The Impact of the Environmental Industry in the Korean Economy: An Analysis Using Input-Output Multipliers

By

JEONG, Yuhui

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ABSTRACT

THE IMPACT OF THE ENVIRONMENTAL INDUSTRY IN THE KOREAN ECONOMY: AN ANALYSIS USING INPUT-OUTPUT MULTIPLIERS

By

JEONG, Yuhui

As the environmental industry plays a significant role in both environmental protection and sustainable economic development, analyzing its economic impact is crucial for policymaking. The purpose of this study is to examine the impact of the environmental industry on the Korean economy. To define the environmental industry for input-output analysis, the Environmental Industry Special Classification Table of the 2018 Report on the Environmental Industry Survey is matched to the Bank of Korea's 2015 Benchmark Year Basic Sector Classification. Also, the data from the 2015 Benchmark Year Input-Output Tables is processed by the author to include the environmental industry among the original classifications of the input-output tables. The environmental industry's production, value-added, import, and employment multipliers are computed to examine its impact on other industries in Korea. The result of the analysis shows that the environmental industry has a high value-added rate compared to other industries and that despite having a low production multiplier, the environmental industry has a strong forward linkage effect, indicating that it plays a significant role as an intermediate good for other industries.

Keywords: environmental industry, input-output analysis, inducement coefficients

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1. Introduction

1.1. Relevance of the Study

The environmental industry can contribute to pollution prevention and resource conservation while also playing a big role in creating jobs and adding value, so the industry is important for both environmental protection and economic growth.

According to the United Nations Department of Economic and Social Affairs, Population Division (2017), the world population is expected to increase from the current seven billion people to more than nine billion by 2050. Humans have also enjoyed unprecedented economic growth in the past few decades, which has improved standards of living and saved many people from extreme poverty.

However, these remarkable achievements on the other hand, have caused significant damage to the environment. Natural resources are relentlessly depleting and the services provided by such natural resources have already been affected by environmental pollution (OECD, 2012).

According to the OECD (2012), fossil fuels are expected to supply about 85 percent of the world's total energy demand in 2050, which will lead to 50 percent increase of greenhouse gas (GHG) emissions unless there is a change to the composition of energy sources. The World Bank (2018) also states that there will be a 70 percent increase in global waste in 2050 compare to the current level.

These enormous environmental issues have created a global consensus on the needs to protect the environment and respond to climate change. Environmental management has become a significant issue for not only governments, but also for companies and enterprises. The global environmental market has maintained a growth rate of about 3.6 percent over the seven years between 2011 to 2017 and the growth is

expected to increase to about 1.34 trillion U.S. dollars in 2020 from 1.20 trillion U.S. dollars in 2017 (Ministry of Environment of the Republic of Korea, 2018).

In Korea, 2018 sales in the environmental sector were estimated at 99.703 trillion KRW, which is a 0.9 percent increase from sales in 2017 of 98.818 trillion KRW. As of the end of 2018, the number of businesses within the scope of the environmental industry had increased by 0.4 percent compared to the previous year (Ministry of Environment of the Republic of Korea, 2018).

As the environmental industry takes a big role in not only environmental protection but also in the national economy, it is important to analyze the impact of the environmental industry on the economy.

1.2. Objectives of the Study

In this thesis, I aim to study the impact of the environmental industry on the national economy of Korea by using the Ministry of Environment of Republic of Korea's 2018 Report on the Environmental Industry Survey and 2015 Korean input-output table. For this purpose, the Environmental Industry Special Classification Table from 2018 Report on the Environmental Industry Survey will be matched to the Korean Standard Industrial Classification codes and then to the Bank of Korea's 2015 Benchmark Year Sector Classification. Through this process, each environmentally related goods and services can be categorized for use in economic analysis. In addition, this study will analyze the impact of the environmental industry on the economy of Korea. For this purpose, a quantitative methodology using the input-output table of Korea in 2015 is adopted. The data will be retrieved from the Bank of Korea. Moreover, the production multiplier, value-Added multiplier, import multiplier and employment

multiplier of total final demand approach and sensitivity coefficient and impact coefficient will be used to estimate the economic impact.

1.3. Research Questions and Hypotheses

This thesis will aim to identify and analyze the impact of the environmental industry has on the economy of Korea. The following research questions and hypothesis will guide this thesis: First, how can the environmental industry's classification can be used for an economic analysis? Second, what are the values of the production multiplier, value-added multiplier, import multiplier, and employment multiplier of the environmental industry and how these values different from the industry average? Regarding these values, I make the following hypotheses:

H1a: The production multiplier of the environmental industry is higher than the industry average

H1b: The value-added multiplier of the environmental industry is higher than the industry average

H1c: The import multiplier of the environmental industry is lower than the industry average

H1d: The employment multiplier of the environmental industry is higher than the industry average

Then, based on the hypothesis that the production inducement coefficient of the environmental industry is higher than the industry average, this study will test the backward and forward linkage of the environmental industry on the Korean economy. The following hypotheses are made regarding these linkages:

H2a: The environmental industry has more significant forward linkage effect than backward linkage effect

H2b: The environmental industry's forward linkage effect is larger than 1

Lastly, policy implications for the development of the environmental industry will be suggested.

2. Literature Review

2.1. The Importance of the Environmental Industry on Economic Growth

In the 21st century, environmental issues have become an important social concern in not only developed countries, but also in developing countries. Additionally, the environmental industry is expected to be one of the most promising industries (Han, 2003). As the environmental industry is growing significantly, researchers have conducted studies to analyze the impact of the environmental industry on the economy. The studies generally show that there is significant development in the environmental industry, resulting in a positive impact on national economies (European Environment Agency, 2018; Carroll, 2019).

According to Eurostat (2019), the environmental economy's contribution to European GDP increased significantly between 2000 to 2016, beginning with 1.5 percent of GDP in 2000 and ending with a 0.5 percent increase to 2.0 percent in 2016. Eurostat (2019) also states that the gross value added by the environmental economy has been augmented as well, from 147 billion euro in 2000 to 303 billion euro in 2016.

Kim, Seo, and Lee (2014) analyzed Japan's environmental industry and how it affected the Japanese economy. According to the authors, the development of

environmental legislation in Japan in the 1990s and a shift in consumer awareness created opportunities for existing eco-businesses, which then developed into a robust environmental industry. The growth of the environmental industry contributed to local economic growth by creating jobs and expanding business areas. However, the study focuses on an institutional approach and does not contain economic analysis.

The environment's impact on the economy is also strongly related to the private sector's actions towards environmental protection. According to Wagner (2005), when firms adopt pollution prevention-oriented corporate environmental strategies, the relationship between environmental and economic performance is more positive, thus making improvements of corporate sustainability more likely.

The environmental industry also plays an important role in the economies of developing countries, as the rapid growth of environmental goods and services combined with new business openings generates new export opportunities for companies in developing countries (Bucher et al., 2014)

2.2. Using Input-Output Analysis to Analyze the Impact of Environmental Industry on Economy

Many researchers have used input-output analysis to estimate the impact of the environmental industry on the economy (Lave et al., 1995; Munksgaard et al., 2005; D'Hernoncourt et al., 2011; Jiang et al., 2014)

Zhou et al. (2015) use Japanese statistics on the environmental industry from 2000 to 2012 and input-output tables of Japan (2000, 2005, 2010, 2011 and 2012) to study the impact of the environmental goods and services sector on the Japanese economy and employment. Multiplier analysis was used and it is concluded that while the target of investment in environmental industry was actually to strengthen energy

security and reduce greenhouse gases, it also resulted in creating economic benefits and employment growth.

As the environmental industry in Korea is becoming more significant, studies have been conducted to analyze the impact of the industry on the economy. According to the study conducted by Kim and Choi (2005), the environmental industry has a relatively high impact on the production and value-added inducement compared to other industries.

Kim et al. (2015) and Son and Kim (2016) conducted studies to analyze the impact of the environmental industry on the Korean economy. Kim et al. (2015) state that concerns over the coexistence of the economy and the environment have generated interest in policies for creating jobs related to the environment. The study is based on the United Nations' Classification of Environmental Activities (CEA), which shows that the annual average growth rate of environment-related jobs is expected to be between 5.5 percent to 7.0 percent by 2020, suggesting that the environmental industry will steadily create more jobs.

While the study of Kim et al. (2015) focuses on employment, Son and Kim (2016) analyze the impact of the new environmental industry on the Korean economy by using input-output analysis. The study shows that as the new environmental industry generates high production and value-added inducement effects, it has a significant economical ripple effect on other industries and the national economy.

Instead of focusing on the whole environmental industry, some researchers have focused on a certain sector or area of the environmental industry to conduct an analysis using input-output tables or analysis. Reducing the amount of carbon dioxide (CO2) in the atmosphere is an important part of the Paris Agreement (UN, 2015) and has had a large impact on the environmental industry. Liping and Bin (2010) use input-output

models to analyze CO2 emissions and industrial linkages. According to Na (2014), industrial and trade systems can be persuaded to switch to sectors with relatively less energy consumption, which can be measured using input-output analysis. Using the input-output approach to design a robust modeling framework for economic analysis, Cruz (2002) analyzes energy-economy-environment interactions in Portugal and proposes suggestions for how CO2 emissions are related to industrial production and final demand.

3. Definition and Characteristics of the Environmental Industry

3.1. Definition of the Environmental Industry

It is necessary to clearly define the key terms referred to in this thesis. In particular, it is imperative to clarify what "environmental industry" means. As "environmental industry" is a relatively new and rapidly growing industry (Day & Thomas, 2010), the scope that the term covers is becoming larger and more difficult to define. According to OECD (1992), environmental industry refers to the group of all producers of environmental products, including cleaner innovations, resources, pollution management, and services. Furthermore, the definition of "environmental industry" also slightly differs across countries and agencies.

Table 1
Definitions of "Environmental Industry" by Country

Country/ Agency	Definition
U.S./Environmental Business International	All kinds of income generating activities related to environmental evaluation, pollution control, regulatory compliance, pollution remediation, waste management and provision and distribution of environmental resources.
OECD/Eurostat	Activities to produce products and services for measuring, preventing, controlling, minimizing and correcting environmental damage related to air, water, soil, waste, noise and ecosystems.
U.K./The Joint Environmental Markets Unit	Industry that produces or provides various products and services for measuring, preventing and minimizing water, air and soil pollution, and dealing with problems related to waste, noise and ecosystems.
Korea/Environmental Industry Statistics	Industrial activities that measure, prevent, or control environmental hazards such as air pollution, wastewater, waste, noise, vibration, and soil degradation, or provide products or services to minimize and restore environmental damage.

Source: GyeongGi-Do Eco-Hub Webpage (2020.04.10) https://www.ecohub.or.kr/company/index

This study covers the environmental industry in Korea, so a more detailed definition of the industry from the Korean government is needed. In Korea, there is a legislative act that provides a legal definition for "environmental industry."

Figure 1
Korean "Environmental Technology and Industry Support Act" (Act No. 15845, Oct. 16, 2018)

The term "environmental industry" means industry designing, manufacturing or installing environmental facilities or measuring apparatus under Article 9 of the Environmental Testing and Inspection Act or providing services concerning environmental technologies for environmental conservation and control, which falls under any of the following categories:
(a) Industry providing facilities, materials or services necessary for activities for conservation of the environment, such as measuring, preventing, minimizing, restoring, etc. from environmental damage, etc. relating to air. water quality, noise and vibration, ecosystem, etc.;
(b) Other industries providing facilities, materials or services necessary for the conservation and management of environment, which are prescribed by Presidential Decree;

Source: Korea Legislation Research Institute, Korea Law Translation Center, https://elaw.klri.re.kr/kor_service/lawView.do?hseq=48869&lang=ENG

However, as this is a legal definition, it is important to consider how "environmental industry" is defined at a more practical level. According to the Korean Ministry of Environment (2018), the environmental industry is designing and manufacturing environmental facilities and measuring equipment for environmental preservation and management, such as climate, water, environmental restoration and recovery, environmental safety and health, resource circulation, sustainable environment and resources, and environmental knowledge and services. "Environmental industry" is defined as an industrial activity that installs or provides services related to environmental technology, etc. Also, in the case of operating general industries, producing environmental products or providing services, or even partially environmentally related businesses, it is regarded as an environment industry (Ministry of Environment of the Republic of Korea, 2018).

3.2. Characteristics of the Environmental Industry

The environmental industry has the following unique features. First, the environmental industry's emergence and growth stems from artificially created demand (Kim et al., 2018). Rather than creating a naturally occurring market, the demand for the environmental industry is normally created by legal and institutional factors such as domestic environmental policy and international environmental regulations (Shin, 2012). The carbon emission trading market can be an example of this characteristic.

Second, the environmental industry is an industry with strong characteristics of public goods (Kim et al., 2018). The activities and facilities related to environmental preservation can also serve as SOC (Social Overhead Capital), which play a big role in public welfare. Household waste collection and management and municipal sewage treatment can be an example for this kind of SOC. It shows that the environmental

industry has characteristics of strong public goods for preserving the general public and a wide range of local environments (Shin, 2012).

Third, the environmental industry is a technology-oriented and complex industry (Kim et al., 2018). Due to the diversity and complexity of factors that cause environmental pollution, the environmental industry is a comprehensive industry which requires basic science such as physics, chemistry, and biology and mobilizes applied science such as machinery, chemical engineering, civil engineering, and electricity (Shin, 2012). Compared to other industries that have their own characteristics, the environmental industry can be said to be an application industry that has multiple characteristics of various other industries (Shin, 2012).

Lastly, the environmental industry is a new growth engine industry for the future (Ahn, 2013). Recently, the environmental industry has been gradually diversifying due to the production of environmentally friendly products and the development of new and renewable energy in response to climate change (Shin, 2012). The environmental industry can also grow together with other industries like the IT industry and it is becoming a driving force for job creation and economic growth (Shin, 2012).

3.3. Classification of the Environmental Industry

As definitions of the environmental industry differ across countries and agencies, the classification of it also differs.

In the U.S., Environmental Business International Inc. developed 14 segments for the classification of environmental industry (U.S. Department of Commerce, 1999).

Table 2
Environmental Business International Inc. Environmental Industry Classification

Category	Segments
Environmental services	Environmental testing and analytical services
	Wastewater treatment works
	Solid waste management
	Hazardous waste management
	Remediation/ industrial services
	Consulting and engineering (C&E)
Environmental equipment	Water equipment and chemicals
	Instruments and information systems
	Air pollution control equipment
	Waste management equipment
	Process and prevention technology
Environmental resources	Water utilities
	Resource recovery
	Environmental energy sources

Source: Arranged by the author using information from Environmental Industry of the United States: Overview by State and Metropolitan Statistical Area, U.S. Department of Commerce (2019).

In case of the U.K. government, the Joint Environmental Markets Unit is in charge of monitoring and classifying the environmental industry, which they divide into eleven segments on the 'Global Environmental Markets and the UK Environmental Industry – Opportunities to 2010' published in 2002 (Korean Chamber of Commerce, 2009).

Table 3
The Joint Environmental Markets Unit Environmental Industry Classification

Segments
Air pollution control
Water and wastewater
Waste management
Soil pollution remediation
Environmental consulting service
Environmental measurement and analytical equipment
Energy management
Renewable energy
Noise and vibration control
Clean technology and process
Marine pollution control

Source: JEMU, Global Environmental Markets and the UK Environmental Industry: Opportunities to 2010 (2002)

OECD/Eurostat also classify environmental goods and services based on their economic activity classification (OECD, 1999). The European System for the Collection of Economic Information on the Environment serves as the starting point for the OECD's classification system (OECD, 1999).

Table 4
OECD/Eurostat Environmental Industry Classification

Main group	Subgroup
Pollution Management	Air pollution control
	Wastewater management
	Solid waste management
	Remediation and clean-up of soil, surface water and groundwater
	Noise and vibration abatement
	Environmental monitoring, analysis and assessment
Cleaner technologies and products	Cleaner/resource-efficient technologies and processes
	Cleaner/resource-efficient products
Resource management	Indoor air pollution control
	Water supply
	Recycled materials
	Renewable energy plant
	Heat/energy saving and management
	Sustainable agriculture and fisheries
	Sustainable forestry
	Natural risk management
	Eco-tourism

Source: Arranged by the author using information from https://read.oecd-ilibrary.org/industry-and-services/the-environmental-goods-and-services-industry_9789264173651-en#page1

In Korea, the classifications for the environmental industry are based on the OECD/Eurostat manual. By surveying the eight classification criteria of environmental industry that are recognized by the Korean government, it is possible to investigate the current status and scale of the Korean environmental industry. (Ministry of Environment of the Republic of Korea, 2018).

Table 5
Environmental Industry Special Classification from the 2018 Report on the Environmental Industry Survey of Korea

Segments
Resource circulation management
Water management
Environment restoration and recovery
Responding to climate change
Air quality management
Environmental safety and health
Sustainable environment and resources
Environmental knowledge, information and monitoring

Source: Ministry of Environment of Republic of Korea (2018). 2018 Report on the Environmental Industry Survey

3.4. Current Status of the Environmental Industry in Korea

As mentioned in section 3.1, “Definition of the Environmental Industry”, the environmental industry in general is still young and its history is short. This is also the case in Korea. Korea's environmental industry policy began with the fifth Five-Year Economic and Social Development Plan (1982 ~ 1986) (Kim, 2013). Since the 1990s, direct and indirect policies have been implemented to create market demand, such as strengthening environmental management and regulatory standards (for example, air and water quality) and expanding public investment in basic environmental facilities such as sewage treatment plants (Kong, 2014). In 2009, the government announced its

"Green Growth National Strategy and Five-Year Plan," which fostered the environmental market to grow rapidly as a new growth engine (Kim, 2013). According to the Korean Ministry of Environment (2018), domestic environmental industry sales grew rapidly from about 21 trillion KRW in 2004 to about 100 trillion KRW in 2018.

