.

Integration of single-medium permits Instead of being subject to individual Acts for each environmental medium, major pollution sources are required to obtain one integrated permit from the Ministry of Environment based on the Integrated Act. An operator of industrial facilities can reduce the burden to secure up to 11 permits from a variety of authorities by seven existing individual Acts. It also means that competent authorities can cut a significant amount of administrative costs.

Figure 1.Individual Acts integrated with the "Integrated Act"



Expansion of targeted industries in stages over five years The Integrated Act is applied to around 1,400 facilities, which have significant environmental impacts from a total of 19 industries[5] in stages over five years since its enforcement in 2017. The priority of each industry sector was decided based on several factors, including environmental impact, anticipated compliance cost, economic and financial conditions of

[5] In particular, the Integrated Act applys to the facility of 19 industries that exceed the air pollutant emission of 20 tons/year and the wastewater discharge of 700 m^3/day.

the industrial sectors concerned, as well as administrative capacity constraints of the permitting authorities. The list of targeted industries is shown in [Figure 2] by chronological order. The Integrated Act has been in effect to a new facility of each industry from the enforcement date. However, as existing industrial facilities need management strategies for compliance with the new system and time to make the necessary investment, the Integrated Act has allowed four years of grace period from the enforcement date to the existing facilities.

Figure 2.Targeted industry of the "Integrated Act"

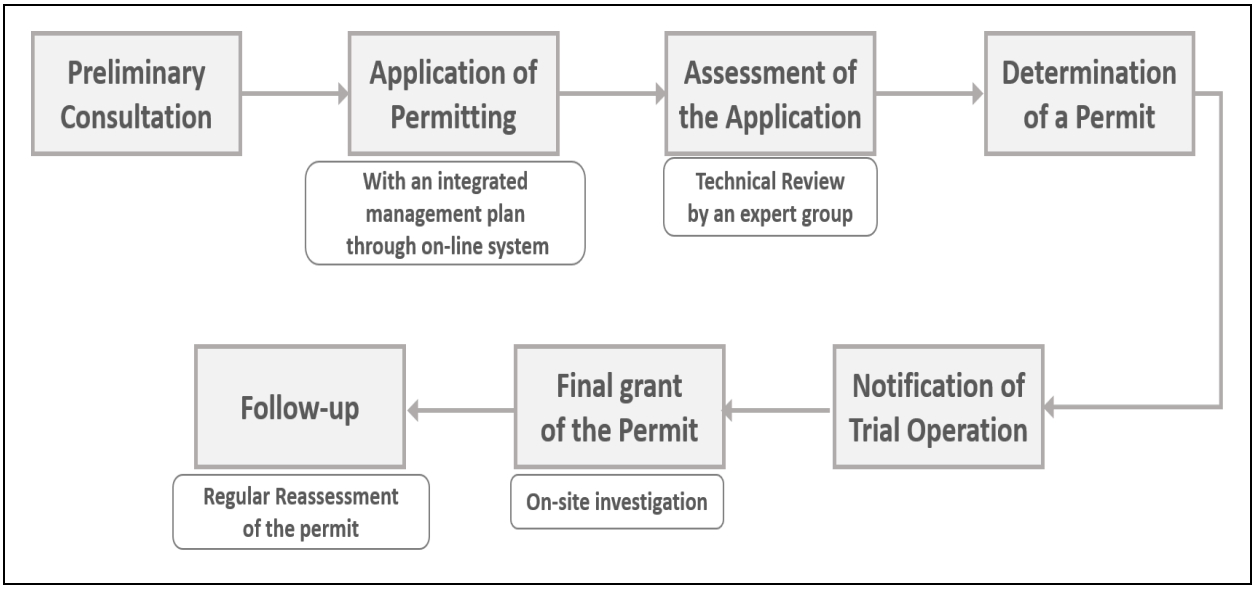
Enforcement date (19 industries in total)	Targeted Industry
1 January 2017 (3 industries)	▪ Thermal power generation / Other power generation ▪ Steam, chilled or hot water and air conditioning supply ▪ Treatment and disposal of non-hazardous / hazardous waste
1 January 2018 (4 industries)	▪ Manufacture of basic organic petrochemicals ▪ Manufacture of synthetic rubber / other plastic materials ▪ Manufacture of basic iron and steel ▪ Manufacture of basic precious and non-ferrous metals
1 January 2019 (3 industries)	▪ Manufacture of refined petroleum products/fertilizers and nitrogen compound ▪ Manufacture of basic chemicals (inorganic chemicals, inorganic pigment, other basic organic chemicals, synthetic dyes) ▪ Manufacture of other chemical products
1 January 2020 (3 industries)	▪ Manufacture of pulp, paper, and paper board (pulp, newsprint, printing and writing paper, kraft paper and paperboard, other paper and paperboard) ▪ Manufacture of other paper and paperboard products ▪ Manufacture of electronic components (flat display components, laminated plates for printed circuit boards, capacitors, other electronic components)
1 January 2021 (6 industries)	▪ Slaughtering of livestock, processing, and preserving of meat and meat products ▪ Manufacture of alcoholic beverages ▪ Dyeing and finishing of textiles and wearing apparel ▪ Manufacture of plastics products ▪ Manufacture of semiconductor ▪ Manufacture of parts and accessories for motor vehicles

