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A Study on the Calculation of Greenhouse Gas from Incineration Plant in Seoul and its Impact on the Surrounding Area

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Abstract

Purpose: This study aims to understand the types and amounts of greenhouse gases among substances generated when operating facilities at resource recovery facilities in Seoul and analyze their impact on the environment. **Research design, data and methodology:** As a research method, you can directly visit four resource recovery facilities in Seoul, investigate greenhouse gases generated when operating the facilities, and then understand the distribution of generation through the greenhouse gas calculation formula. In addition, the impact, distribution, etc. that they have regionally can be confirmed by comparing the emission source and the surrounding site boundary line through the environmental impact survey report **Results:** When operating resource recovery facilities, you can determine whether there is a possibility that they will actually affect the surrounding areas, especially in areas where humans reside, such as private homes and vulnerable facilities, and if so, the results can be determined. The goal of this study is to understand how much the effects of greenhouse gases contribute to climate change and what the effects are on the human body. **Conclusions:** he results of this study can identify the causes of negative images of the survival of resource recovery facilities and the expansion and establishment of new resource recovery facilities, and suggest eco-friendly measures such as waste export, recycling, and recycling instead of new construction on the impact on climate change.

Keywords : Resource Recovery Facility, Incineration, Greenhouse Gas, Resident Health Impact Survey

JEL Classification Code : Q26, Q28, Q42

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1. Introduction

Incineration plants in Seoul are currently called resource recovery facilities. This is because the etymology of the incinerator caused opposition and disgust from local residents due to the NIMBY phenomenon, so the name was changed to a resource recovery facility, and initial resource recovery facilities were mainly installed outside the city due to residents' opposition and environmental pollution.

However, the increase in waste, such as urbanization and population concentration after industrialization, is an inevitable factor. The total domestic waste generation has increased by about 3.8% per year on average over the past 7 years (2013-2019), of which the domestic waste generation has increased by about 2.7% per year on average over the past 7 years (2013-2019). As the waste continues to increase, various environmental issues related to waste, such as domestic abandoned waste and illegal waste export cases, are increasing, and it is approaching as a problem close to our lives so that the people can feel it.

Methods of treating increasing waste include incineration, an intermediate disposition, and landfill, a final disposition. Both incineration and landfill treatment have similar rates of greenhouse gas emissions, and carbon dioxide (CO_2) is emitted when the waste is incinerated. In 2018, it was found to account for 39.8% of the total greenhouse gas emissions in the waste sector with 6,808,020 tCO_2eq, and the annual average emissions continue to increase.

Among the waste treatment methods, substances generated during incineration typically include dioxin, ammonia, carbon monoxide, ammonia, hydrogen sulfide, and fine dust. These odors and harmful substances are discharged from the waste storage of the resource recovery facility, causing mental and physiological stress in humans and affecting the human body such as headache, nausea, and shortness of breath. As a result, complaints from environmental groups and residents about odors and harmful gases generated in resource recovery facilities are intensifying. As a result, their occurrence is inevitable for the purpose of incineration, but their environmental impact remains extensively and step by step, affecting the human body.

There are a total of four resource recovery facilities in Seoul: Gangnam Resource Recovery Facility, Nowon Resource Recovery Facility, Mapo Resource Recovery Facility, and Yangcheon Resource Recovery Facility. Where they are located, there is clearly an environmental impact from incineration. Since they have different incineration methods for each recovery facility and the number and capacity of incineration equipment are also different, the amount of greenhouse gas emissions by location and their surrounding impact will be different.

Therefore, through comparative analysis such as incineration method and incineration amount for each recovery facility, greenhouse gas emissions are calculated when the facility is operated, and the impact on climate change as well as the human body is identified by using surrounding environmental impact assessment data to reveal the relationship. In addition, when residents want to construct additional resource recovery facilities in the future, these results can be analyzed to persuade residents.

2. Literature Review

2.1. Role of Resource Recovery Facility

Resource recovery facilities replace incineration plants and can be said to mean incineration. An incineration plant is a facility that simply burns waste to reduce it and does not turn it into a resource such as waste heat recovery, whereas a resource recovery facility is a facility that hygienically incinerates household waste and recovers incineration heat to turn it into a resource.