Ministry of Environment of Republic of Korea (2018) states that as of the end of 2018, the number of environmentally related businesses is 58,235 which is a 0.4 percent increase from the previous year. Also, the number of environmental industry businesses has been constantly increasing every year since 2010. The total number of employees working for these 58,235 environmentally related businesses is 1,147,797 of which 447,544 are environmental sector workers, accounting for 39.0 percent. This number is an increase of 0.8 percent from the previous year (443,956 employees).

The number of environmental industry businesses and the total number of environmental sector workers from 2015 to 2018 are presented in Table 6 and the proportion of the workers to the businesses, which is the average number of environmental sector workers per environmentally related businesses, is presented in Figure 2. According to this information, the average number of environmental sector workers in environmental industry businesses from 2015 to 2018 is 7.73, 7.62, 7.44 and 7.69 respectively which indicates that the environmental related businesses are on average, small-sized enterprises. The average number of workers in environmental safety and health industry is the highest in all four years, but the number is still small.

Table 6

Number of Environmental Businesses and Environmental Sector Workers from 2015 to 2018

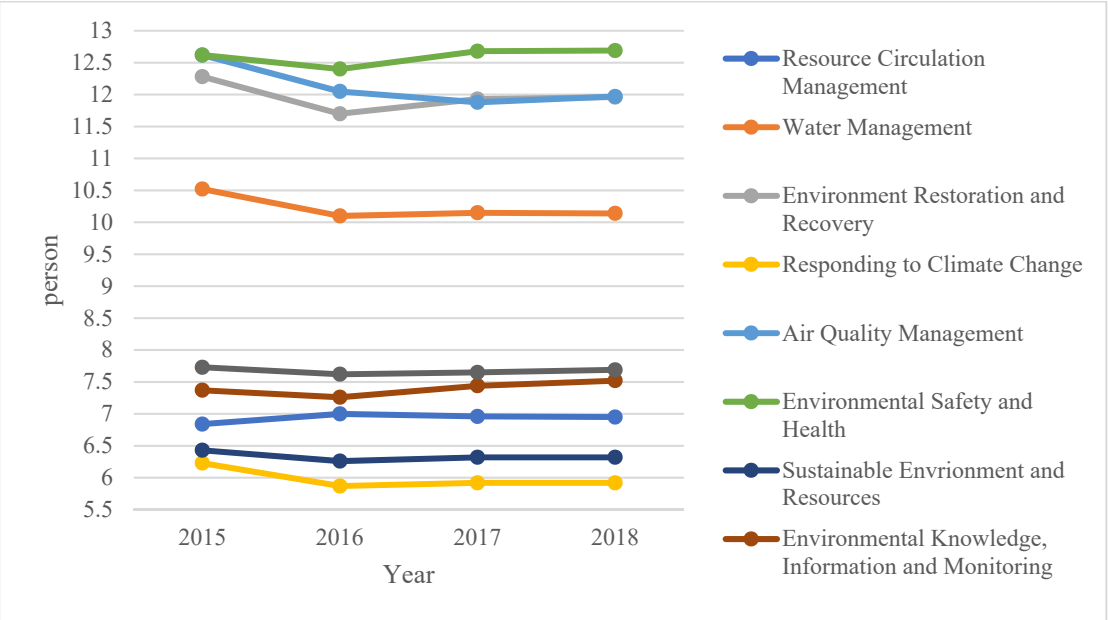
(Unit: business, person)

	2015		2016		2017		2018	
	[1]N.O.B	[2]E.S.W	N.O.B	E.S.W	N.O.B	E.S.W	N.O.B	E.S.W
All industry	57,311	443,130	57,858	440,756	58,013	443,956	58,235	447,544
Resource circulation management	19,500	133,293	18,571	129,917	18,906	131,470	18,900	131,346
Water management	6,272	66,012	6,665	67,312	6,794	68,964	6,909	70,080
Environment restoration and recovery	752	9,236	795	9,298	772	9,207	781	9,343
Responding to climate change	3,355	20,886	3,624	21,264	3,654	21,628	3,659	21,660
Air quality management	2,410	30,407	2,296	27,675	2,421	28,753	2,447	29,300
Environmental safety and health	2,856	36,030	2,962	36,714	2,786	35,315	2,918	37,018
Sustainable environment and resources	17,124	110,129	18,060	113,128	17,951	113,442	17,827	112,747
Environmental knowledge, information and monitoring	5,042	37,137	4,885	35,448	4,728	35,177	4,793	36,050

Source: Arranged by the author using information from 2016, 2017 and 2018 Report on the Environmental Industry Survey, Ministry of Environment of Republic of Korea (2016, 2017 and 2018)

Figure 2

Average Number of Environmental Sector Workers in Environmentally Related Businesses from 2015 to 2018



Source: Arranged by the author using information from 2016, 2017 and 2018 Report on the Environmental Industry Survey, Ministry of Environment of Republic of Korea (2016, 2017 and 2018)

[1] N.O.B = Number of businesses

[2] E.S.W = Environmental sector workers

Among the eight sectors, the average number of environmental sector workers in the environmental safety and health score the highest every year and those who work in responding to climate change have the lowest score all year. It shows that the environmental safety and health sector is a labor-intensive industry. The average number of workers in the climate change response sector has significantly dropped from 2015, which can be explained by the industry's growing focus on technology.

2018 sales in the environmental sector were estimated to be 99.703 trillion KRW, which is 0.9 percent higher than in 2017 which is 98.818 trillion KRW (Ministry of Environment of Republic of Korea, 2018). In specific, sales in the sectors of 'environmental safety and health' (3.7 percent), 'air management' (2.8 percent), 'water management' (2.0 percent), 'environmental knowledge, information and monitoring' (1.8 percent), 'environment restoration and recovery' (1.1 percent), and 'climate response' (0.2 percent) increased compared to the previous year (Ministry of Environment of Republic of Korea, 2018).

The number of environmental related businesses and the environmental sector sales are presented in Table 7, and Figure 3 is computed based on the information in Table 7.

Table 7
Environmental Sector Sales from 2015 to 2018

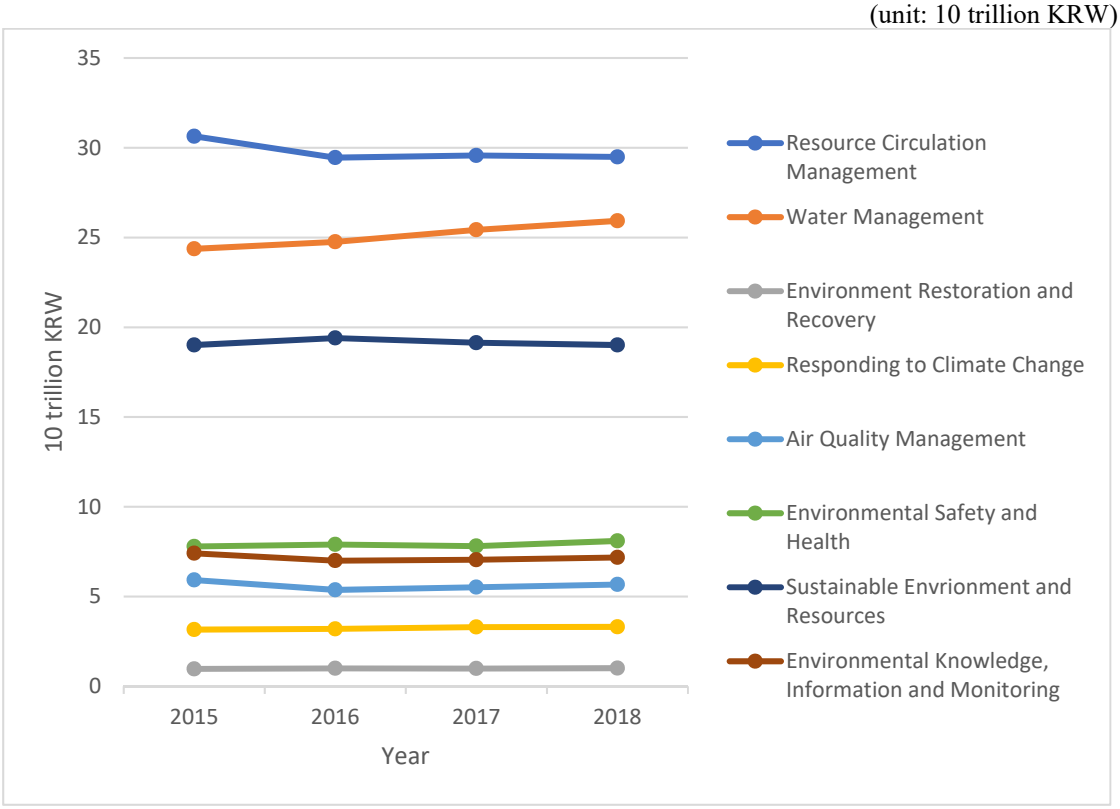
(unit: 100 million KRW)

	2015	2016	2017	2018
	[3]E.S.S	E.S.S	E.S.S	E.S.S
All industry	992,664	980,628	988,188	997,030
Resource circulation management	306,420	294,517	295,679	294,928
Water management	243,708	247,571	254,310	259,325
Environment restoration and recovery	9,662	9,970	9,940	10,054
Responding to climate change	31,590	31,964	33,010	33,068
Air quality management	59,232	53,656	55,169	56,732
Environmental safety and health	77,891	78,995	78,128	81,004
Sustainable environment and resources	190,109	193,993	191,432	190,115
Environmental knowledge, information and monitoring	74,052	69,961	70,520	71,804

Source: Arranged by the author using information from 2016, 2017 and 2018 Report on the Environmental Industry Survey, Ministry of Environment of Republic of Korea (2016, 2017 and 2018)

Figure 3
Trend of the Environmental Sector Sales from 2015 to 2018

(unit: 10 trillion KRW)



Source: Arranged by the author using information from 2016, 2017 and 2018 Report on the Environmental Industry Survey, Ministry of Environment of Republic of Korea (2016, 2017 and 2018)

[3]E.S.S = Environmental sector sales

According to the information, sales in the environmental safety and health sector show a significant growth and from 2017 to 2018, it increased by 3.7 percent, which is the highest growth rate among the eight industries. This seems to be the impact of the government policy—including the submission of the Act on the Integrated Management of Environmental Pollution Facilities (2014), the establishment of safety management measures for household chemical products (2016), and reinforcement of safety management policies.

4. Data and Methodology

4.1. Matching Table

In this study, the classification codes of each of the goods and services from the Environmental Industry Special Classification Table of the 2018 Report on the Environmental Industry Survey are matched to the Korean Standard Industrial Classification codes and then to the Bank of Korea's 2015 Benchmark Year Basic Sector Classification as shown in Table 17 - Appendix.

Environmental industry statistics are surveyed based on the eight classification criteria within the special classification of environmental industry based on the OECD/Eurostat manual to investigate the current status and scale of the environmental industry in Korea (Ministry of Environment of the Republic of Korea, 2018).

Korean Standard Industrial Classification is a system that classifies the production activities of various products and services that are performed by production entities by applying certain criteria and principles (Statistics Korea, 2020). The National Statistical Office enacts and announces the Korean Standard Industrial Classification, which reflects domestic industrial structure and technological changes based on the UN's International Standard Industrial Classification (Statistics Korea, 2020).

The Bank of Korea's sector classification categorizes industries and products in Korea. The commodity classification contains basic sector classification (381), small-sized classification (165), medium-sized classification (83) and large-sized (33) classification. In the matching table, basic sector classification is used to be matched with the Environmental Industry Special Classification codes.

This matching table provides information on how each environmental commodity as defined by the 2018 Report on the Environmental Industry Survey can be matched to economic classifications, which enables input-output analysis and analysis of the economic impact of the environmental industry.

Even though this matching table contains significant information, the whole table is not used for the analysis in this study due to its limitation. As the Input-Output Table sector classification covers a wide scope of industry, applying all the matched Input-Output Table sector classification as the environmental industry will lead to overestimation in the result of the analysis. Having discussed the limitations of the matching table, I will explain how I used the data for the analysis.

4.2. Reclassification of the Environmental Industry for Input-Output Analysis

I have selected the most well-represented and matched classified sectors from the Input-Output Table classification among the Environmental Industry Special Classification - Korean Standard Industrial Classification - Input-Output Table Sector Classification matching table (Table 18, Appendix).

In the matching table, the smallest sector classification of the IOTs has been used. However, the analyzable tables provided by the Bank of Korea do not include the basic classification but only small-sized, medium-sized and large-sized sector classifications (For employment, only medium-sized and large-sized sector

classifications based input-output tables are available). Therefore, the study uses the input-output table of small-sized sector classification for comparing the environmental industry's gross output, GDP, income structure and input and output structures to the whole industry and for the employment comparison, the input-output table of medium-sized sector classification is used. Similarly, the small-sized classification-based input-output table is used for the production, value-added and import multipliers analysis while the input-output table of medium-sized sector classification is used for employment multiplier analysis.

So, for the analysis, I have identified seven small-sized sectors and grouped them as the environmental industry (For employment, six medium-sized sectors are used) (Table 8).

Table 8
IOT (Input-Output Table) Sector Classification Used as the Environmental Industry for the Analysis

Code	IOT Sector Classification (Small-Sized)	Code	IOT Sector Classification (Medium-Sized)
385	Controlling instruments for air and liquid	38	General-purpose machinery and equipment
450	Electricity supply and renewable energy	45	Electricity supply and renewable energy
480	Sewage and wastewater treatment services	48	Sewage and wastewater treatment services
491	Waste collection and disposal	49	Waste treatment and disposal services
492	Materials recycling services		
513	Constructions of industrial plants and facilities for manufacturing	51	Civil engineering
729	Other scientific, technical, and professional services	72	Scientific, technical, and other professional services

Source: Arranged by the author using information from 2015 Input-output table statistics information report, Bank of Korea (2015)

For the analysis, all the small-sized classifications — 158, which equal to total number of small-sized classifications (165) minus the number of small-sized classifications defined as the environmental industry (7) — except for the ones I have extracted to be combined as the environmental industry, are further combined into large-sized classifications (33) based on the Bank of Korea's sector classification table. The

environmental industry, which consists of seven small-sized sector classifications is added as the 34th large-sized classification for the analysis.

For the employment related analysis, each medium-sized classification — 77, the total number of medium-sized classifications (83) minus the number of medium-sized classifications defined as part of the environmental industry (6) — except for the ones I have extracted to be combined as the environmental industry, are again combined as part of the 33 large-sized classifications. Meanwhile, six medium-sized classifications are added to the 34th large-sized classification used in this analysis, the environmental industry.

Therefore, the input-output tables used for this study are a rearranged version of the Bank of Korea's 2015 Benchmark Year Input-Output Tables, using the structure of previous input-output table for conducting the analysis. Also, as mentioned above, the classification of sectors has been rearranged as can be seen below. The composition and the value of the 33 large-sized classification is different from the original composition and value and, by including the environmental industry, an analysis is conducted using these newly composed 34 large-sized classifications (Table 9).

Table 9
New Large-Sized Classification of Industry Used for the Analysis

No.	Large-sized classifications
1	Agricultural, forest, and fishery goods
2	Mined and quarried goods
3	Food, beverages and tobacco products
4	Textile and leather products
5	Wood and paper products, printing and reproduction of recorded media
6	Petroleum and coal products
7	Chemical products
8	Non-metallic mineral products
9	Basic metal products
10	Fabricated metal products, except machinery and furniture
11	Computing machinery, electronic equipment and optical instruments
12	Electrical equipment
13	Machinery and equipment

14	Transport equipment
15	Other manufactured products
16	Manufacturing services and repair services of industrial equipment
17	Electricity, gas, and steam supply
18	Water supply, sewage and waste treatment and disposal services
19	Construction
20	Wholesale and retail trade and commodity brokerage services
21	Transportation
22	Food services and accommodation
23	Communications and broadcasting
24	Finance and insurance
25	Real estate services
26	Professional, scientific, and technical services
27	Business support services
28	Public administration, defense, and social security services
29	Education services
30	Health and social care services
31	Art, sports, and leisure services
32	Other services
33	Others
34	Environmental industry

Source: Arranged by the author using information form 2015 Benchmark Year Sector Classification, Bank of Korea (2015)

4.3. Input-Output Tables

Input-output models are a quantitative economic model that represents the interdependencies between different sectors of a national economy (Raa, 2010). The input-output table is based on Leontief's analytical system (Miernyk, 2020).

Input-output analysis has the advantage of being able to grasp the relationship between industries in terms of structure. In addition, it can be used to establish economic policies and measure policy effects because it can analyze the ripple effects of production, employment, and income—which are caused by the final demand—by sector (Bank of Korea, 2015).

The benchmark input-output statistics are compiled every five years and the updated input-output statistics are compiled every year (Bank of Korea, 2019). The benchmark statistics are used as reference materials for revising the base year figures

for various statistics including GDP statistics, the Producer Price Index and the Facilities Investment Estimation Index (The Bank of Korea, 2015).