Application of Best Available Techniques (BAT) The new system has been operated based on Best Available Techniques (BAT) for each industry in consideration of economic feasibility and the effectiveness in tackling pollution. The BAT refers to the most effective and advanced techniques that are technologically and economically applicable to the management of discharged pollutants, such as techniques concerning the design, installation, operation, and management of industrial facilities. A Technical Working Groups (TWG), which includes participants from the industrial sector, supports the task of selecting the BAT in the light of the suitability to the on-site, the reduction of pollutants, the economic costs, the effectiveness of energy use, and the reduction of wastes. The TWG publishes BAT reference documents (BREF) for each industry every five years to provide the regulated industries with relevant, up-to-date technical guidance.

Emission limit value based on the specific condition Emission limit values of each facility is set in consideration of the BAT, the local level of pollution, the environmental quality standards, and unique conditions of each industry, instead of applying uniformed emission limit values to all facilities. As the first step, a maximum value of emitted pollutants is decided, assuming the BAT is applied to a facility. Then, the environmental impacts on the surroundings influenced by installing and operating a facility are analyzed. If it has its least impact on the environment, the maximum value is set as the emission limit value of the facility. On the other hand, if it brings about a significant environmental impact, the emission limit value is set more stringently below the maximum value. Since this BAT-based approach pursues the most achievable environmental improvement under the current technological level, there is no need for regulated industries to take additional, or to continue ineffective, measures in terms of reducing the pollutants. Therefore, the scheme ensures cost-effective environmental protection, as well as encourages the development of technology.

A systematic procedure for permitting The whole process for the integrated permitting consists of several steps: preliminary consultation, permitting, notification of the operation commencement, and trial operation. At a preliminary consultation stage, the operator of industrial facilities can be provided with proper technical advice about the management plan and the emission limit value from the permitting authority before the official application for permission of installation or alteration of the facility. Then, the operator applies for the permit with the integrated management plan to the permitting authority. After this, the permitting authority evaluates if the facility complies with legal requirements based on information including the emission limit value, the operation plan, and the management plan for an emergency. The authority determines the permission with several conditions necessary to minimize the environmental impacts. The operator should notify the commencement of trial operation to the relevant authority, and the authority checks the operation through the on-site inspection to ensure if the facility operates in compliance with the permission. The permit applicant also reserves the right to make an appeal to the permitting authority against a refusal to grant a permit or against certain conditions in the granted permit. These procedures take place through an online Integrated Environment Permitting System operated to support transparent permit procedures and to provide technical information.

Figure 3.The procedure of the integrated permitting



Flexible and self-regulated management After permission, regular inspections are carried out at the facility once every one to three years to check whether it is operated following the permit, not exceeding the emission limit values. This inspection is not only focusing on the crackdown on its failure to comply with the Law but providing appropriate solutions. In this method, an operator of the industrial facility will get a chance to improve its processes and equipment in cases of one-off illegality during the operation period. Also, it is mandatory for the operator to measure the emission amount regularly by itself according to its monitoring plan and to input the result on the online Integrated Environment Permitting System. Besides, the operator should disclose information to the public, including the volume of raw materials, the location of facilities, terms of the permit, the status of emission, and emergency plans through the assessment report of permit and the annual management report of the facility.

Unlike the previous system, the permitting authority reassesses terms of the permit or emission limit values every five years to reflect the change of conditions and advanced technology. The operator should obtain the permit again in cases of significant revision or renewal of the facility; the increase of discharged pollutants, the generation of new pollutants caused by new installation and the changes of process or raw materials, the change of terms of the permit due to additional installation of equipment, or the application of new regulation. [Figure4] briefly shows the difference between the previous and the new system.