Since incineration facilities of resource recovery facilities simultaneously consume and produce energy, the waste heat generated at this time can be used as an energy resource to replace fossil fuels and reduce the amount of fuel required for energy production, thereby achieving greenhouse gas reduction. Incineration facilities recover most of the heat held by waste and convert it into electricity and district heating. Therefore, even though energy can be recovered by using such household waste, it is regulated by the Waste Management Act in Korea by recycling even though it is incineration.

Typical methods of recycling resources using resource recovery facilities include waste heat recycling and electricity generation.

2.1.1. Recycling waste heat

Resource recovery facilities produce steam from waste heat generated during incineration and supply it to cooling and heating heat sources in neighboring areas, or operate steam turbines to generate electricity and use it as alternative energy. In addition, by using the residues generated during incineration, waste resources can be recycled as much as possible by producing raw materials for sidewalk blocks and road auxiliary basins.

2.1.2. Electricity generation

Resource recovery facilities generate electricity by turning the facility's own turbine with steam generated from waste heat boilers during waste combustion, and then sending steam to the cogeneration plant or sending steam

to the cogeneration plant to drive the steam turbine. The facility where the turbine is installed generates electricity and uses it within the facility, and the remaining electricity is transmitted to the cogeneration plant, and the cogeneration plant reversely transmits and sells the electricity produced along with the transmitted electricity to KEPCO.
In Seoul, steam turbines are installed at Yangcheon and Mapo resource recovery facilities to generate electricity, and Gangnam and Nowon resource recovery facilities do not have their own steam turbines, but steam turbines are installed at adjacent cogeneration plants.

Table 1: Electricity production and transmission (sales) volume of resource recovery facilities in 2020

(Unit : Kwh/Year)

Sortation	Total	Yangcheon	Mapo
The amount of electricity produced	33,384,794	11,250,945	22,133,849
The amount of self-use	23,061,499	8,084,421	14,977,078
Transmission (sales) volume	9,981,479	2,824,708	7,156,771

As such, the resource recovery facility generates electricity using waste heat (400°C or higher) produced in the process of burning waste at a high temperature of 850°C or higher and then lowered to around 120°C by supplying it to district heating around the resource recovery facility, thereby using it as alternative energy to create a clean and pleasant living environment.

2.2. Treatment of Air Pollutants Emitted from Resource Recovery Facilities

Air pollutants generated during incineration in resource recovery facilities typically include dioxin, ammonia, carbon monoxide, nitrogen oxides, sulfur oxides, and fine dust. In order to prevent these exhaust gases from affecting nearby areas, prevention techniques are important.

Resource recovery facilities are discharged through chimneys at a much lower concentration than the legal standard through various processes such as garbage entry, waste incineration, waste heat boilers, heat supply, and air pollution prevention facilities (pollutant removal facilities). Representative air pollution prevention facilities operate advanced prevention facilities such as electric dust collection devices, wet cleaning devices, semi-dry reaction towers, bag filters, and selective catalytic reduction (SCR), although they vary slightly by resource recovery facilities.

In addition, the Ministry of Environment monitors the condition of pollutants in real time through the automatic chimney measurement system (Clean sys) 24 hours a day, and discloses them through electronic boards and the website of resource recovery facilities. The automatic chimney measurement system measures and collects data items such as dust, sulfur oxide (SO_2), hydrogen chloride (HCl), nitrogen oxide (NO_X), carbon monoxide (CO), oxygen (O_2), flow rate, and temperature through each measuring device installed in the chimney of the workplace, and monitors real-time wireless transmission to the Seoul Metropolitan Control Center of the Environmental Management Corporation and the discharge of harmful gases at all times. In addition, the emission gas level is displayed through the electronic board installed in the nearby area so that residents can directly check the data measured by the automatic chimney measurement system.

2.3. Classification of the 6 Major Greenhouse Gases

At the 3rd Conference of the Parties to the Climate Change Convention in Kyoto, six types of carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF_6) were defined as the six major greenhouse gases to be reduced and managed.