It is true that there are limitations to using the benchmark statistics. Because the industry linkage table is prepared every five years, the fact that the available input-output table contains past information could constrain analysis of the current or future economy (Son & Kim, 2016). Therefore, research using the tables could assume that the economic structure of the industry remains the same in the year to be analyzed when performing an industry-related analysis (Bank of Korea, 2015).

Also, input-output analysis is based on the following four assumptions because the input parameter, the parameter of analysis, is fixed (Seo et al., 2014). First, there is no combined production. It is assumed that one industry produces only one product; that is, each product and industry are in a one-to-one correspondence (Bank of Korea, 2015). Second, there is no alternative production method. There is only one production method for each product (The Bank of Korea, 2015). Third, economies of scale do not exist. In other words, the input used by each industry sector for production is proportional to the production level of that industry sector (Seo et al., 2014). Fourth, there is no external economy. The total number of results of production activities performed by each industry sector are the same as the results of each sector (Seo et al., 2014).

According to the above assumptions, input-output analysis is performed using a symmetric input-output table (matrix) that can identify rows and columns on the same basis (Seo et al., 2014). In this study, the Bank of Korea's 2015 benchmark input-output tables are used as a main data source. Input-output tables of basic price and supplementary tables of employment are the statistical basis of the input-output analysis conducted.

4.4. The Structure of an Input-Output Table

The vertical section of an input-output table refers to the composition of production costs spent by each industrial sector to produce goods and services (Bank of Korea, 2018). So, the total input equals a sum of the intermediate input and the total value-added and this is defined as the input structure (Bank of Korea, 2018). Also, an output structure is the horizontal section of an input-output table which indicates in what sector the product was used as intermediate or final demand for each individual industry. In here, gross output is a sum of the intermediate demand and the final demand minus the total import. In an input-output table, the total input and the gross output of an individual industry is always the same (Kim, 2019). Below is the basic structure of the input-output table used in this thesis (Figure 4).

Figure 4
Basic Structure of Input-Output Table

		Endogenous		Exogenous									
		Individual Industry	Intermediate Demand	Private Consumption	Government Consumption	Private Investment	Government Investment	Export	Final Demand	Total Demand	Gross Output	Total Import	Total Supply
Endogenous	Individual Industry	$X_{11} \cdots X_{1n}$ $X_{12} \cdots X_{2n}$ $\cdots$ $X_{n1} \cdots X_{nn}$	W_1 W_2 $\cdots$ W_n	C_1 C_2 $\cdots$ C_n	G_1 G_2 $\cdots$ G_n	I_1 I_2 $\cdots$ I_n	H_1 H_2 $\cdots$ H_n	E_1 E_2 $\cdots$ E_n	Y_1 Y_2 $\cdots$ Y_n	D_1 D_2 $\cdots$ D_n	X_1 X_2 $\cdots$ X_n	M_1 M_2 $\cdots$ M_n	S_1 S_2 $\cdots$ S_n
	Intermediate Input	$U_1 \cdots U_n$											
Exogenous	Wages and Salaries	$V_1^a \cdots V_n^a$											
	Operating Surplus	$V_1^a \cdots V_n^a$											
	Depreciation	$V_1^b \cdots V_n^b$											
	Net Production Tax	$V_1^c \cdots V_n^c$											
	Total Value-Added	$V_1 \cdots V_n$											
Total Input		$X_1 \cdots X_n$											

Source: Arranged by the author using information from 2015 Benchmark Year Input-Output Tables, Bank of Korea (2018) and Identities inside and among input-output tables, Kim, D. (2019).

Also, the identical equations below should hold in an input-output table (Table 10).

Table 10
Identical Equations of the Input-Output Table

Identical equations for columns	(1) Intermediate demand = Sum of each individual industry's intermediate demand (2) Final demand = Private consumption + Government consumption + Private investment + Government investment + Export (3) Total demand = Intermediate demand + Final demand (4) Gross output = Total demand – Total import (5) Total supply = Gross output + Total import (6) Total demand = Total supply
Identical equations for rows	(1) Intermediate input = Sum of each individual industry's intermediate input (2) Total value-added = Wages and salaries + Operating surplus + Depreciation + Net production tax (3) Total input = Intermediate input + Total value-added
Identical equations between row and column	(1) Total input = Gross output

Source: Arranged by author using information from Kim, D. (2004) Sanup bumunbyul seongjang yoin boonseok mit gookje bigyo [Analysis of growth factors by industry sector and international comparison]. Korea Development Institute.

5. Analysis of Current Status of the Environmental Industry in Korea by Using the Input-Output Table

In this section, some significant indicators of the environmental industry are computed by using the newly arranged input-output tables with 34 large-sized industry classifications (33 large-sized classifications with the environmental industry as the 34th). Microsoft Excel is used to conduct this analysis.

5.1. The Environmental Industry's Gross Output, GDP, and Employment Compared to All Industries

The gross output, GDP (Gross Domestic Product), and employment of the environmental industry are compared to all industry using the 2015 Korean input-output tables (Table 19 – Appendix).

According to this information, the gross output of the environmental industry is 147,021,159 million KRW which makes up 3.84 percent of the total gross output (3,833,562,080 million KRW). The gross output of the environmental industry is slightly higher than the average (112,751,826 million KRW) total gross output of all industry. The environmental industry's GDP is 69,648,499 million KRW which is 4.25 percent of the GDP of all industries (1,637,450,668 million KRW) and it is higher than the average industry's GDP of 48,160,314 million KRW. GDP refers to the total value-added.

In the employment side, the environmental industry also higher than average (700,861 persons). Out of the total employment of 23,829,259 persons, the environmental industry accounts for the employment of 1,242,707 persons or 5.22 percent of total employment.

Therefore, the environmental industry overall plays a significant role in the economy of Korea.

5.2. The Income Distribution of the Environmental Industry

The value-added distribution structure can be computed by using an input-output table (Miller & Blair, 2009). In an input-output table, total value-added is divided into four categories, which are 'compensation of employees' (wages and salaries), 'net operating surplus' (operating surplus), 'consumption of fixed capital' (depreciation) and 'taxes on production and products less subsidies' (net production tax) (Bank of Korea, 2018). This information can inform regarding the income distribution structure of an

economy. The income distribution of the environmental industry can be explained using these four categories. Each component is explained in percentage (out of total value added).

First, the labor income distribution is computed using a ratio of compensation for labor in the production process (Hong, 2014). Based on the information from 2015 Korean input-output table, the environmental industry's labor income distribution rate is computed at 40.96 percent. This is smaller than the labor income distribution rate for all industry (45.82 percent), which can be explained by the fact that businesses in the environmental industry tend to be small-sized enterprises.

Second, the ratio of the operating surplus to the total value-added is 30.62 percent, which is higher than the average (26.96 percent). This can also be explained by the fact that environmental industry consists of many small-sized enterprises. As small businesses and self-employed entrepreneurs normally operate at the scale of family, the majority of the income is calculated as operating surplus (Kim, 2009).

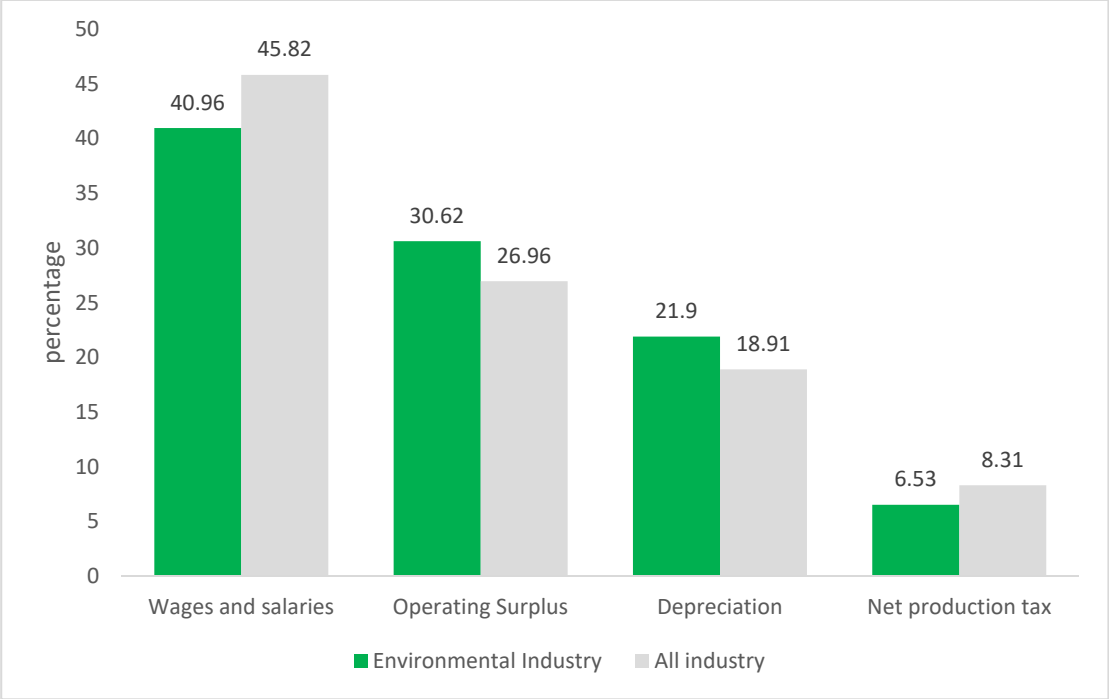
Third, the consumption of fixed capital rate (depreciation rate) is computed. Consumption of fixed capital rate refers to the decrease in value due to physical depreciation and obsolescence caused by the use of fixed assets in production over a certain period of time (Pyo, 2018). In other words, in the case of tangible fixed assets, the value decreases as it is used in the production process or due to aging and etc. (Son, 2018). So, depreciation refers to the decrease of the value of assets described in currency. The environmental industry's depreciation rate (ration of depreciation divided by the total value added) is 21.90 percent, which is higher than the average of 18.91 percent.

Lastly, the net production tax ratio is computed. The average ratio of net production tax to the total value-added is 8.31 percent, but it is 6.53 percent for the

environmental industry. So, compared to other industries, the taxes on environmental production and products are not high.

Figure 5 represents the ratios of each income distribution component divided by the total value-added.

Figure 5
Income Distribution Ratio of the Environmental Industry and All Industries



Source: Arranged by the author using information from 2015 Benchmark Year Input-Output table (2015), Bank of Korea.

Also, the value of each total value-added components of individual industries (34) and all Korean industries in total and their share out of total value-added in 2015 can be seen in Table 20 – Appendix.

5.3. Input Structure

Production of goods and services can be largely divided into the intermediate inputs and value-added for each industry's production (Bank of Korea, 2014). Intermediate goods are purchased from other industries to produce goods or services for another industry; these intermediate inputs can include raw materials, electricity, gas,

and water (Bank of Korea, 2014). Intermediate inputs can be divided into domestic products and imported products to derive the degree of localization (Bank of Korea, 2015). Total value-added consists of 'wages and salaries,' 'operating surplus,' 'depreciation,' and 'net production tax' (Kim, 2019). So, the total input equals the sum of intermediate inputs (domestic intermediate inputs plus imported intermediate inputs) and the value-added.

In this part, I summarize 34 industries (classified as large-sized industries) into five sectors, 'agriculture, forestry and fishing,' 'manufacturing,' 'service,' 'environmental industry,' and 'other', and compare the input structure of the environmental industry to 'agriculture, forestry and fishing,' 'manufacturing,' 'service,' and the whole industry (Table 12). How the 34 industries are classified for each of the five sectors is described in Table 11.

Table 11
Classification of Five Sectors Based on the New Large-Sized Classification of Industry Used for the Analysis

Sectors	No.	Large-sized classifications
Agriculture, Forestry and fishing	1	Agricultural, forest, and fishery goods
Manufacturing	2	Mined and quarried goods
	3	Food, beverages and tobacco products
	4	Textile and leather products
	5	Wood and paper products, printing and reproduction of recorded media
	6	Petroleum and coal products
	7	Chemical products
	8	Non-metallic mineral products
	9	Basic metal products
	10	Fabricated metal products, except machinery and furniture
	11	Computing machinery, electronic equipment and optical instruments
	12	Electrical equipment
	13	Machinery and equipment
	14	Transport equipment
	15	Other manufactured products

Service	16	Manufacturing services and repair services of industrial equipment
	17	Electricity, gas, and steam supply
	18	Water supply, sewage and waste treatment and disposal services
	19	Construction
	20	Wholesale and retail trade and commodity brokerage services
	21	Transportation
	22	Food services and accommodation
	23	Communications and broadcasting
	24	Finance and insurance
	25	Real estate services
	26	Professional, scientific, and technical services
	27	Business support services
	28	Public administration, defense, and social security services
	29	Education services
	30	Health and social care services
	31	Art, sports, and leisure services
	32	Other services
Others	33	Others
Environmental industry	34	Environmental industry

Source: Arranged by the author using information form 2015 Benchmark Year Sector Classification, Bank of Korea (2015).

Table 12
Input Structure – Agriculture, Forestry and Fishing, Manufacturing, Service, Environmental Industry and All Industries

(unit: percent)

	Intermediate input rate	Domestic intermediate input rate	Import intermediate input rate	Degree of localization	Value added rate
Agriculture, forestry and fishing	45.8	42.74	3.06	93.31	54.19
Manufacturing	72.41	51.07	21.34	70.54	27.59
Service	45.5	39.9	5.6	87.7	54.51
Environmental Industry	52.63	41.87	10.75	79.57	47.37
All industry	57.29	44.84	12.45	78.27	42.71

Source: Calculated and arranged by the author using information from 2015 Benchmark Year Input-Output Tables, Bank of Korea (2015).

Intermediate input rate is the amount of intermediate inputs divided by the total input. So, based on the information from the 2015 Benchmark Year Input-Output table, the intermediate input rate of all industry is 57.29 percent. For the environmental industry, it is 52.63 percent which is lower than the amount for all industry. It is also lower the manufacturing (72.41 percent, but higher than the percentages for the agriculture, forestry and fishing and service sectors.

Intermediate input rate can be divided into domestic and import and the imported intermediate input rate means the rate of dependence on imports (Kim, 2019). For the environmental industry, both the domestic and imported intermediate input rates are lower than the rates for all industry. The degree of localization (rate of domestic intermediate input divided by intermediate inputs) of the environmental industry is 79.57 percent which is higher than the localization rates for all industry (78.27 percent) and the manufacturing industry (70.54 percent).

So, overall the environmental industry has a high degree of localization compared to other industries. This can be explained by the implementation of government's policies to localize environmental goods.

For example, Ministry of Environment has started the Environmental Technology Development Project since 1992 with the goal of developing advanced domestic environmental technologies to secure competitiveness and solve environmental problems (Ministry of Environment, 2012). The implementation of such a policy greatly increased the level of environmental technology investment in Korea from around 10 to 20 percent of the amount developed countries invested in their own environmental technology development in 1992 to around 60 to 70 percent in 2011. In addition, in 2010, Korea—which had once been a technology-importing country—

became one of the world's top five countries in nine technological fields, including indoor air pollution reduction technology and advanced sewage treatment technology (Ministry of Environment, 2012). The high degree of localization seems to be the result of government policy.

For the valued-added rate, the service industry scores the highest and the environmental industry came third with a rate of 47.37 percent, which is still higher than that of all industries (42.71 percent).

The input structure information of all 34 large-sized classification-based industries is described in Table 21 – Appendix.

5.4. Output Structure

Looking in the horizontal direction of the input-output table, how much each product was used in which industry or how much it was used in the final demand can be computed by using a distribution structure (output structure). The output structure is composed of the intermediate demand sector, which represents the intermediate goods used in the production of other industries, and the final demand sector, where final goods are sold for such as consumption, investment, and export.

In this part, I also classified 34 industries into five sectors like in the analysis of the input structure (Section 5.3 “Input Structure”) and Table 13 is the output structure of these sectors. More detailed output structure information of 34 large-sized classification-based industries is described in Table 22 – Appendix.

Table 13
Output Structure – Agriculture, Forestry and Fishing, Manufacturing, Service, Environmental Industry and All Industry

(unit: percent)

	Intermediate demand[4]	Final Demand					Total Supply	
		Private consumption[5]	Government consumption[6]	Private investment[7]	Government investment[8]	Export[9]	Domestic	Import
Agriculture, forestry and fishing	73.68	23.13	0	0.59	0.02	0.93	83.47	16.53
Manufacturing	57.14	8.5	0	5.24	0.62	28.17	76.57	23.43
Service	39.39	28.35	11.88	12.62	2.7	5.03	94.97	5.03
Environmental Industry	62.27	8.64	0.77	21.49	1.35	5.5	96.65	3.35
All industry	49.29	18.06	5.61	9.18	1.61	16.04	86.04	13.96

Source: Calculated and arranged by the author using information from 2015 Benchmark Year Input-Output Tables, Bank of Korea (2015).

First, the intermediate demand rate of the environmental industry is 62.27 percent which is higher than the industry average which signifies that it has a strong characteristic as an intermediate good.

Second, in the final demand section, the private consumption of the environmental industry is lower than average, but, interestingly, the private investment is the highest among the sectors with 21.49. This seems like a result of private firms' investment on environment related R&D due to environmental regulations or policies. The export rate of the environmental industry is 5.5 percent (10.54 percentage points lower than the industry average) which suggests that the environmental industry is not an export-oriented industry.