Figure 4.The changes after implementation of the integrated-permitting

	Before	After
Preliminary Consultation	▪ No formal procedure	▪ Preliminary consultation available ▪ Technical advisory service
Application of permitting	▪ Multiple permitting up to 10 - 73 documents for application - various permit authorities - to be submitted in writing	▪ Integrated permitting - one document: an integrated management plan - permit authority: Ministry of Environment - to be submitted through online
Assessment / Determination	▪ Focused on reviewing documents ▪ Unilateral notice	▪ Technical review by experts ▪ Mutual communication with the operator
Operation	▪ Uniformed emission limit value ▪ Inefficient operation / lack of technical information	▪ Emission limit value set based on specific conditions ▪ BAT based management; BREF is provided
Follow-up	▪ Permanent permit ▪ Punitive crackdown	▪ Regular review every 5 to 8 years ▪ Technical assistance / integrated inspection

6. Recommendations for Other Countries to Launch Integrating Permitting

Since the integrated environmental permitting implemented in 2017 in Korea, among a total of 131 applications, 62 permits have been granted as of November 2019. According to the analysis of the Ministry of Environment of the ROK, it expected that the amount of the Particulate Matter (PM2.5) emitted from those facilities would be reduced by 39.4% compared to before. Although it is now the early stage, it has shown that integrated permitting can support environmental improvements.

Box 6. The case study of the first permitted facility under the integrated permitting system

The power plant of GS E&R in Banwol got approval in March 2018 as the first case of obtaining the integrated permit under the Integrated Environmental Management System. The power plant is one of the largest integrated energy co-generation plants in the ROK, which utilizes coal and heavy oil to generate power and discharges approximately 1,200 tons of air pollutants per year.

Accordingly, this power plant applied for a preliminary consultation in 2017. The application went through two rounds of document revision, and technical reviews were conducted as regards to the items for which the recommendations had been reflected. The preliminary consultation was carried out around four months. Based on the consultation results, the power plant devised and submitted the integrated environmental management plan to the Ministry of Environment. The management plan was reviewed based on legal validity, compliance with the environmental standards, and the status of the BAT application, and underwent two rounds of document revision followed by technical reviews to verify those revisions in the management plan. The process took another 68 days to make the final decision. Under this integrated permit, the power plant anticipated that the emission of air pollutants would be decreased by up to 43%.

As the region is industrializing rapidly and facing complex environmental challenges, many countries in Asia and the Pacific will need to reformulate legislation to address these challenges. Countries should consider adopting new strategies for environmental control, including through integrated permitting. However, there are some valuable lessons to be learned from the Korean experience that other countries should take into account as they develop their policy responses. It includes stakeholder involvement in the development of the process, and cooperation with all relevant entities early on.

First, it is necessary to organize a well planned preparatory process in anticipation of the enforcement of the Act. Although the Act for the integrated permitting only came in effect in 2017, the ROK had begun preparation of the Law from 2013 onwards, by organizing a task force for the new system. At that time, it already had access to research findings, supporting the development of the new strategy. The task force designed a 5-year master plan for the transition towards an advanced environmental control system. Based on the master plan, pilot projects to each industry had been implemented in phases to experiment with the new system. Through this preparatory period, both the regulated industry and the permit authority could build institutional capacity for the new system in terms of enhancing the expertise of staff, developing procedures, and BAT guidance, addressing the needs for human and financial resources under the new system.

Second, extensive stakeholder engagement in the process should be encouraged. The Ministry of Environment of the ROK had organized more than 320 consultation meetings in which a total of 13,000 stakeholders participated to build a social consensus among various industries before implementing the

"Act on the Integrated Control of Pollutant-Discharging Facilities." Various stakeholders from every industry acted as part of both the development of the regulatory framework for permitting (procedure, rules, and guidance including BREF) and the permit determination process itself (active mutual communication process).

Lastly, relevant entities should cooperate and be assigned appropriate tasks. The Ministry of Environment, the designated permitting authority, established the Integrated Permit System Division to exchange information and coordinate decisions between different internal units and communicate with the regulated industry and other competent authorities. The National Institute of Environment Research is responsible for producing the BREF of each targeted industry through organizing the TWG, which reviews and discusses the BAT. The last competent authority is the Korean Environment Corporation, which conducts a technical review of the application documents and provides technical advisory service to the regulated community. This well-designed assignment to all entities promotes a 'one-stop' permitting system and brings expertise to the whole process.

5. Conclusion

This policy brief has explored the experience of Korea in adopting the integrated environmental management system in the industrial sector. The ROK implemented the single-medium permitting for several decades as it had faced the rapid industrialization since the 1960s. However, the single-medium approach proved its limitations that it could not fully achieve its primary purpose to protect the environment and human health, and it led to the emergence of a new approach – the integrated environmental permitting. The ROK is just in the early stage of the new system, and several tasks remain to stabilize it further. The ROK is preparing the advisory services to support the industry sector in applying to the new legal framework. Also, it developed the technical data analysis program to help the operators prepare the integrated environmental management plan for the application. Even though the full transition has not finished yet in the ROK, the ROK's effort to introduce the advanced management control tool into the industrial sector so far offers valuable lessons to other member States considering environmentally sustainable development with rapid industrial expansion.

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