Table 2: The six major greenhouse gases

Types of greenhouse gases	Global warming potential	Contribution to warming	A major source of emissions
CO_2	1	55	Fuel Use/Industrial Process
CH_4	21	15	Waste / agriculture / Livestock
N_2O	310	6	Industrial processes/Fertilizer use/Waste
HFCs	140~11,700	24	Refrigerant/Solvent/Foaming /Cleaning agent
PFCs	6,500~11,700		A freezer/Fire extinguisher/Cleaning agent
SF_6	23,900		Charger insulation gas/Semiconductor etching gas

Among them, carbon dioxide (CO_2) has the lowest global warming index of 1, but it exists for a long time in the atmosphere and accounts for the largest proportion of greenhouse gases, so it can be seen as a representative gas of greenhouse gases. Since global warming accelerates due to their emissions and causes climate change, the parties are considering ways to reduce and reduce greenhouse gases worldwide. In addition, it is important for Korea to maintain the global average temperature increase promised in the Paris Agreement at a significantly lower level than 2°C than before industrialization, and to establish and implement a greenhouse gas reduction roadmap to practice carbon neutrality by 2050 and achieve net zero carbon emissions.

3. Research Methods and Materials

3.1. Characteristics of Resource Recovery Facilities and Types of Emissions in Seoul

In Seoul, four resource recovery facilities have been installed and operated: Gangnam Resource Recovery Facility in Ilwon-dong, Gangnam-gu, Nowon Resource Recovery Facility in Sanggye-dong, Nowon-gu, Yangcheon Resource Recovery Facility in Mok-dong, Yangcheon-gu, and Mapo Resource Recovery Facility in Sangam-dong, Mapo-gu.

When operating a facility, the facility utility is used, which causes greenhouse gas generation by its own energy use, so the amount of generation for each facility can be calculated and compared.

The characteristics of each resource recovery facility and the status of facility operation are as follows.

3.1.1. Gangnam Resource Recovery Facility

The Gangnam Resource Recovery Facility is located in Ilwon-dong, 3318 Nambu Circulation-ro, Gangnam-gu, Seoul.

As for the facility scale, a capacity of 900 tons is operating per day, and three incinerators are operating 300 tons per day. As for the treatment area, wastes from Gangnam, Gangdong, Gwanak, Gwangjin, Dongjak, Seocho, Seongdong, and Songpa are treated.

The main facilities are as follows.

- Incineration method: Stalker type (horizontal type)
- Preventive facilities: There are cleaning towers, semi-dry reaction towers, bag filters, and SCR catalyst towers.

Table 3: Annual Facilities Operation Status of Gangnam Resource Recovery Facility from 2018 to 2022

Sortation	Incineration volume (tones)		LNG Usage (Nm^3)	Energy sales	
	Monthly average	Daily average		Waste Heat (Gcal)	Power Amount (KWh)
2022	238,770	793	333,830	442,989	0
2021	247,907	803	356,705	473,549	0
2020	242,058	817	211,800	440,996	0
2019	250,734	823	302,678	446,140	0
2018	259,113	812	202,685	462,646	0

Therefore, an average of 280,000 Nm^3 of LNG is required per year to operate the facility.

Figure 1: Gangnam Resource Recovery Facility

3.1.2. Nowon Resource Recovery Facility

Nowon Resource Recovery Facility is located in 99 Sanggye-dong, 70-gil, Deokneung-ro, Nowon-gu, Seoul.

As for the size of the facility, 800 tons of capacity is operating per day, and two incinerators are operating 400 tons per day.

As for the treatment area, wastes from Jungnang, Seongbuk, Gangbuk, Dobong, Nowon, and Dongdaemun are treated.

The main facilities are as follows.

- Incineration method: Stalker type (rotation type)
- Preventive facilities: There are electric dust collectors, wet cleaning towers, bag filters, and SCR catalyst towers.

Table 4: Annual Facilities Operation Status of Nowon Resource Recovery Facility from 2018 to 2022

Sortation	Incineration volume (tones)		LNG Usage (Nm^3)	Energy sales	
	Monthly average	Daily average		Waste Heat (Gcal)	Power Amount (KWh)
2022	163,785	551	234,133	247,936	0
2021	175,034	565	152,186	274,521	0
2020	175,420	570	287,073	261,358	0
2019	177,314	563	289,670	260,749	0
2018	180,852	601	242,010	249,494	0

Therefore, an average of 240,000 Nm^3 of LNG is required per year to operate the facility.