[4] Intermediate demand rate = (intermediate demand / total demand) *100
[5] Private consumption rate = (private consumption / final demand) * 100
[6] Government consumption rate = (government consumption / final demand) * 100
[7] Private investment rate = (private investment/ final demand) * 100
[8] Government investment rate = (government investment / final demand) * 100
[9] Export rate = (export / final demand) * 100

Third, the total supply section provides information on the composition ratio of domestic gross output and import. The environmental industry's import rate out of total supply is the lowest among the four industries and about 10 percentage point lower than the industry average.

6. Analysis of the Economic Ripple Effect of the Environmental Industry

The input coefficient is a parameter used to measure the magnitude of the production-inducing effect that is spread to each sector when the final demand for goods or services occurs (Bank of Korea, 2015). However, in the case of a large number of sectors, it is very difficult to measure infinitely continuous production ripple effects only with the input coefficient. Therefore, the method of deriving and using the production inducement coefficient uses a mathematical method called inverse matrix (Bank of Korea, 2015). The equation that expresses the dependence for sector i is described as below (Miller & Blair, 2009).

$$Xi = \sum jXij + Yi \quad (1)$$

Xi = Total output of sector i

Xij= The amount of a product from sector i used as an intermediate input in production by sector j

Yi = The final demand of sector i (where i, j= 1,…,n)

The above equation (1) can be written in matrix form for the entire economy to define the technical coefficient $aij = \frac{Xij}{Xj}$ as a ratio of a product from sector i that is needed by sector j to generate one unit of its product.

$$X = AX + Y \quad (2)$$

Where X = $\begin{bmatrix} Xi \\ \vdots \\ Xn \end{bmatrix}$, A = $\begin{bmatrix} a11 & \cdots & a1n \\ \vdots & \ddots & \vdots \\ an1 & \cdots & ann \end{bmatrix}$ and Y = $\begin{bmatrix} Yi \\ \vdots \\ Yn \end{bmatrix}$

Matrix A is called the technology matrix. A solution to equation (2) is:

$$X = (I - A)^{-1}Y \quad (3)$$

$I =$ n-by-n identity matrix

$(I - A)^{-1}$ = The Leontief Inverse matrix

Therefore, $(I - A)^{-1}$ is the production inducement coefficient that combines the direct and indirect production ripple effects caused by one unit increase in final demand (Bank of Korea, 2015). The production inducement coefficient has a property of multiplier that shows a ripple effect derived from the final demand and is called a Leontief multiplier (Bank of Korea, 2015). In this section, (a) production, (b) value-added, (c) import and (d) employment multipliers of the final demands for individual domestic products are derived using the Bank of Korea's 2015 Benchmark Year Input-Output Tables based on the 34 classifications of large-sized industries arranged by the author. These tables are also used for the analysis of backward and forward linkage effects. Microsoft Excel and STATA are used for the calculations of multipliers and the coefficients of backward and forward linkage effects. The multipliers of production, value-added, import and employment of all industries are presented in Table 14.

Table 14

Production, Value-Added, Import and Employment Multipliers of All Industries (34 Industries)

Industry	Production multiplier	Value-added multiplier	Import multiplier	Employment Multiplier[10]
Agricultural, forest, and fishery goods	1.824	0.859	0.141	27.03
Mined and quarried goods	1.848	0.872	0.128	8.77
Food, beverages and tobacco products	2.169	0.752	0.248	14.5
Textile and leather products	1.966	0.573	0.427	10.19
Wood and paper products, printing and reproduction of recorded media	2.024	0.714	0.286	10.94
Petroleum and coal products	1.232	0.4	0.6	1.4
Chemical products	1.856	0.612	0.388	5.74
Non-metallic mineral products	2.109	0.757	0.243	9.05
Basic metal products	1.84	0.508	0.492	5.78
Fabricated metal products, except machinery and furniture	2.089	0.754	0.246	7.97
Computing machinery, electronic equipment and optical instruments	1.708	0.606	0.394	4.87
Electrical equipment	2.032	0.683	0.317	7.81
Machinery and equipment	2.124	0.711	0.289	7.2
Transport equipment	2.439	0.679	0.321	8.34
Other manufactured products	2.145	0.718	0.282	14.27
Manufacturing services and repair services of industrial equipment	1.899	0.854	0.146	10.55
Electricity, gas, and steam supply	1.145	0.28	0.72	1.23
Water supply, sewage and waste treatment and disposal services	1.6	0.89	0.11	6.7
Construction	2.035	0.816	0.184	11.06
Wholesale and retail trade and commodity brokerage services	1.732	0.889	0.111	19
Transportation	1.694	0.663	0.337	14.78
Food services and accommodation	2.151	0.824	0.176	22.61
Communications and broadcasting	1.694	0.87	0.13	10.1
Finance and insurance	1.649	0.928	0.072	8.84
Real estate services	1.389	0.966	0.034	5.32
Professional, scientific, and technical services	1.831	0.859	0.141	12.34
Business support services	1.481	0.915	0.085	19.62
Public administration, defense, and social security services	1.365	0.938	0.062	10.62
Education services	1.527	0.922	0.078	17.56
Health and social care services	1.73	0.833	0.167	18.32
Art, sports, and leisure services	1.77	0.888	0.112	15.02
Other services	2.009	0.835	0.165	24.71
Others	2.592	0.856	0.144	11.64
Environmental Industry	1.714	0.748	0.252	12.15
All industry	1.813	0.774	0.226	11.7

Source: Calculated and arranged by the author using information from 2015 Benchmark Year Input-Output Tables, Bank of Korea (2015).

[10]Employment multiplier for each industry: The number of employees induced directly or indirectly in all industries including that industry when the final demand for one product (1 billion KRW) occurs for a specific product.

6.1. Production Inducement Coefficient

Production inducement coefficient, or production multiplier, is defined as the level of production that is directly or indirectly induced in each industry sector by an additional unit of final demand through consumption, investment, or export (Sasaki & Ueyama, 2009; Bank of Korea, 2015). So, it refers to the ripple effect of the direct and indirect production induced, in the whole economy (all industries) from the final demand in the sector.

The production multiplier of the environmental industry is 1.714, which is lower than the industry average (1.813). Except for 'others', the production multiplier of 'transport equipment' is the highest (2.439) followed by 'food, beverages and tobacco products' – 2.169.

The backward and forward linkage effects will be analyzed in section 6.5 using this production multiplier result.

6.2. Value-Added Inducement Coefficient

The value-added multiplier (value added inducement coefficient) refers to the amount of value-added that is generated directly or indirectly through changes in final demand in each industry (i.e. through a matrix of production inducement coefficient). (Bank of Korea, 2014). So, the value-added inducement coefficient of the environmental industry refers to the ability to directly or indirectly induce value-added due to the change of final demand of the environmental industry. The value-added multiplier of the environmental industry is 0.748 which is slightly lower than the industry average (0.774). The real estate services' value-added multiplier is the highest among 34 industries which is 0.966.

6.3. Import Inducement Coefficient

The import multiplier (import inducement coefficient) refers to the amount of imports that occur directly or indirectly due to changes in final demand (Bank of Korea, 2015). The import inducement coefficient is high when the proportion of imports (i.e., dependence on imports) that are used as intermediates in the production of the sector is high, or when using domestic intermediates that themselves require a lot of imports.

The import multiplier of the environmental industry is 0.252 which is slightly higher than the industry average (0.226).

6.4. Employment Multiplier

The employment multiplier refers to the induced volume of employments that are directly or indirectly induced in all industry when 1 billion KRW of final demand in the industry of is made (Bank of Korea, 2015). The environmental industry's employment multiplier is 12.15, which is higher than the industry average of 11.7. So, it means that the environmental industry has high employment inducement effect. The high employment multiplier of the environmental industry can be explained by the fact that the environmental industry is mainly comprised of small-sized enterprises as explained in section 3.4.

6.5. Backward and Forward Linkage Effects

The production multiplier table indicates the degree of direct and indirect linkages between sectors. Using this table, the degree of interdependence between each sector is expressed as a relative size to the average of all sectors; the degree of interdependence can be seen in the impact coefficient and sensitivity coefficient (Bank of Korea, 2015). For this part, the 34 classifications of large-sized industries is used to

analyze the backward and forward linkage effects of the environmental industry and the rank of each industry is indicated for comparison (Table 15).

Table 15
Impact Coefficients and Sensitivity Coefficients of All Industries (34 Industries)

Industry	Impact coefficient	Rank	Sensitivity coefficient	Rank
Agricultural, forest, and fishery goods	1.044	17	1.06	14
Mined and quarried goods	1.058	15	0.648	28
Food, beverages and tobacco products	1.242	3	1.314	5
Textile and leather products	1.125	12	0.904	21
Wood and paper products, printing and reproduction of recorded media	1.158	10	1.11	13
Petroleum and coal products	0.705	31	1.137	12
Chemical products	1.062	14	2.037	1
Non-metallic mineral products	1.207	6	0.86	22
Basic metal products	1.053	16	1.411	4
Fabricated metal products, except machinery and furniture	1.196	7	1.241	8
Computing machinery, electronic equipment and optical instruments	0.978	22	1.06	14
Electrical equipment	1.163	9	1.023	17
Machinery and equipment	1.216	5	0.939	19
Transport equipment	1.396	2	1.024	16
Other manufactured products	1.228	4	0.679	26
Manufacturing services and repair services of industrial equipment	1.087	13	1.195	10
Electricity, gas, and steam supply	0.655	32	0.846	23
Water supply, sewage and waste treatment and disposal services	0.916	24	0.599	32
Construction	1.165	8	0.618	31
Wholesale and retail trade and commodity brokerage services	0.991	19	1.544	2
Transportation	0.318	34	0.752	24
Food services and accommodation	0.573	33	0.375	34
Communications and broadcasting	0.883	26	1.214	9
Finance and insurance	0.901	25	1.311	6
Real estate services	0.755	29	0.997	18
Professional, scientific, and technical services	0.97	23	1.298	7
Business support services	0.791	28	1.15	11
Public administration, defense, and social security services	0.739	30	0.924	20
Education services	0.806	27	0.596	33
Health and social care services	0.99	20	0.641	29
Art, sports, and leisure services	1.013	18	0.655	27
Other services	1.15	11	0.708	25
Others	1.484	1	0.629	30
Environmental Industry	0.981	21	1.501	3

Source: Calculated and arranged by the author using information from 2015 Benchmark Year Input-Output Tables, Bank of Korea (2015).

6.5.1. Impact Coefficient (Backward Linkage Effects)

The impact coefficient refers to the effect on all sectors when the final demand for a certain sector is generated by one more unit. It is a coefficient which indicates the degree of the backward linkage effect in relative magnitude (Seo et al., 2014). So, the backward linkage effect, in other words, refers to the change in the production of the national economy when the final demand for a product changes (e.g. the impact of the environmental industry on the business). The impact coefficient is calculated by summing the production multipliers of the sector vertically and then dividing it by the average production multiplier of all sectors. If the coefficient of an industry is larger than 1, it means that the industry has a strong backward linkage effect (Bank of Korea, 2015).

The environmental industry's impact coefficient is 0.981 which is the 21st among 34 industries. Except for the 'others,' the impact coefficient of 'transport equipment' is the highest (1.396) and 'food, beverages and tobacco products' comes next with the coefficient of 1.242.

6.5.2 Sensitivity Coefficient (Forward Linkage Effect)

The forward linkage effect represents the extent to which products of a certain industry are sold for production activities in other industries (Bank of Korea, 2015). The sensitivity coefficient is used to measure the change in the production when the final demand for all products change (e.g. the impact of the business on the environmental industry) and it is the sum of the rows of each sector of the production induction coefficient matrix divided by the average of all industry (Bank of Korea, 2015). So, in general, the sensitivity coefficient increases when the product of an industry is widely used as an intermediate material in other industrial sectors.

The sensitivity coefficient of the environmental industry is 1.501 and it is ranked as the 3rd among 34 industries. As the sensitivity coefficient bigger than 1, it means that the environmental industry has a big forward linkage effect.

In this section, the impact coefficient and the sensitivity coefficient are derived for the analysis of the backward and forward linkage effects of the environmental industry. The impact coefficient of the industry (0.981) is lower than 1 while the sensitivity coefficient (1.501) is higher than 1.

Generally, the industrial sector can be classified into four types based on the size of the forward and backward linkage effects. If an industry has both high forward and backward linkage effects, it can be defined as an intermediate demand manufacturing industry. If the forward linkage effect is high and the backward linkage effect is low, it is classified as an intermediate demand primary industry. The industry with high backward linkage effect and low forward linkage effect is the final demand manufacturing industry and if both of them are low, it is classified as a final demand primary industrial type (Shin, 2012).

Accordingly, the environmental industry can be classified as an intermediate demand primary industrial type. In other words, the environment industry functions as an essential input factor for other industries and it is widely used as intermediate goods.

7. Conclusion

The environmental industry is an induced industry that is greatly affected by government environmental regulations and policies, which serve to give this industry a number of unique features. As climate change and environmental degradation have become serious threats for humankind and sustainable development has been a global goal, environmental protections and reinforcement have been naturally strengthened.

Korea has set a goal to reduce greenhouse gas emissions by 30 percent compared to BAU (business as usual) by 2020. To achieve this objective, the government has selected "job creation by green development" as one of its strategies by highlighting the importance of investment in green energy and technology (Min et al., 2010).

The major goal of environmental regulations is to protect the environment, but there are also concerns about the adverse reactions that were not originally intended (Min et al., 2010). For example, the production of individual industries can increase due to the R&D investment in environmental related technologies, but it can also lead to negative effects such as increases in production costs or compliance costs, which can be a big burden for firms (Jang & Lee, 2019). This thesis does not analyze the impact of environmental regulations, but environmental regulations are a significant factor that can be used to explain the impact of government policy on the environmental industry, inducement coefficients, the environment, and the economy.

So, this paper focuses on the economic impact of the environmental industry. In preparation for this thesis, an input-output analysis using the Bank of Korea's 2015 Benchmark Year Input-Output Tables was carried out. Before conducting the analysis, the matching of the Environmental Industry Special Classification codes and the Bank of Korea's sector classification codes was done to facilitate economic analysis and, based on this information, the environmental industry is defined in the input-output table.

Based on the rearranged input-output table, the characteristics of the environmental industry are analyzed. First, the environmental industry's gross output, GDP, and employment are compared with the industry average and it is shown that all three factors of the environmental industry are higher than the average. Second, the income distribution of the environmental industry is analyzed, revealing that the industry's wages and salaries rate to be lower than average. However, this low rate can

be attributed to the environmental industry's composition of mostly small-sized businesses.

In addition, the input and output structures are analyzed which shows that the environmental industry has high degree of localization and the value-added rate. Also, the environmental industry's import and export rates are lower than the industry average which shows that, compared to other industries, the environmental industry has low dependence on imports and exports.

The analysis of multipliers is conducted to further study the economic impact of the environmental industry and its relationship with other industries, including the impact it has on the others. The production multiplier of the environmental industry is 1.714 which is lower than the industry average, indicating that the environmental industry is not one of the nation's strategic industries. However, the environmental industry has high forward linkage effect which suggests that the environmental industry plays a significant role as an essential intermediate goods widely used in other industries

The value-added multiplier (0.748) and the import multiplier (0.252) of the environmental industry are also derived. The value-added multiplier is lower than the industry average, and the import multiplier is higher which suggests that despite its high degree of localization, the environmental industry still depends on import. This can be explained by the reality of the Korean environmental industry that importing certain goods for production is inevitable. For example, majority of major parts and equipment used in atmospheric industry are imported which suggests that R&D on environmental related technologies and products should be made (Lee et al., 2011).

The employment multiplier is larger than the average (12.15 persons for the environmental industry and 11.7 persons for the industry average) which can be

explained by the environmental industry's characteristic of being mainly composed of small-sized businesses.

Table 16
Results of Hypotheses Testing

Hypotheses	Result
H1a: The production multiplier of the environmental industry is higher than the industry average	Not Supported
H1b: The value-added multiplier of the environmental industry is higher than the industry average	Not Supported
H1c: The import multiplier of the environmental industry is lower than the industry average	Not Supported
H1d: The employment multiplier of the environmental industry is higher than the industry average	Supported
H2a: The environmental industry has more significant forward linkage effect than backward linkage effect	Supported
H2b: The environmental industry's forward linkage effect is larger than 1	Supported

Overall, the environmental industry's forward linkage effect is very high which suggests that if the price of the products of the environmental industry decreases through technological innovation, the production costs of many industries using the environmental industry's products as an intermediate input will also be greatly reduced, contributing to the overall competitiveness of the whole industry. So, investments on R&D of the environmental industry is crucial as it can bring significant benefits for the entire economy. As the environmental industry is greatly affected by the government's policies and regulations on environmental issues and also its impact on other industries is significant, the implementation of such policies must consider making an empirical analysis of the industry like this study has done.

Nevertheless, this study is limited to using the 2015 Benchmark Year Input-Output Tables to analyze the environmental industry in 2018. These Benchmark Year Tables are only released every five years. Also, the classification of the environmental

industry for input-output analysis is based on the Environmental Industry Special Classification Table from the 2018 Report on the Environmental Industry Survey, but as the input-output table classifications cover the broader range of the industry, there is concern regarding overestimation. This is a limitation due to the data and, as the environmental industry continues to become an important part of the economy, more specific interindustry table classifications for the environmental industry can be expected in the future. Despite these limitations, this thesis is a significant contribution to the existing literature as a study of the environmental industry's economic impacts in detail and provides information about the important implications of the implementation of government policies.

Appendix

Table 17

Matching Table of the Environmental Industry Special Classification, Korean Standard Industrial Classification and 2015 Benchmark Year Input-Output Table Basic Sector Classification

Environmental Industry Special Classification from 2018 Report on the Environmental Industry Survey			**Korean Standard Industrial Classification**		**Input-Output Table (2015 Benchmark Year Basic Sector Classification)**	
S[11]	C[12]	Description	C	Description	C	Description
1. Resource circulation management	101. Manufacture of waste management equipment					
	1010101	Manufacture of cement for storage and treatment of hazardous waste	23311	Manufacture of cement	2620	Cement
			23329	Manufacture of other concrete and similar products n.e.c.	2632	Concrete products
	1010102	Manufacture of metal processed products for storage and treatment of hazardous waste	24213	Manufacture of smelting, refining and alloys of lead and zinc	2831	Products of smelting, refining and alloys of lead and zinc
	1010201	Manufacture of general waste collection equipment	29299	Manufacture of other special purpose machinery, n.e.c.	3999	Other special purpose machinery, n.e.c.
	1010301	Manufacture of plastic film, sheet and plate for waste disposal equipment	22213	Manufacture of plastic sheets and plates	2399	Other plastic products
	1010302	Manufacture of electric appliances for kitchens for waste disposal equipment	28511	Manufacture of electric appliances for kitchen	3752	Electric appliances for kitchen and heating
	1010303	Manufacture of automobile for waste treatment and cleaning	30122	Manufacture of truck and motor vehicles for transportation of goods and special purpose	4013	Truck
	1010401	Manufacture of general waste handling equipment	29299	Manufacture of other special purpose machinery, n.e.c.	3999	Other special purpose machinery, n.e.c.
	1010501	Manufacture of general waste separation equipment	29299	Manufacture of other special purpose machinery, n.e.c.	3999	Other special purpose machinery, n.e.c.
	1010601	Manufacture of container washer and dryer	29192	Manufacture of machinery for cleaning, packing and charging	3999	Other special purpose machinery, n.e.c.
	1010602	Manufacture of other recycling equipment and machinery	29299	Manufacture of other special purpose machinery, n.e.c.	3999	Other special purpose machinery, n.e.c.
	1010701	Manufacture of incinerator	29150	Manufacture of industrial ovens, furnaces and furnace burners	3014	Industrial boiler and steam generator
	102. Construction of waste management facilities					
	1020101	Construction of waste treatment facilities	41224	Construction of environmental facilities	5131	Environment purification facilities
	1020201	Construction of resource management buildings	42110	Wrecking and demolition of buildings and other structures	5030	Construction repair
	103. Waste management services					
	1030101	Designated waste collection and transportation	38120	Hazardous waste collection	4912	Waste collection and treatment (Industry)
	1030102	Designated waste-related remediation activities and waste management services	39009	Other remediation activities and waste management services	5131	Environmental purification facilities
	1030103	Treatment and disposal of hazardous waste	38220	Treatment and disposal of hazardous waste	4912	Waste collection and treatment (Industry)

[11] S = Segments of the Environmental Industry Special Classification from 2018 Report on the Environmental Industry Survey

[12] C = Classification code

	1030201	Non-hazardous waste collection	38110	Non-hazardous waste collection	4912	Waste collection and treatment (Industry)
	1030202	Construction waste collection and transportation	38130	Construction and demolition waste collection	4912	Waste collection and treatment (Industry)
	1030203	Treatment and disposal of non-hazardous waste	38210	Treatment and disposal of non-hazardous waste	4912	Waste collection and treatment (Industry)
	1030204	Treatment and disposal of construction and demolition waste	38230	Treatment and disposal of construction and demolition waste	4912	Waste collection and treatment (Industry)
	1030205	Cleaning of industrial facilities, transportation equipment and public places related to general waste	74212	Cleaning of industrial facilities, transportation equipment and public places	7410	Business facility maintenance and landscaping service
	1030301	Renting of waste related machinery and equipment	76390	Renting of other industries machinery and equipment	7300	Renting of equipment, supplies and intellectual property
	104. Manufacture of waste to energy equipment					
	1040101	Manufacture of auxiliary equipment and dryer related to waste to energy	29299	Manufacture of other special purpose machinery, n.e.c.	3999	Other special purpose machinery, n.e.c.
	1040102	Manufacture of waste to energy fuel production and handling equipment	29299	Manufacture of other special purpose machinery, n.e.c.	3999	Other special purpose machinery, n.e.c.
	1040201	Manufacture of waste to energy storage equipment	25122	Manufacture of tanks and reservoirs	3013	Metal tank and pressure vessel
	1040301	Manufacture of waste to energy reactor and fermenter	29299	Manufacture of other special purpose machinery, n.e.c.	3999	Other special purpose machinery, n.e.c.
	1040302	Manufacture of oven, furnace and furnace burner for energy use of waste to energy	29150	Manufacture of industrial ovens, furnaces and furnace burners	3014	Industrial boiler and steam generator
	1040303	Manufacture of waste heat recovery and steam generator	25130	Manufacture of nuclear reactors and steam generators	3014	Industrial boiler and steam generator
	1040304	Manufacture of turbines for waste to energy	29119	Manufacture of other engines and turbines	3810	Internal combustion engine and turbine
	105. Construction of waste to energy related facilities					
	1050101	Construction of incinerator facility	41224	Construction of environmental facilities	5131	Environment purification facilities
	1050102	Construction of dry fueling facility	41224	Construction of environmental facilities	5131	Environment purification facilities
	1050201	Construction of bio-gasification facility and power plant	41225	Construction of industrial plants	5134	Industrial Plant
	1050202	Construction of pyrolysis gasification facility and power plant	41225	Construction of industrial plants	5134	Industrial Plant
	1050203	Construction of bio-fueling facilities and power plant	41225	Construction of industrial plants	5134	Industrial Plant
	1050204	Construction of gasification melting facility	41225	Construction of industrial plants	5134	Industrial Plant
	1050205	Construction of solid fuel (SRF) manufacturing facility	41225	Construction of industrial plants	5134	Industrial Plant
	1050301	Plumbing, heating, air conditioning works	42201	Plumbing, heating, air conditioning works	5190	Other constructions
	106. Construction of waste to energy related facilities					
	1060101	Waste to energy facility consignment processing service	38210	Treatment and disposal of non-hazardous waste	4912	Waste collection and treatment (Industry)
	1060201	Waste to energy facility maintenance	74100	Combined facilities support activities	5030	Construction repair
	1060202	Waste to energy facility safety diagnosis and investigation	72919	Other technical testing and analysis	7410	Business facility maintenance and landscaping service
	1060301	Raw material and harmful gas analysis	72911	Testing and analysis services of composition and purity of materials	7292	Science and technology service

	1060401	Waste resource energy utilization steam and electricity supply service	35300	Steam, chilled or hot water and air conditioning supply	4629	Steam and hot water supply
			35119	Other power generation	4505	Renewable energy
	1060501	Waste to energy technology consulting	72129	Other engineering services	7292	Science and technology service
	107. Manufacture of processed raw materials for recycling and recycled products					
	1070101	Manufacture of animal oils and fats	10401	Manufacture of animal oils and fats	0862	Oils and fats
	1070102	Manufacture of ingredients and other prepared animal feeds	10802	Manufacture of single ingredients and other prepared animal feeds	0880	Animal feeds
	1070201	Manufacture of recycled fabric and garment product	13213	Weaving of man-made fiber fabrics	1122	Other fiber fabrics
	1070301	Manufacture of recycled pulp	17110	Manufacture of pulp	1410	Pulp
	1070401	Manufacture of recycled lubricating oils and greases	19221	Manufacture of lubricating oils and greases	1631	Lubricating oils and greases
	1070402	Other oil refinery reprocessing service	19229	Reprocessing of other fractionation in petroleum refinery	1639	Other oil refined products
	1070501	Manufacture of renewable basic inorganic chemical and organic solvent	20129	Manufacture of other basic inorganic chemicals	1722	Basic inorganic compounds
			20411	Manufacture of general paints and similar products	2211	Paints
	1070502	Manufacture of other renewable basic organic chemical	20119	Manufacture of coal and other basic organic chemicals	1729	Other basic organic chemicals
	1070503	Manufacture of renewable natural resin and wood chemicals	20112	Manufacture of natural gum and silvichemicals	1729	Other basic organic chemicals
	1070504	Manufacture of industrial regenerative gas	20121	Manufacture of industrial gases	1721	Industrial gas
	1070505	Manufacture of other basic inorganic chemicals	20129	Manufacture of other basic inorganic chemicals	1722	Basic inorganic chemicals
	1070506	Manufacture of recycled inorganic pigments and other metal oxides	20131	Manufacture of metal oxides for inorganic pigments and related products	2813	Lead and zinc smelting, refining and alloy products
	1070507	Production of recycled plastic raw material	20203	Manufacture of mixed, blended and recycled plastic materials	2399	Other plastic products
	1070508	Manufacture of other unclassified recycled chemical	20499	Manufacture of other chemical products n.e.c.	2299	Other chemical products
	1070509	Manufacture of regenerated fibers	20502	Manufacture of regenerated fibers	1119	Other fibers
	1070601	Manufacture of parts for retreading of tires and tubes	22111	Manufacture of rubber tires and tubes	2410	Tires and tubes
	1070602	Retreading of rubber tires	22112	Retreading of rubber tires	2410	Tires and tubes
	1070603	Manufacture of other retread rubber products n.e.c.	22199	Manufacture of other rubber products n.e.c.	1802	Synthetic rubber
	1070604	Manufacture of recycled plastic sheets and plates	22213	Manufacture of recycled plastic sheets and plates	2399	other plastic products
	1070605	Manufacture of other recycled foamed plastic products	22259	Manufacture of other foamed plastic products	2391	Plastic products for construction
	1070701	Manufacture of other recycled industrial glass products	23129	Manufacture of other industrial glass products	2503	Industrial glass products (except for the use of electronics)
	1070702	Manufacture of other recycled glass products n.e.c.	23199	Manufacture of other glass products n.e.c.	2509	Other glass products
	1070703	Manufacture of recycled asphalt concrete	23991	Manufacture of asphalt concrete and related products	2694	Asphalt concrete and asphalt products
	1070801	Manufacture of steel slag and by-products	24111	Manufacture of basic iron	2711	Pig iron
	1070802	Manufacture of steel slag and by-products	24112	Manufacture of basic steel	2713	Crude steel

	1070803	Manufacture of ferro-alloys slag and by-products	24113	Manufacture of ferro-alloys	2712	Ferro-alloys
	1070804	Manufacture of other steel and ferro-alloys slag and by-products	24119	Manufacture of other basic iron and steel	2799	Other primary steel products
	1070805	Manufacture of smelting, refining and alloys of copper slag	24211	Manufacture of smelting, refining and alloys of copper	2811	Smelting, refining and alloys products of copper
	1070806	Manufacture of smelting, refining and alloys of aluminum slag and by-products	24212	Manufacture of smelting, refining and alloys of aluminum	2812	Smelting, refining and alloys products of aluminum
	1070807	Manufacture of smelting, refining and alloys of lead and zinc slag and by-products	24213	Manufacture of smelting, refining and alloys of lead and zinc	2813	Smelting, refining and alloys products lead and zinc
	1070808	Manufacture of smelting, refining and alloys of other non-ferrous metals slag and by-products	24219	Manufacture of smelting, refining and alloys of other non-ferrous metals	2819	Smelting, refining and alloys products of other non-ferrous metals
	1070901	Metal raw material recycling service	38312	Recovery of metal waste	0719	Other non-ferrous metal ores
	1070902	Non-metal raw material recycling service	38322	Recovery of non-metal waste	0729	Other non-metal minerals
	108. Retail of recycled products					
	1080101	Wholesale of materials for recycling	46791	Wholesale of materials for recycling	5200	Wholesale and retail trade and commodity brokerage services
	1080201	Retail sale of second-hand furniture	47861	Retail sale of second-hand furniture	5200	Wholesale and retail trade and commodity brokerage services
	1080202	Retail sale of electronic equipment	47862	Retail sale of electronic and communication equipment	5200	Wholesale and retail trade and commodity brokerage services
	1080203	Retail sale of other second-hand goods	47869	Retail sale of other second-hand goods	5200	Wholesale and retail trade and commodity brokerage services
	109. Resource circulation-related analysis, data collection and evaluation service					
	1090101	Resource circulation-related analysis, data collection and evaluation service	72911	Testing and analysis services of composition and purity of materials	7292	Science and technology service
2. Water management	201. Manufacture of wastewater management equipment and products					
	2010101	Manufacture of fluid power equipment for sewage and wastewater equipment	29120	Manufacture of fluid power equipment	3820	Pumps and compressors
	2010102	Manufacture of air or vacuum pumps and compressors for sewage and wastewater equipment	29132	Manufacture of air or vacuum pumps and compressors	3820	Pumps and compressors
	2010201	Manufacture of other basic inorganic chemicals for chemical recovery	20129	Manufacture of other basic inorganic chemicals	1722	Basic inorganic compounds
	2010202	Manufacture of metal oxides for inorganic pigments and related products for chemical recovery	20131	Manufacture of metal oxides for inorganic pigments and related products	2813	Smelting, refining and alloys products lead and zinc
	2010203	Manufacture of other chemical products n.e.c. for chemical recovery	20499	Manufacture of other chemical products n.e.c.	2299	Other chemical products
	2010204	Manufacture of lime and plaster for chemical recovery	23312	Manufacture of lime and plaster	2691	Lime and plaster products
	2010205	Manufacture of filtering or purifying machinery for liquids or oils for chemical recovery	29175	Manufacture of filtering or purifying machinery for liquids or oils	3852	Controlling instruments for air and liquid
	2010301	Manufacture of liquid separators related to oil and water separation	29175	Manufacture of filtering or purifying machinery for liquids or oils	3852	Controlling instruments for air and liquid

	2010302	Manufacture of centrifuge and waste solution solvent freon recovery machines	29199	Manufacture of other general-purpose machinery n.e.c.	3899	Other general-purpose machinery
			29299	Manufacture of other special purpose machinery, n.e.c.	3899	Other general-purpose machinery
	2010401	Manufacture of screening and liquid filtering machinery	29175	Manufacture of filtering or purifying machinery for liquids or oils	3852	Controlling instruments for air and liquid
	2010402	Manufacture of plastic products for screening and liquid filtering machinery	29299	Manufacture of other special purpose machinery, n.e.c.	3899	Other general-purpose machinery
	2010403	Manufacture of textile products for sorters and liquid filters for screening and liquid filtering machinery	13219	Weaving of special textiles and other fabrics	1122	Other fiber fabrics
	2010502	Manufacture of plastic products for wastewater management	22222	Manufacture of plastic products for installation and sanitation	2393	Plastic products for transportation equipment and for assembly
	2010503	Manufacture of metal tanks for wastewater management	25122	Manufacture of tanks and reservoirs	3013	Metal tank and pressure vessel
	2010504	Manufacture of wastewater treatment machinery and parts	29199	Manufacture of other general-purpose machinery n.e.c.	3899	Other general-purpose machinery
	2010601	Manufacture of water pollution control equipment and wastewater recycling equipment	27216	Manufacture of industrial process control equipment	3612	Measuring and analyzing instruments
	2010701	Manufacture of hydraulic pumps and power units for water handling	29120	Manufacture of fluid power equipment	3820	Pumps and compressors
	2010702	Manufacture of pumps for liquids for water handling	29131	Manufacture of pumps for liquids	3820	Pumps and compressors
	2010703	Manufacture of taps, valves and similar products for water handling	29133	Manufacture of taps, valves and similar products	3931	Valve
	2010704	Manufacture of physical properties testing, measuring and inspection equipment for water handling equipment	27213	Manufacture of physical properties testing, measuring and inspection equipment	3612	measuring and analyzing instruments
	202. Construction related to wastewater and wastewater management					
	2020101	Sewer construction	41223	Construction of harbor and river works, waterways, dams and other water works	5113	Port facilities
	2020102	Construction of wastewater treatment facilities	41224	Construction of environmental facilities	5131	Environment purification facilities
	2020103	Construction of sewage and ventilation facilities	42201	Plumbing, heating, air conditioning works	5190	Other constructions
	2020104	Construction of waterworks and drainpipe	41229	Other construction of civil engineering projects	5124	Urban civil engineering
	203. Wastewater management service					
	2030101	Sewage treatment services	37011	Sewage treatment services	4802	Sewage, wastewater and human and animal waste treatment (industry)
	2030102	Human waste treatment services	37021	Human waste treatment services	4802	Sewage, wastewater and human and animal waste treatment (industry)
	2030103	Animal waste treatment services	37022	Animal waste treatment services	4802	Sewage, wastewater and human and animal waste treatment (industry)
	2030104	Remediation activities and waste management related to wastewater	39009	Other remediation activities and waste management services	5131	Environment purification facilities
	2030105	Wastewater treatment services	37012	Wastewater treatment services	4802	Sewage, wastewater and human and animal waste treatment (industry)