Figure 2: Nowon Resource Recovery Facility

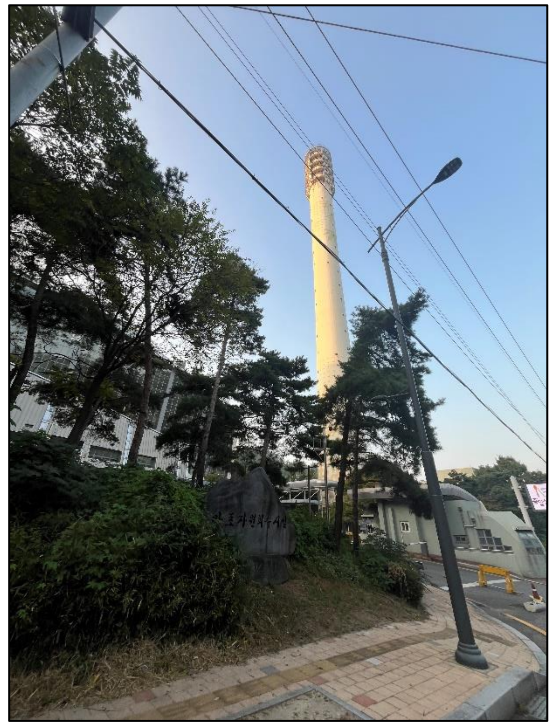


Figure 3: Mapo Resource Recovery Facility

3.1.3. Mapo Resource Recovery Facility

Mapo Resource Recovery Facility is located in Sangam-dong, 86 Haneul Park-ro, Mapo-gu, Seoul.

The facility has a capacity of 750 tons per day, and three incinerators are operating 250 tons per day.

As for the treatment area, wastes from Jongno, Jung-gu, Yongsan, Seodaemun, and Mapo are treated.

The main facilities are as follows.

- Incineration method: Stalker + Rotary Kill type
- Preventive facilities: There are semi-dry reaction towers, bag filters, SCR catalyst towers, and police filters.

Table 5: Annual Facilities Operation Status of Mapo Resource Recovery Facility from 2018 to 2022

Sortation	Incineration volume (tones)		LNG Usage (Nm^3)	Energy sales	
	Monthly average	Daily average		Waste Heat (Gcal)	Power Amount (KWh)
2022	169,781	589	263,414	295,452	7,878,847
2021	172,573	568	174,292	307,338	12,169,015
2020	175,889	585	185,141	295,098	8,429,433
2019	163,174	577	266,510	267,528	11,486,009
2018	190,002	601	375,963	307,120	13,826,799

In addition, Mapo Resource Recovery Facility is equipped with steam turbines to generate electricity.

Therefore, an average of 250,000 Nm^3 of LNG is required per year to operate the facility.

3.1.4. Yangcheon Resource Recovery Facility

Yangcheon Resource Recovery Facility is located in Mok-dong, 1121, Anyangcheon-ro, Yangcheon-gu, Seoul.

The facility has a capacity of 400 tons per day and two incinerators are operating 200 tons per day.

As for the treatment area, waste from Yangcheon, Gangseo, and Yeongdeungpo is treated.

The main facilities are as follows.

- Incineration method: Stalker type (step type)
- Preventive facilities: There are cleaning towers, semi-dry reaction towers, bag filters, and SCR catalyst towers

Table 6: Annual Facilities Operation Status of Yangcheon Resource Recovery Facility from 2018 to 2022

Sortation	Incineration volume (tones)		LNG Usage (Nm^3)	Energy sales	
	Monthly average	Daily average		Waste Heat (Gcal)	Power Amount (KWh)
2022	104,176	341	664,489	171,365	2,479,464
2021	100,296	338	884,438	167,585	2,219,688
2020	108,924	346	661,188	163,853	3,166,524
2019	107,834	347	681,594	180,810	4,166,492
2018	110,724	344	612,390	184,459	4,481,460

In addition, Yangcheon Resource Recovery Facility is equipped with steam turbines to generate electricity.