	2030201	Mine drainage service	08000	Mining support service activities	7291	Engineering service
	204. Water supply and management service					
	2040101	Production of natural mineral waters	11202	Production of natural mineral waters and other bottled waters	0920	Non-alcoholic drinks and ice
	2040102	Manufacture of basic inorganic chemicals related to water supply	20129	Manufacture of other basic inorganic chemicals	1722	Basic inorganic compounds
			20499	Manufacture of other chemical products n.e.c.	2299	Other chemical products
	2040103	Manufacture of synthetic resin and other plastic materials for water supply	20202	Manufacture of synthetic resin and other plastic materials	1801	Synthetic resin
	2040104	Tap water supply	36010	Water collection, treatment and distribution activities for domestic needs	4700	Water supply
	2040105	Industrial water supply	36020	Water collection, treatment and distribution activities for industrial needs	4700	Water supply
	205. Water related analysis, data collection and evaluation service					
	2050101	Water related analysis, data collection and evaluation service	72911	Testing and analysis services of composition and purity of materials	7292	Science and technology service
3. Environment restoration and recovery	301. Manufacture of soil, surface water and groundwater improving and purifying equipment					
	3010101	Manufacture of soil remediation equipment	29299	Manufacture of other special purpose machinery, n.e.c.	3999	Other special purpose machinery, n.e.c.
	3010102	Manufacture of other soil remediation equipment	29299	Manufacture of other special purpose machinery, n.e.c.	3999	Other special purpose machinery, n.e.c.
	3010201	Manufacture of electric equipment for water treatment equipment	28909	Manufacture of other electrical equipment n.e.c.	3799	Other electrical equipment
	3010202	Manufacture of chemical products for water treatment	20421	Manufacture of surface-active agents	2221	Soap, detergent and toothpaste
	3010203	Manufacture of water treatment and oil spill purification equipment	28909	Manufacture of other electrical equipment n.e.c.	3799	Other electrical equipment
			29299	Manufacture of other special purpose machinery, n.e.c.	3999	Other special purpose machinery, n.e.c.
	3010204	Manufacture of other water management equipment	28909	Manufacture of other electrical equipment n.e.c.	3799	Other electrical equipment
	302. Soil, surface water and groundwater improving and purifying services					
	3020101	Decontamination of soils and water biological treatment	39001	Decontamination of soils and groundwater	4920	Materials recycling services
	3020102	Remediation activities and restoration services related to soil and water resources	39009	Other remediation activities and waste management services	5131	Environment purification facilities
	3020103	Cleaning service related to soil and water purification	74212	Cleaning of industrial facilities, transportation equipment and public places	7410	Business facility maintenance and landscaping service
	3020104	Landscape care and maintenance service activities related to soil and water purification	74300	Landscape care and maintenance service activities	7410	Business facility maintenance and landscaping service
	303. Environmental remediation and recovery related analysis, data collection and evaluation service					
	3030101	Environmental remediation and recovery related analysis, data collection and evaluation service	72911	Testing and analysis services of composition and purity of materials	7292	Science and technology service

4. Responding to climate change	401. Manufacture of climate change adaptation related products					
	4010101	Manufacture of carbon dioxide capture-related equipment	29174	Manufacture of filtering or purifying machinery for air or gases	3852	Controlling instruments for air and liquid
	4010102	Manufacture of carbon dioxide capture-related textile products	13219	Weaving of special textiles and other fabrics	1122	Other fiber fabrics
			23995	Manufacture of carbon fibers	1122	Other fiber fabrics
	4010201	Manufacture of liquid filter related to climate change	29175	Manufacture of filtering or purifying machinery for liquids or oils	3852	Controlling instruments for air and liquid
	4010301	Manufacture of measuring equipment related to climate change	27213	Manufacture of physical properties testing, measuring and inspection equipment	3612	measuring and analyzing instruments
	4010401	Manufacture of bio coal	19102	Manufacture of briquettes and other coal products	1612	Briquette
	4010501	Manufacture of weather observation equipment	27211	Manufacture of radar, navigation, aeronautical, nautical equipment; measuring and recording equipment	3519	Other wireless communication equipment and broadcasting equipment
	402. Climate change adaptation related construction					
	4020101	Low carbon building construction	41111	Detached dwelling house and multi-dwelling house construction	5010	Residential building
	403. Climate change adaptation related services					
	4030101	Carbon management consulting	71531	Activities of management consultancy	7112	Market research and management support services
	4030102	Climate Insurance Consulting	65121	Non-life insurance	6603	Non-life insurance
	4030201	Weather information and climate analysis software development	58222	Application software publishing	6212	Software development supply
			62010	Computer programming services	6290	Other IT services
	404. Climate adaptation related analysis, data collection and evaluation services					
	4040101	Climate adaptation related analysis, data collection and evaluation services	72911	Testing and analysis services of composition and purity of materials	7292	Science and technology service
5. Air quality management	501. Manufacture of air pollution control equipment					
	5010101	Manufacture of fluid power equipment for gas handling equipment	29120	Manufacture of fluid power equipment	3820	Pumps and compressors
	5010102	Manufacture of air or vacuum pumps and compressors	29132	Manufacture of air or vacuum pumps and compressors	3820	Pumps and compressors
	5010201	Manufacture of filtering or purifying machinery for air or gases for catalytic converter	29174	Manufacture of filtering or purifying machinery for air or gases	3852	Controlling instruments for air and liquid
	5010202	Manufacture of catalytic converter for automobile	30399	Manufacture of other new parts and accessories for motor vehicles n.e.c.	4032	Automobile parts
	5010301	Manufacture of natural resins and wood chemicals for chemical recovery	20499	Manufacture of other chemical products n.e.c.	2299	Other chemical products
	5010302	Manufacture of basic inorganic chemical for chemical recovery	20129	Manufacture of other basic inorganic chemicals	1722	Basic inorganic compounds
	5010303	Manufacture of lime for chemical recovery	23312	Manufacture of lime and plaster	2691	Lime and plaster products
	5010304	Manufacture of filtering or purifying machinery for air or gases for chemical recovery	29174	Manufacture of filtering or purifying machinery for air or gases	3852	Controlling instruments for air and liquid
	5010401	Manufacture of air pollution-related dust collector	29174	Manufacture of filtering or purifying machinery for air or gases	3852	Controlling instruments for air and liquid

	5010501	Manufacture of separator and sedimentation machine related glass fiber products	23121	Manufacture of basic glass products, glass fibers and optical glass	2501	Plate glass and primary glass products
	5010502	Manufacture of filtering or purifying machinery for air or gases for separators and sedimentation machine	29174	Manufacture of filtering or purifying machinery for air or gases	3852	Controlling instruments for air and liquid
	5010503	Manufacture of distiller, heat exchanger and gas generator	29176	Manufacture of distilling machinery, heat exchangers and gas generators	3014	Industrial boiler and steam generator
	5010504	Manufacture of materials handling equipment using temperature change	29176	Manufacture of distilling machinery, heat exchangers and gas generators	3014	Industrial boiler and steam generator
	5010601	Manufacture of filtering or purifying machinery for air or gases related to air pollution	29174	Manufacture of filtering or purifying machinery for air or gases	3852	Controlling instruments for air and liquid
	5010701	Manufacture of odor prevention equipment	29193	Manufacture of equipment for projecting, dispersing or spraying liquids or powders	3899	Other general-purpose machinery
	5010801	Manufacture of eco-friendly car	30121	Manufacture of passenger motor vehicles	4011	Car
	5010901	Manufacture of eco-friendly motor controller	28111	Manufacture of electric motors and generators	4032	Automobile parts
	502. Air pollution control-related construction					
	5020101	Air pollution control-related construction	41224	Construction of environmental facilities	5131	Environment purification facilities
	503. Air pollution control-related services					
	5030101	Environmental administration related to air pollution prevention	84213	Regulation of the activities of environment affairs	7511	Central government
	5030102	Air pollution-related environmental movement groups	94931	Environmental advocacy organizations	8109	Other services of membership organizations
	5030103	Air pollution inspection services	72911	Testing and analysis services of composition and purity of materials	7292	Science and technology service
	504. Manufacture of indoor air quality control equipment					
	5040101	Manufacture of indoor air quality related gas filter	29174	Manufacture of filtering or purifying machinery for air or gases	3852	Controlling instruments for air and liquid
	5040201	Manufacture of indoor air quality-related gas handling equipment	29132	Manufacture of air or vacuum pumps and compressors	3820	Pumps and compressors
	5040301	Manufacture of indoor air quality related dust collector	29174	Manufacture of filtering or purifying machinery for air or gases	3852	Controlling instruments for air and liquid
	5040401	Manufacture of indoor air measurement and analysis equipment	27213	Manufacture of physical properties testing, measuring and inspection equipment	3612	measuring and analyzing instruments
	505. Indoor air quality control related services					
	5050101	Indoor air purity measurement services	72911	Testing and analysis services of composition and purity of materials	7292	Science and technology service
	5050102	Indoor environment related engineering services	72122	Environmental consulting and related engineering services	7292	Science and technology service
	5050103	Indoor pollution measurement services	72911	Testing and analysis services of composition and purity of materials	7292	Science and technology service
	5050104	Indoor air related civic groups	94931	Environmental advocacy organizations	8109	Other services of membership organizations
	506. Atmospheric analysis, data collection and evaluation services					

	5060101	Atmospheric analysis, data collection and evaluation services	72911	Testing and analysis services of composition and purity of materials	7292	Science and technology service
6. Environmental safety and health	601. Manufacture of noise and vibration reduction devices					
	6010101	Manufacture of noise attenuator and related electrical equipment	28909	Manufacture of other electrical equipment n.e.c.	3799	Other electrical equipment
	6010102	Manufacture of automobile silencer and exhaust pipe	30399	Manufacture of other new parts and accessories for motor vehicles n.e.c.	4032	Automobile parts
	6010201	Manufacture of vibration prevention device and related electrical equipment	28909	Manufacture of other electrical equipment n.e.c.	3999	Other special purpose machinery, n.e.c.
	6010202	Manufacture of other anti-vibration device related products	29299	Manufacture of other special purpose machinery, n.e.c.	3999	Other special purpose machinery, n.e.c.
	6010301	Manufacture of metal soundproofing wall	25112	Manufacture of structural metal sheet products and metal works used on building	3012	Metal products for structures
	6010302	Manufacture of plastic soundproofing wall	22229	Manufacture of other fabricated structural plastic products	2391	Plastic products for construction
	6010303	Manufacture of concrete soundproofing wall	23325	Manufacture of concrete pipes and other structural concrete products	2632	Concrete products
	602. Noise and vibration reduction facility construction					
	6020101	Noise and vibration reduction facility installation	42203	Soundproofing, isolating vibration and fireproofing works	5190	Other constructions
	6020102	Construction of soundproof for facilities	42203	Soundproofing, isolating vibration and fireproofing works	5190	Other constructions
	603. Manufacture of environmental health responses					
	6030101	Manufacture of monitoring equipment and supplies of harmful factors in indoor and living environment and their impact on human	27213	Manufacture of physical properties testing, measuring and inspection equipment	3612	Measuring and analyzing instruments
	6030102	Manufacture of monitoring equipment and supplies of harmful factors in atmosphere and water environment and their impact on human	27213	Manufacture of physical properties testing, measuring and inspection equipment	3612	Measuring and analyzing instruments
	6030103	Manufacture of monitoring equipment and supplies of direct exposure to chemicals and its impact on human	27213	Manufacture of physical properties testing, measuring and inspection equipment	3612	Measuring and analyzing instruments
	6030104	Manufacture of monitoring equipment and supplies of hazardous heavy metals and its impact on human	27213	Manufacture of physical properties testing, measuring and inspection equipment	3612	Measuring and analyzing instruments
	6030105	Manufacture of bio sample analysis equipment	27213	Manufacture of physical properties testing, measuring and inspection equipment	3612	Measuring and analyzing instruments
	6030201	Manufacture of environmental health risk reduction devices (building ventilation system)	29173	Manufacture of non-domestic fans and ventilators	3851	Air conditioning and refrigerating equipment
		Air purifier	29174	Manufacture of filtering or purifying machinery for air or gases	3852	Controlling instruments for air and liquid
		Manufacture of noise insulation board	23994	Manufacture of mineral wools and other similar products	2699	Other non-metallic mineral products
		Eco-friendly wallpaper	17903	Manufacture of wallpaper and oilpaper	1439	Other paper products

		Eco-friendly paints	20411	Manufacture of general paints and similar products	2211	Paints
	6030202	Manufacture of dust mask and hygiene products	13229	Manufacture of other household made-up textile articles	1141	Textile articles
	6030301	Manufacture of animal charcoal substitutes	20112	Manufacture of natural gum and silvichemicals	1729	Other basic organic compounds
	6030302	Manufacture of natural basic inorganic chemicals	20129	Manufacture of other basic inorganic chemicals	1722	Basic inorganic compounds
	6030303	Manufacture of natural resins and related products	20411	Manufacture of general paints and similar products	2211	Paints
	6030304	Manufacture of natural glue	20493	Manufacture of adhesives and gelatine	2291	Adhesive and gelatin
	6030305	Manufacture of other resource-efficient chemical products	20499	Manufacture of other chemical products n.e.c.	2299	Other chemical products
	6030306	Manufacture of eco-friendly metal tanks and storage containers	25122	Manufacture of tanks and reservoirs	3013	Metal tank and pressure vessel
	6030307	Manufacture of low noise air compressor	29132	Manufacture of air or vacuum pumps and compressors	3820	Pumps and compressors
	6030308	Manufacture of other natural and resource-efficient products	29299	Manufacture of other special purpose machinery, n.e.c.	3999	Other special purpose machinery, n.e.c.
	604. Environmental health response services					
	6040101	Environmental pollution measurement and analysis services	72911	Testing and analysis services of composition and purity of materials	7292	Science and technology service
	6040102	Environmental technology inspection and analysis	72911	Testing and analysis services of composition and purity of materials	7292	Science and technology service
	6040201	Environmental health risk reduction services	74220	Disinfecting, exterminating and pest control services	7701	Medical and health care services
	605. Environmental safety and health related analysis, data collection and evaluation services					
	6050101	Environmental safety and health related analysis, data collection and evaluation services	72911	Testing and analysis services of composition and purity of materials	7292	Science and technology service
7. Sustainable environment and resources	701. Manufacture of heat, energy saving and recovery equipment					
	7010101	Manufacture of energy-saving ovens, furnaces and furnace burners	29150	Manufacture of industrial ovens, furnaces and furnace burners	3014	Industrial boiler and steam generator
	7010102	Manufacture of pellet and biomass boiler	25121	Manufacture of industrial heating boilers and radiators	3014	Industrial boiler and steam generator
	7010103	Manufacture of other energy-saving boiler-related equipment	29150	Manufacture of industrial ovens, furnaces and furnace burners	3014	Industrial boiler and steam generator
	7010201	Manufacture of burner and combustion device using heat waste	29150	Manufacture of industrial ovens, furnaces and furnace burners	3014	Industrial boiler and steam generator
	7010202	Manufacture of waste heat recovery heat exchanger	29176	Manufacture of distilling machinery, heat exchangers and gas generators	3014	Industrial boiler and steam generator
	7010203	Manufacture of energy-saving cooking burner	28520	Manufacture of domestic non-electric cooking and heating appliances	3752	Electric appliances for kitchen and heating
	7010204	Manufacture of generator using waste heat and waste steam	28111	Manufacture of electric motors and generators	4032	Automobile parts
	7010205	Manufacture of other waste heat-related equipment	29132	Manufacture of air or vacuum pumps and compressors	3820	Pumps and compressors
	7010301	Manufacture of energy-saving bulb and lamp	28410	Manufacture of electric lamps and bulbs	3791	Light bulb and lamp
	7010303	Manufacture of energy-saving pump, compressor and blower	29132	Manufacture of air or vacuum pumps and compressors	3820	Pumps and compressors
			29131	Manufacture of pumps for liquids	3820	Pumps and compressors