Therefore, an average of 700,000 Nm^3 of LNG is required per year to operate the facility.

Figure 4: Yangcheon Resource Recovery Facility

3.2. Calculation and Impact of Greenhouse Gas in Resource Recovery Facility

The amount of LNG used for five years when operating the resource recovery facility is as follows for each facility.

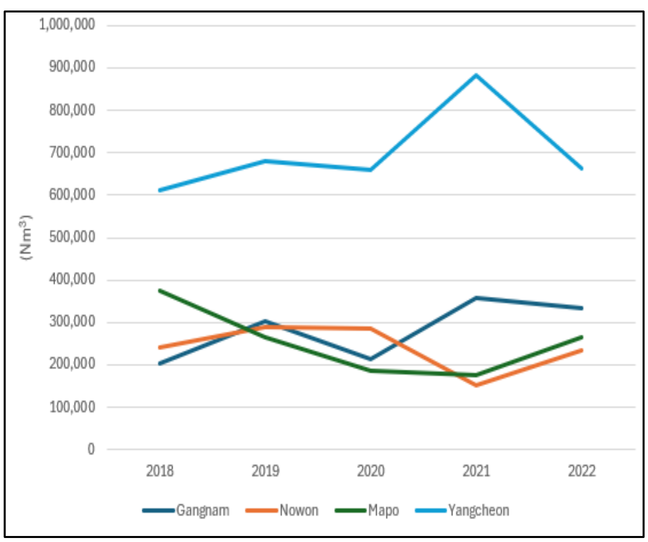


Figure 5: Annual LNG consumption when resource recovery facility is in operation

For each facility's LNG use, greenhouse gas emissions can be compared using the greenhouse gas emission calculation formula.

According to attached Table 4 related to Article 7 (2) of the Guidelines on the Management and Operation of Greenhouse Gas Targets in the Public Sector, the method of calculating the Gaseous Fuel Greenhouse Gas Calculation Equation is as follows.

The following formula may be used when the emission source corresponds to facilities such as boilers, burners, heaters, water heaters, hot water heaters, and hot air fans that burn gaseous fuels such as LNG, LPG, propane, and other by-products for building heating.

Greenhouse Gas Emissions (tCO2eq)
= ∑ [Gasic fossil fuel usage (Nm^3) × Net heat generation (MJ/Nm^3) × Emission coefficient (kgGHG (CO^2/TJ) × 10^{-9} × Global Warming Index)]

At this time, since LNG for each facility uses Nm^3 units, the LNG density can be calculated at 1 atmosphere at 0℃ with 447.093 kg/m^3 (Source: Korea Gas Corporation).

In addition, the net calorific value of LNG can be calculated as 48 TJ/Gg in accordance with attached Table 11 related to Article 15, Paragraph 1 of the Guidelines on Emission Reporting and Certification of Greenhouse Gas Emissions Trading Systems.

Finally, the emission coefficient of LNG can be 56,100 based on carbon dioxide using the IPCC basic emission coefficient, and the corresponding global warming index is 1.

3.3. A Study on the Health Impact of Residents around Resource Recovery Facilities in Seoul

In formulating and implementing a plan for the installation of resource recovery facilities, an environmental impact survey shall be conducted to promote safe residents' health and smooth operation of facilities by evaluating and reviewing the impact of the relevant project on the environment and humans. Among them, the residents' health impact survey is a long-term investigation and study on the impact of resource recovery facilities on residents' health at research institutes selected by residents at the request of local residents in indirect impact areas.

The background of the resident health impact survey is as follows.

In order to objectively and scientifically evaluate the environmental and human impacts of resource recovery facilities over a long period of time at the request of residents of four resource recovery facilities in Gangnam, Nowon, Yangcheon, and Mapo, which are operated in Seoul, the resident health impact survey has been conducted continuously since 2000, and the research institute is being conducted by Yonsei University's Environmental Pollution

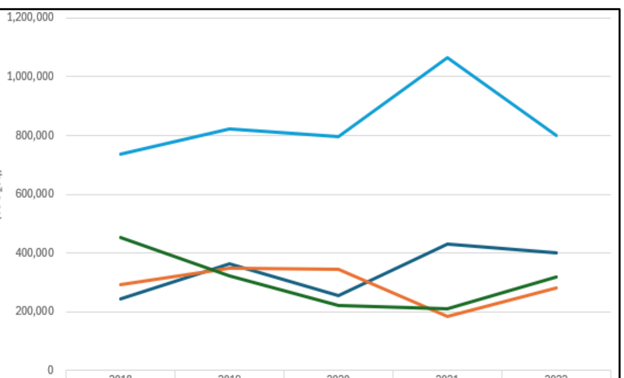
Research Institute recommended by residents.