			29173	Manufacture of non-domestic fans and ventilators	3851	Air conditioning and refrigerating equipment
	7010401	Manufacture of energy-saving dyeing and paper machine	29261	Manufacture of industrial machinery for washing, dyeing, finishing and processing of textile	3994	Paper and printing machine
	7010501	Manufacture of energy-saving evaporation and concentration equipment	29176	Manufacture of distilling machinery, heat exchangers and gas generators	3014	Industrial boiler and steam generator
	7010601	Manufacture of energy-saving dryer	29299	Manufacture of other special purpose machinery, n.e.c.	3999	Other special purpose machinery, n.e.c.
			29293	Manufacture of machinery for printing and bookbinding	3994	Paper and printing machine
	7010701	Manufacture of energy-saving air conditioning equipment	29172	Manufacture of air conditioning and control machines	3851	Air conditioning and refrigerating equipment
	7010702	Manufacture of far infrared heating devices	28512	Manufacture of of domestic electrothermic appliances	3752	Electric appliances for kitchen and heating
	7010703	Manufacture of other energy-saving equipment	29193	Manufacture of equipment for projecting, dispersing or spraying liquids or powders	3899	Other general-purpose machinery
	7010801	Manufacture of energy-saving cooling equipment	29172	Manufacture of air conditioning and control machines	3851	Air conditioning and refrigerating equipment
	7010802	Manufacture of solar module and energy-saving commercial self-generating equipment	28909	Manufacture of other electrical equipment n.e.c.	3799	Other electrical equipment
			28111	Manufacture of electric motors and generators	4032	Automobile parts
	7010803	Manufacture of other power storage devices	28114	Manufacture of energy storage system	3722	Electric converter
	7010901	Manufacture of catalyst	20499	Manufacture of other chemical products n.e.c.	2299	Other chemical products
	7010902	Manufacture of glass fiber products	23121	Manufacture of basic glass products, glass fibers and optical glass	2501	Plate glass and primary glass products
	7010903	Manufacture of glass multi-layer insulation unit	23119	Manufacture of other products made of flat glass	2509	Other glass products
	7010904	Manufacture of heat pump	29171	Manufacture of refrigerating or freezing industrial equipment	3851	Air conditioning and refrigerating equipment
	7010905	Manufacture of heat exchanger	29176	Manufacture of distilling machinery, heat exchangers and gas generators	3014	Industrial boiler and steam generator
	7010906	Manufacture of heat and energy-saving fluorescent lamp	28410	Manufacture of electric lamps and bulbs	3791	Light bulb and lamp
	7010907	Manufacture of solar cell	26129	Manufacture of other diodes, transistors and similar semi-conductor devices	3101	Discrete device
	7010908	Manufacture of gas and liquid totalizer	27214	Manufacture of speedometers and integrating meters	3612	Measuring and analyzing instruments
	7010909	Manufacture of equipment for automatic temperature adjustment	27215	Manufacture of environmental controls and automatic controls for appliances	3612	Measuring and analyzing instruments
	702. Heat, energy saving and recovery related construction					
	7020101	Heat, energy saving and recovery related construction	41225	Construction of industrial plants	5134	Industrial Plant
	703. Heat, energy saving and recovery related services and supply					
	7030102	Heat, energy saving and recovery related services	72121	Building and civil engineering projects	7210	Construction and civil engineering services

				related engineering services		
	7030201	Renewable energy generation	35113	Thermal power generation	4502	Thermoelectric power
	7030202	Steam, cold and hot water and air conditioning supply	35300	Steam, chilled or hot water and air conditioning supply	4629	Steam and hot water supply
	704. Manufacture of biological resource management and conservation equipment					
	7040101	Manufacture of electrical equipment related to biological resource management and conservation	28909	Manufacture of other electrical equipment n.e.c.	3799	Other electrical equipment
	7040102	Manufacture of other biological resource management and conservation equipment	33999	Other manufacturing n.e.c.	4399	Other manufacturing products
	7040103	Manufacture of metal furniture related to biological resources management	32091	Manufacture of metal furniture	3099	Other metal products
	7040104	Manufacture of containers made of glass for biological resources management	23192	Manufacture of bottles and other containers made of glass	2509	Other glass products
	7040105	Manufacture of wooden products for animal transportation	16232	Manufacture of wooden packing boxes, drums and similar containers	1322	Wooden container and loading plate
	7040106	Manufacture of other wooden products for biological resource management and conservation	16299	Manufacture of other wood products n.e.c.	1329	Other wooden products
	705. Biological resource management and conservation related construction					
	7050101	Biological resource management and conservation related construction	41129	Other non-residential building construction	5020	Non-residential building
	706. Biological resource management and conservation related services					
	7060101	Operation of nature reserves	90232	Operation of nature reserves	7901	Cultural Service (National and public)
	7060102	Veterinary activities	73100	Veterinary activities	0299	Other livestock
	7060103	Biological resource management and conservation-related environmental movement groups	94931	Environmental advocacy organizations	8109	Other social groups
	707. Manufacture of forest management equipment					
	7070101	Manufacture of forest disaster prevention equipment	29194	Manufacture of power-driven hand tools	3093	Tools
			13922	Manufacture of fishing nets and other products of rope or netting	1149	Other fiber fabrics
			33999	Other manufacturing n.e.c.	4399	Other manufacturing products
			27219	Manufacture of other measuring, testing, navigating, control instruments n.e.c.	3612	Measuring and analyzing instruments
	7070102	Manufacture of forest safety equipment	22299	Manufacture of other plastic products n.e.c.	2399	Other plastic products
			13921	Manufacture of cordage and rope	1149	Other fiber fabrics
			14199	Manufacture of other sewn wearing apparel n.e.c.	1151	Sewn wearing apparel
	7070103	Manufacture of forest measuring equipment	27219	Manufacture of other measuring, testing, navigating, control instruments n.e.c.	3612	Measuring and analyzing instruments

	7070104	Manufacture of fluid power equipment for forest management equipment	29120	Manufacture of fluid power equipment	3820	Pumps and compressors
	708. Forest management-related construction					
	7080101	Specialized construction related to construction of landscaping facilities	42139	Installing other outdoor facility works	5190	Other constructions
	7080102	Construction of landscaping works	41226	Construction of landscaping works	5190	Other constructions
	7080103	Land subdivision with land improvement related to landscaping	41210	Land subdivision with land improvement	5190	Other constructions
	709. Forest management-related services					
	7090101	Landscaping management and maintenance services	74300	Landscape care and maintenance service activities	7410	Business facility maintenance and landscaping service
	7090102	Support services to forestry	02040	Support services to forestry	7299	Other professional services
	7090103	Agents involved in the sale of forestry machinery and equipment	46106	Agents involved in the sale of machinery and equipment	5200	Wholesale and retail trade and commodity brokerage services
	7090104	Wholesale of forestry machinery and equipment	46531	Wholesale of agricultural and forestry machinery and equipment	5200	Wholesale and retail trade and commodity brokerage services
	7090105	Forestry architectural services	72112	Urban planning landscape architectural services	7210	Construction and civil engineering services
	710. Forest management and maintenance services					
	7100101	Forest management and maintenance services	02012	Afforestation	0302	Wood
	711. Manufacture of biodiversity and landscape protection equipment					
	7110101	Manufacture of metal tanks and storage containers related to biodiversity	25122	Manufacture of tanks and reservoirs	3013	Metal tank and pressure vessel
	7110102	Manufacture of fishing nets and other string processed products for ecological restoration	13922	Manufacture of fishing nets and other products of rope or netting	1149	Other fiber fabrics
	7110103	Manufacture of measuring instruments related to environmental protection and maintenance	27213	Manufacture of physical properties testing, measuring and inspection equipment	3612	Measuring and analyzing instruments
	712. Biodiversity and landscape protection related services					
	7120101	Ecological and river restoration services	39009	Other remediation activities and waste management services	5131	Environment purification facilities
	7120102	Ecological resource management and experience services	90232	Operation of nature reserves	7901	Cultural Service (National and public)
	7120103	Environmental administration related to biodiversity and landscape protection	84213	Regulation of the activities of environment affairs	7511	Central government
			74300	Landscape care and maintenance service activities	7410	Business facility maintenance and landscaping service
	713. Construction related to biodiversity and landscape protection					
	7130101	Construction related to biodiversity and landscape protection	42139	Installing other outdoor facility works	5190	Other constructions
	714. Biodiversity and bio-related production, manufacture and services					
	7140101	Agriculture, forestry and fisheries research and development	70112	Research and experimental development on agriculture, forestry, fishery and veterinary science	7003	R&D (Industry)
	7140102	Biological research and development	70111	Research and experimental development on physics, chemistry and biology	7003	R&D (Industry)
	7140201	Biomaterial production	01299	Raising of other animals n.e.c.	0299	Other livestock

	7140202	Seed and seedling production	01123	Growing of seed crops and nursery products	0195	Seeds
	7140203	Forestry Seedling Production	02011	Operation of forest tree nurseries	0195	Seeds
	7140301	Manufacture of biological seed and reedling related equipment	29210	Manufacture of agricultural and forestry machinery	3911	Agricultural machinery
	7140401	Wholesale of flowers and plants	46204	Wholesale of flowers and plants	5200	Wholesale and retail trade and commodity brokerage services
	7140402	Retail of flowers and plants	47851	Retail sale of flowers and plants	5200	Wholesale and retail trade and commodity brokerage services
	7140501	Bio-related construction	41129	Other non-residential building construction	5020	Non-residential building
	7140601	Fishery-related services	03220	Services incidental to fishing and aquaculture	0500	Agriculture and fishery services
	7140602	Resource management related landscaping management and maintenance services	74300	Landscape care and maintenance service activities	7410	Business facility maintenance and landscaping service
	7140603	Operation of botanical and zoological gardens	90231	Operation of botanical and zoological gardens	7901	Cultural Service (National and public)
	715. Sustainable environment, resource-related analysis, data collection and evaluation services					
	7150101	Sustainable environment, resource-related analysis, data collection and evaluation services	72911	Testing and analysis services of composition and purity of materials	7292	Science and technology service
8. Environmental knowledge, information and monitoring	801. Manufacture of environmental monitoring, analysis and measurement equipment					
	8010101	Manufacture of environment related instruments for measuring and testing electricity and electrical signals	27212	Manufacture of instruments for measuring and testing electricity and electrical signals	3612	Measuring and analyzing instruments
	8010102	Manufacture of analytical instruments for environmental measurement and monitoring	27213	Manufacture of physical properties testing, measuring and inspection equipment	3612	Measuring and analyzing instruments
	8010103	Manufacture of environmental measuring and monitoring controller	27215	Manufacture of environmental controls and automatic controls for appliances	3613	Automatic adjustment and controller
	8010104	Manufacture of other optical devices for environmental measurement and monitoring	27309	Manufacture of other optical instruments and photographic equipment	3692	Other optical equipment
	8010201	Manufacture of control panel for environmental monitoring, analysis and measurement	28123	Manufacture of boards for electric control or distribution	3724	Switchboard and electric automatic control panel
	8010202	Manufacture of process control equipment for environmental monitoring, analysis and measurement	27215	Manufacture of environmental controls and automatic controls for appliances	3612	Measuring and analyzing instruments
	8010203	Manufacture of environmental monitoring, analysis and measurement system equipment	27216	Manufacture of industrial process control equipment	3613	Automatic adjustment and controller
	802. Environmental R&D related services					
	8020101	Soil science, earth science, meteorology research and development	70119	Research and experimental development on other natural sciences	7003	R&D (Industry)
	8020102	Environmental engineering research and development	70129	Research and experimental development on other engineering	7003	R&D (Industry)
	8020103	Other environmental research and development	70129	Research and experimental development on other engineering	7003	R&D (Industry)

	8020201	Geological survey and other resource management services	72923	Geological surveying and prospecting services	7292	Science and technology service
	803. Environmental engineering, evaluation and consulting services					
	8030101	Environmental consulting and related engineering services	72122	Environmental consulting and related engineering services	7292	Science and technology service
	8030201	Environmental impact assessment and consulting	72122	Environmental consulting and related engineering services	7292	Science and technology service
	804. Environmental law and education services					
	8040101	Environmental lawyers	71101	Offices of lawyers	7111	Legal- and accounting-related professional services
	8040102	Environmental patent attorney	71102	Offices of patent attorney	7111	Legal- and accounting-related professional services
	8040201	Environmental technology and vocational high school	85229	Other technical and vocational secondary education	7601	Education services (National and public)
	8040202	Environmental technology and vocational training school	85669	Other technical and trade schools	7603	Education services (Industry)
	8040203	Environmental university	85302	Universities	7603	Education services (Industry)
	8040204	Environmental graduate school	85303	Graduate schools	7603	Education services (Industry)
	805. Environmental knowledge, information, monitoring-related analysis, data collection and evaluation services					
	8050101	Environmental knowledge, information, monitoring-related analysis, data collection and evaluation services	72911	Testing and analysis services of composition and purity of materials	7292	Science and technology service

Table 18

Matching Table of the Environmental Industry Special Classification and 2015 Benchmark Year Input-Output Table Small-Sized and Medium-Sized Classifications

Environmental Industry Special Classification from 2018 Report on the Environmental Industry Survey			**Input-Output Table (2015 Benchmark Year Small-Sized Classification)**		**Input-Output Table (2015 Benchmark Year Medium-Sized Classification)**	
S[13]	C[14]	Description	C	Description	C	Description
1. Resource circulation management	1020101	Construction of waste treatment facilities	513	Constructions of industrial plants and facilities for manufacturing	51	Civil engineering
	1030101	Designated waste collection and transportation	491	Waste collection and disposal	49	Waste treatment and disposal services
	1030102	Designated waste-related remediation activities and waste management services	513	Constructions of industrial plants and facilities for manufacturing	51	Civil engineering
	1030103	Treatment and disposal of hazardous waste	491	Waste collection and disposal	49	Waste treatment and disposal services
	1030201	Non-hazardous waste collection	491	Waste collection and disposal	49	Waste treatment and disposal services
	1030202	Construction waste collection and transportation	491	Waste collection and disposal	49	Waste treatment and disposal services
	1030203	Treatment and disposal of non-hazardous waste	491	Waste collection and disposal	49	Waste treatment and disposal services

[13]S = Segments of the Environmental Industry Special Classification from 2018 Report on the Environmental Industry Survey

[14]C = Classification code

	1030204	Treatment and disposal of construction and demolition waste	491	Waste collection and disposal	49	Waste treatment and disposal services
	1050101	Construction of incinerator facility	513	Constructions of industrial plants and facilities for manufacturing	51	Civil engineering
	1050102	Construction of dry fueling facility	513	Constructions of industrial plants and facilities for manufacturing	51	Civil engineering
	1050201	Construction of bio-gasification facility and power plant	513	Constructions of industrial plants and facilities for manufacturing	51	Civil engineering
	1050202	Construction of pyrolysis gasification facility and power plant	513	Constructions of industrial plants and facilities for manufacturing	51	Civil engineering
	1050203	Construction of bio-fueling facilities and power plant	513	Constructions of industrial plants and facilities for manufacturing	51	Civil engineering
	1050204	Construction of gasification melting facility	513	Constructions of industrial plants and facilities for manufacturing	51	Civil engineering
	1050205	Construction of solid fuel (SRF) manufacturing facility	513	Constructions of industrial plants and facilities for manufacturing	51	Civil engineering
	1060101	Waste to energy facility consignment processing service	491	Waste collection and disposal	49	Waste treatment and disposal services
	1060301	Raw material and harmful gas analysis	729	Other scientific, technical, and professional services	72	Scientific, technical, and other professional services
			450	Electricity supply and renewable energy	45	Electricity supply and renewable energy
	1060501	Waste to energy technology consulting	729	Other scientific, technical, and professional services	72	Scientific, technical, and other professional services
	1090101	Resource circulation-related analysis, data collection and evaluation service	729	Other scientific, technical, and professional services	72	Scientific, technical, and other professional services
2. Water management	2010205	Manufacture of filtering or purifying machinery for liquids or oils for chemical recovery	385	Controlling instruments for air and liquid	38	General-purpose machinery and equipment
	2010301	Manufacture of liquid separators related to oil and water separation	385	Controlling instruments for air and liquid	38	General-purpose machinery and equipment
	2010401	Manufacture of screening and liquid filtering machinery	385	Controlling instruments for air and liquid	38	General-purpose machinery and equipment
	2020102	Construction of wastewater treatment facilities	513	Constructions of industrial plants and facilities for manufacturing	51	Civil engineering
	2030101	Sewage treatment services	480	Sewage and wastewater treatment services	48	Sewage and wastewater treatment services
	2030102	Human waste treatment services	480	Sewage and wastewater treatment services	48	Sewage and wastewater treatment services
	2030103	Animal waste treatment services	480	Sewage and wastewater treatment services	48	Sewage and wastewater treatment services
	2030104	Remediation activities and waste management related to wastewater	513	Constructions of industrial plants and facilities for manufacturing	51	Civil engineering
	2030105	Wastewater treatment services	480	Sewage and wastewater treatment services	48	Sewage and wastewater treatment services
	2030201	Mine drainage service	729	Other scientific, technical, and professional services	72	Scientific, technical, and other professional services

	2050101	Water related analysis, data collection and evaluation service	729	Other scientific, technical, and professional services	72	Scientific, technical, and other professional services
3. Environmental restoration and recovery	3020101	Decontamination of soils and water biological treatment	492	Materials recycling services	49	Waste treatment and disposal services
	3020102	Remediation activities and restoration services related to soil and water resources	513	Constructions of industrial plants and facilities for manufacturing	51	Civil engineering
	3030101	Environmental remediation and recovery related analysis, data collection and evaluation service	729	Other scientific, technical, and professional services	72	Scientific, technical, and other professional services
4. Responding to climate change	4010101	Manufacture of carbon dioxide capture-related equipment	385	Controlling instruments for air and liquid	38	General-purpose machinery and equipment
	4010201	Manufacture of liquid filter related to climate change	385	Controlling instruments for air and liquid	38	General-purpose machinery and equipment
	4040101	Climate adaptation related analysis, data collection and evaluation services	729	Other scientific, technical, and professional services	72	Scientific, technical, and other professional services
5. Air quality management	5010201	Manufacture of filtering or purifying machinery for air or gases for catalytic converter	385	Controlling instruments for air and liquid	38	General-purpose machinery and equipment
	5010304	Manufacture of filtering or purifying machinery for air or gases for chemical recovery	385	Controlling instruments for air and liquid	38	General-purpose machinery and equipment
	5010401	Manufacture of air pollution-related dust collector	385	Controlling instruments for air and liquid	38	General-purpose machinery and equipment
	5010502	Manufacture of filtering or purifying machinery for air or gases for separators and sedimentation machine	385	Controlling instruments for air and liquid	38	General-purpose machinery and equipment
	5010601	Manufacture of filtering or purifying machinery for air or gases related to air pollution	385	Controlling instruments for air and liquid	38	General-purpose machinery and equipment
	5020101	Air pollution control-related construction	513	Constructions of industrial plants and facilities for manufacturing	51	Civil engineering
	5030103	Air pollution inspection services	729	Other scientific, technical, and professional services	72	Scientific, technical, and other professional services
	5040101	Manufacture of indoor air quality related gas filter	385	Controlling instruments for air and liquid	38	General-purpose machinery and equipment
	5040301	Manufacture of indoor air quality related dust collector	385	Controlling instruments for air and liquid	38	General-purpose machinery and equipment
	5050101	Indoor air purity measurement services	729	Other scientific, technical, and professional services	72	Scientific, technical, and other professional services
	5050102	Indoor environment related engineering services	729	Other scientific, technical, and professional services	72	Scientific, technical, and other professional services
	5050103	Indoor pollution measurement services	729	Other scientific, technical, and professional services	72	Scientific, technical, and other professional services
	5060101	Atmospheric analysis, data collection and evaluation services	729	Other scientific, technical, and professional services	72	Scientific, technical, and other professional services

6. Environmental safety and health	6030201	Manufacture of environmental health risk reduction devices (building ventilation system)	385	Controlling instruments for air and liquid	38	General-purpose machinery and equipment
		Air purifier	385	Controlling instruments for air and liquid	38	General-purpose machinery and equipment
	6040101	Environmental pollution measurement and analysis services	729	Other scientific, technical, and professional services	72	Scientific, technical, and other professional services
	6040102	Environmental technology inspection and analysis	729	Other scientific, technical, and professional services	72	Scientific, technical, and other professional services
	6050101	Environmental safety and health related analysis, data collection and evaluation services	729	Other scientific, technical, and professional services	72	Scientific, technical, and other professional services
			385	Controlling instruments for air and liquid	38	General-purpose machinery and equipment
7. Sustainable environment and resources	7010701	Manufacture of energy-saving air conditioning equipment	385	Controlling instruments for air and liquid	38	General-purpose machinery and equipment
	7010801	Manufacture of energy-saving cooling equipment	385	Controlling instruments for air and liquid	38	General-purpose machinery and equipment
	7010904	Manufacture of heat pump	385	Controlling instruments for air and liquid	38	General-purpose machinery and equipment
	7020101	Heat, energy saving and recovery related construction	513	Constructions of industrial plants and facilities for manufacturing	51	Civil engineering
	7030201	Renewable energy generation	450	Electricity supply and renewable energy	45	Electricity supply and renewable energy
	7090102	Support services to forestry	729	Other scientific, technical, and professional services	72	Scientific, technical, and other professional services
	7120101	Ecological and river restoration services	513	Constructions of industrial plants and facilities for manufacturing	51	Civil engineering
	7150101	Sustainable environment, resource-related analysis, data collection and evaluation services	729	Other scientific, technical, and professional services	72	Scientific, technical, and other professional services
8. Environmental knowledge, information and monitoring	8020201	Geological survey and other resource management services	729	Other scientific, technical, and professional services	72	Scientific, technical, and other professional services
	8030101	Environmental consulting and related engineering services	729	Other scientific, technical, and professional services	72	Scientific, technical, and other professional services
	8030201	Environmental impact assessment and consulting	729	Other scientific, technical, and professional services	72	Scientific, technical, and other professional services
	8050101	Environmental knowledge, information, monitoring-related analysis, data collection and evaluation services	729	Other scientific, technical, and professional services	72	Scientific, technical, and other professional services

Table 19
Gross Output, GDP, and Employment of All Industries (34 industries)

(unit: million KRW, person, percent)

Industry	Gross Output		GDP		Employment	
	Value	Per-cent	Value	Per-cent	Person	Per-cent
Agricultural, forest, and fishery goods	61,371,723	1.6	33,258,343	2.03	1,298,875	5.45
Mined and quarried goods	4,125,218	0.11	2,137,509	0.13	12,298	0.05
Food, beverages and tobacco products	122,147,220	3.19	30,650,945	1.87	342,662	1.44
Textile and leather products	79,329,137	2.07	15,349,356	0.94	335,232	1.41
Wood and paper products, printing and reproduction of recorded media	42,914,016	1.12	13,370,767	0.82	193,437	0.81
Petroleum and coal products	110,150,033	2.87	33,886,371	2.07	13,558	0.06
Chemical products	245,383,162	6.4	70,835,404	4.33	384,656	1.61
Non-metallic mineral products	39,678,688	1.04	12,459,257	0.76	107,115	0.45
Basic metal products	124,914,202	3.26	25,182,674	1.54	175,150	0.74
Fabricated metal products, except machinery and furniture	100,287,562	2.62	35,968,628	2.2	282,454	1.19
Computing machinery, electronic equipment and optical instruments	282,213,561	7.36	93,915,596	5.74	435,164	1.83
Electrical equipment	95,673,140	2.5	29,177,344	1.78	281,265	1.18
Machinery and equipment	107,216,259	2.8	32,133,581	1.96	218,161	0.92
Transport equipment	257,977,501	6.73	49,635,276	3.03	513,869	2.16
Other manufactured products	20,146,498	0.53	5,631,066	0.34	154,599	0.65
Manufacturing services and repair services of industrial equipment	61,203,821	1.6	30,076,271	1.84	305,075	1.28
Electricity, gas, and steam supply	33,225,107	0.87	7,445,754	0.45	19,600	0.08
Water supply, sewage and waste treatment and disposal services	3,971,392	0.1	2,592,430	0.16	13,312	0.06
Construction	195,436,190	5.1	80,297,034	4.9	1,075,286	4.51
Wholesale and retail trade and commodity brokerage services	247,647,642	6.46	135,380,386	8.27	3,363,114	14.11
Transportation	141,344,511	3.69	54,881,256	3.35	1,495,951	6.28
Food services and accommodation	131,926,155	3.44	45,545,237	2.78	1,796,197	7.54
Communications and broadcasting	135,412,832	3.53	73,016,876	4.46	672,677	2.82
Finance and insurance	156,925,173	4.09	92,230,098	5.63	694,474	2.91
Real estate services	191,497,517	5	146,396,975	8.94	521,882	2.19
Professional, scientific, and technical services	160,302,544	4.18	77,589,385	4.74	1,084,227	4.55
Business support services	76,481,272	2	53,434,327	3.26	1,213,919	5.09
Public administration, defense, and social security services	123,378,849	3.22	95,491,004	5.83	984,385	4.13
Education services	116,328,647	3.03	80,420,998	4.91	1,579,911	6.63
Health and social care services	119,620,062	3.12	63,143,100	3.86	1,631,900	6.85
Art, sports, and leisure services	40,293,777	1.05	22,222,458	1.36	369,872	1.55

Other services	54,193,336	1.41	24,046,463	1.47	1,016,275	4.26
Others	3,824,174	0.1	-	0	-	0
Environmental Industry	147,021,159	3.84	69,648,499	4.25	1,242,707	5.22
Average	112,751,826	2.94	48,160,314	2.94	700,861	2.94
All industry	3,833,562,080	100	1,637,450,668	100	23,829,259	100

Source: Calculated and arranged by the author using information from 2015 Benchmark Year Input-Output Tables, Bank of Korea (2015).

Table 20

Wages and Salaries, Operating Surplus, Depreciation and Net Production Tax of All Industries (34 industries)

(unit: million KRW, percent)

Industry	Wages and Salaries		Operating Surplus		Depreciation		Net Production Tax	
	Value	Per.[15]	Value	Per.	Value	Per.	Value	Per.
Agricultural, forest, and fishery goods	5,243,464	15.77	22,576,442	67.88	4,828,393	14.52	610,044	1.83
Mined and quarried goods	694,732	32.5	1,148,712	53.74	355,891	16.65	(61,826)	-2.89
Food, beverages and tobacco products	9,906,095	32.32	5,076,670	16.56	3,818,737	12.46	11,849,443	38.66
Textile and leather products	7,417,072	48.32	4,095,066	26.68	2,140,284	13.94	1,696,934	11.06
Wood and paper products, printing and reproduction of recorded media	5,973,894	44.68	5,416,981	40.51	1,109,629	8.3	870,263	6.51
Petroleum and coal products	1,366,271	4.03	8,606,221	25.4	2,750,547	8.12	21,163,332	62.45
Chemical products	21,429,173	30.25	30,620,004	43.23	16,098,393	22.73	2,687,834	3.79
Non-metallic mineral products	4,644,470	37.28	4,032,787	32.37	3,204,533	25.72	577,467	4.63
Basic metal products	8,872,812	35.23	7,486,610	29.73	8,177,470	32.47	645,782	2.56
Fabricated metal products, except machinery and furniture	16,436,533	45.7	15,980,609	44.43	2,709,100	7.53	842,386	2.34
Computing machinery, electronic equipment and optical instruments	25,422,542	27.07	24,466,676	26.05	41,342,737	44.02	2,683,641	2.86
Electrical equipment	9,931,479	34.04	8,306,589	28.47	9,981,111	34.21	958,165	3.28
Machinery and equipment	16,532,972	51.45	9,122,071	28.39	5,645,032	17.57	833,506	2.59
Transport equipment	23,985,502	48.32	2,987,149	6.02	15,454,361	31.14	7,208,264	14.52
Other manufactured products	2,958,342	52.54	1,765,980	31.36	118,325	2.1	788,419	14
Manufacturing services and repair services of industrial equipment	18,818,145	62.57	9,763,067	32.46	1,007,431	3.35	487,628	1.62
Electricity, gas, and steam supply	1,077,146	14.47	3,204,026	43.03	2,102,455	28.24	1,062,127	14.26
Water supply, sewage and waste	830,813	32.05	193,368	7.46	1,554,968	59.98	13,281	0.51

[15]Per. = Percent

treatment and disposal services								
Construction	56,282,667	70.09	8,432,789	10.5	3,457,427	4.31	12,124,151	15.1
Wholesale and retail trade and commodity brokerage services	68,805,333	50.82	48,740,778	36	7,541,473	5.57	10,292,802	7.6
Transportation	29,782,807	54.27	7,544,026	13.75	20,574,817	37.49	(3,020,394)	-5.5
Food services and accommodation	25,047,779	55	10,049,543	22.06	2,834,890	6.22	7,613,025	16.72
Communications and broadcasting	26,761,141	36.65	21,139,053	28.95	21,068,853	28.85	4,047,829	5.54
Finance and insurance	37,605,414	40.77	40,090,569	43.47	7,305,129	7.92	7,228,986	7.84
Real estate services	12,461,734	8.51	70,670,408	48.27	35,758,611	24.43	27,506,222	18.79
Professional, scientific, and technical services	54,589,898	70.36	11,539,131	14.87	10,011,373	12.9	1,448,983	1.87
Business support services	31,258,538	58.5	16,067,489	30.07	4,305,131	8.06	1,803,169	3.37
Public administration, defense, and social security services	59,572,563	62.39	-	0	35,915,574	37.61	2,867	0
Education services	68,393,110	85.04	1,686,652	2.1	10,205,584	12.69	135,652	0.17
Health and social care services	46,641,138	73.87	9,626,201	15.25	6,663,180	10.55	212,581	0.34
Art, sports, and leisure services	7,829,860	35.23	5,344,520	24.05	4,182,436	18.82	4,865,642	21.9
Other services	15,114,717	62.86	4,361,049	18.14	2,192,106	9.12	2,378,591	9.89
Others	-	0	-	0	-	0	-	0
Environmental Industry	28,524,889	40.96	21,323,933	30.62	15,253,700	21.9	4,545,977	6.53
All industry	750,213,045	45.82	441,465,169	26.96	309,669,681	18.91	136,102,773	8.31

Source: Calculated and arranged by the author using information from 2015 Benchmark Year Input-Output Tables, Bank of Korea (2015).

Table 21

Input Structure of All Industries (34 industries)

(Unit: percent)

	Intermediate input rate	Domestic intermediate input rate	Import intermediate input rate	Degree of localization	Value added rate
Agricultural, forest, and fishery goods	45.81	42.74	3.06	93.31	54.19
Mined and quarried goods	48.18	47.5	0.68	98.58	51.82
Food, beverages and tobacco products	74.91	62.04	12.87	82.82	25.09
Textile and leather products	80.65	52.1	28.55	64.6	19.35
Wood and paper products, printing and reproduction of recorded media	68.84	54.56	14.29	79.25	31.16
Petroleum and coal products	69.24	13.52	55.71	19.53	30.76
Chemical products	71.13	48.39	22.75	68.02	28.87
Non-metallic mineral products	68.6	60.62	7.98	88.36	31.4
Basic metal products	79.84	46.6	33.24	58.36	20.16
Fabricated metal products, except machinery and furniture	64.13	57.64	6.49	89.88	35.87
Computing machinery, electronic equipment and optical instruments	66.72	39.63	27.09	59.4	33.28
Electrical equipment	69.5	54.79	14.71	78.83	30.5

Machinery and equipment	70.03	57.91	12.12	82.7	29.97
Transport equipment	80.76	69.31	11.45	85.82	19.24
Other manufactured products	72.05	60.88	11.17	84.49	27.95
Manufacturing services and repair services of industrial equipment	50.86	48.16	2.69	94.7	49.14
Electricity, gas, and steam supply	77.59	10.01	67.58	12.9	22.41
Water supply, sewage and waste treatment and disposal services	34.72	32.79	1.93	94.45	65.28
Construction	58.91	54.32	4.6	92.2	41.09
Wholesale and retail trade and commodity brokerage services	45.33	42.62	2.71	94.02	54.67
Transportation	61.17	41.28	19.89	67.49	38.83
Food services and accommodation	65.48	60.2	5.27	91.95	34.52
Communications and broadcasting	46.08	39.81	6.27	86.39	53.92
Finance and insurance	41.23	38.61	2.62	93.65	58.77
Real estate services	23.55	23.04	0.51	97.85	76.45
Professional, scientific, and technical services	51.6	47.52	4.07	92.1	48.4
Business support services	30.13	27.07	3.06	89.84	69.87
Public administration, defense, and social security services	22.6	20.78	1.82	91.94	77.4
Education services	30.87	29.46	1.41	95.45	69.13
Health and social care services	47.21	41	6.21	86.84	52.79
Art, sports, and leisure services	44.85	42.35	2.5	94.43	55.15
Other services	55.63	52.66	2.97	94.66	44.37
Others	100	99.96	0.04	99.96	0
Environmental Industry	52.63	41.87	10.75	79.57	47.37
All industry	57.29	44.84	12.45	78.27	42.71

Source: Calculated and arranged by the author using information from 2015 Benchmark Year Input-Output Tables, Bank of Korea (2015).

Table 22
Output Structure of All Industries (34 industries)

(Unit: percent)

Industry	Intermediate demand	Final Demand					Total Supply	
		Private consumption	Government consumption	Private investment	Government investment	Export	Domestic	Import
Agricultural, forest, and fishery goods	73.68	23.13	0	0.59	0.02	0.93	83.47	16.53
Mined and quarried goods	99.98	0.01	0	0	0	0.11	3.55	96.45
Food, beverages and tobacco products	56.69	38.3	0	0	0	4.98	82.44	17.56
Textile and leather products	38.46	28.34	0	0.12	0.02	32.16	74.04	25.96
Wood and paper products, printing and reproduction of recorded media	90.26	2.48	0	0	0	7.06	84.31	15.69
Petroleum and coal products	59.78	10.68	0	0	0	29.17	79.81	20.19
Chemical products	70.88	2.64	0	0	0	26.68	79.8	20.2
Non-metallic mineral products	93.36	0.52	0	0	0	6.16	84.61	15.39

Basic metal products	78.86	-0.34	0	-1.48	-0.04	23.91	75.58	24.42
Fabricated metal products, except machinery and furniture	81.68	1.22	0	3.5	2.25	10.95	92.32	7.68
Computing machinery, electronic equipment and optical instruments	39.25	6.73	0	5.83	0.78	46.93	76.22	23.78
Electrical equipment	59.29	4.62	0	9.54	0.18	25.9	83.83	16.17
Machinery and equipment	36.93	0.18	0	32.75	0.26	29.62	74.84	25.16
Transport equipment	30.87	10.86	0	9.72	2.46	45.05	89.62	10.38
Other manufactured products	45.9	26.37	0	10.42	1.01	10.16	74.32	25.68
Manufacturing services and repair services of industrial equipment	96.04	0.04	0	0	0	3.92	86.13	13.87
Electricity, gas, and steam supply	72.98	27	0	0	0	0.02	99.88	0.12
Water supply, sewage and waste treatment and disposal services	57.62	42.28	0	0	0	0.1	99.71	0.29
Construction	5.85	0	0	71.47	23.32	0.08	99.97	0.03
Wholesale and retail trade and commodity brokerage services	53.63	31.46	0	4.4	0.28	9.61	98.65	1.35
Transportation	61.03	15.7	0	0.15	0.04	23.03	85.78	14.22
Food services and accommodation	38.22	56.94	0	0	0	4.84	90.68	9.32
Communications and broadcasting	53.01	23.02	0	19.87	0.17	3.91	95.8	4.2
Finance and insurance	57.27	40.94	0	0	0	1.79	98.04	1.96
Real estate services	26.93	59.38	0	13.46	0.01	0.22	99.08	0.92
Professional, scientific, and technical services	53.92	0.91	0	32.29	5.46	7.42	88.08	11.92
Business support services	85.94	4.33	0	0	0	9.74	84.79	15.21
Public administration, defense, and social security services	2.22	1.09	96.65	0	0	0.03	99.51	0.49
Education services	1.84	47.21	50.81	0	0	0.14	98.04	1.96
Health and social care services	5.94	38.21	55.55	0	0	0.31	99.36	0.64
Art, sports, and leisure services	17.19	75.05	4.31	1.07	0	2.32	90.23	9.77
Other services	25.53	73.35	0	0	0	1.12	98.85	1.15
Others	108.36	-8.36	0	0	0	0	100	0
Environmental Industry	62.27	8.64	0.77	21.49	1.35	5.5	96.65	3.35
All industry	49.29	18.06	5.61	9.18	1.61	16.04	86.04	13.96

Source: Calculated and arranged by the author using information from 2015 Benchmark Year Input-Output Tables, Bank of Korea (2015).

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