The scope of the study was for residents living in areas affected by resource recovery facilities for more than five years, and the survey items are as follows.

- Environmental impact assessment: It was conducted in the areas around Gangnam, Nowon, and Yangcheon resource recovery facilities, such as fine dust, heavy metals, and odors.
- Human Impact Assessment: Changes in the concentration of harmful substances (dioxins in blood, harmful metals, inflammatory response indicators) in the body were investigated for long-term residents who lived within 300m of each resource recovery facility for more than five years.
- Health impact assessment: A total of 251 residents (77 in Gangnam, 100 in Nowon, 74 in Yangcheon) living near resource recovery facilities were questioned, surveyed, and health checkups were conducted.

4. Results and Discussion

As a result of the calculation according to the greenhouse gas calculation formula, the current status of greenhouse gas emissions by resource recovery facility (tCO^2-eq) by LNG used in annual facility operation is as follows.



	2018	2019	2020	2021	2022
Gangnam	244,019	364,404	254,993	429,449	401,909
Nowon	291,364	348,743	345,616	183,222	281,880
Mapo	452,634	320,860	222,897	209,836	317,133
Yangcheon	737,276	820,593	796,025	1,064,803	800,000

Figure 6: Annual greenhouse gas emissions

Looking at the changes in greenhouse gas emissions caused by the operation of each facility over the five years from 2018 to 2022, Gangnam resource recovery facilities are on the rise to about 200,000 to 400,000 tCO^2eq, while Nowon and Mapo resource recovery facilities are on the decline with similar emissions. Yangcheon resource recovery facilities, on the other hand, emit 700,000 to 1 million tCO^2eq of greenhouse gas, which is four times higher than other resource recovery facilities.

Table 7: Current Status of Resource Recovery Facility in Seoul

Facility name	Gangnam	Nowon	Mapo	Yangcheon
Location of facilities	Ilwon-dong, Gangnam-gu	Sanggye-dong, Nowon-gu	Sangam-dong, Mapo-gu	Mok-dong, Yangcheon-gu
Site area (m^3)	63,818	46,307	58,435	16,914
Daily processing capacity (ton/day)	900	800	750	400

In addition, there is a difference in capacity by facility, and Yangcheon Resource Recovery Facility emits the most greenhouse gases due to the use of the facility, even though the site area and daily processing capacity are the smallest than other resource recovery facilities. This can be estimated to be related to higher electricity sales than other resource recovery facilities.

On the other hand, according to the results of the resident health impact survey, the air quality results were as follows.

In the case of fine dust (PM10), the average value was within the air environment standard (100 μg/m^3) for 24 hours, and the average value of ultra fine dust (PM2.5) was within the air environment standard (35 μg/ m^3) for 24 hours. The average value of lead (Pb) among harmful metals contained in fine dust was measured much lower than the air environment standard (0.5 μg/ m^3 per year), and the average value of chromium (Cr), nickel (Ni), cadmium (Cd), mercury (Hg), and arsenic (As) were also measured low, with no difference between regions.

The average value of benzene among volatile organic compounds (VOCs) in the atmosphere was measured below the atmospheric environmental standard (annual average of 5 μg/ m^3), and at all measurement points, toluene> xylene>ethylbenzene> benzene> styrene was detected, and the average value of dioxin in the atmosphere was also measured to be much lower than the atmospheric environmental standard (0.6 pg-TEQ/ m^3 per year), and there was no difference between regions.

Therefore, they all showed levels within the atmospheric environmental standards, but fine dust and black carbon tended to be measured high during commuting and garbage vehicle travel times.

The human impact assessment also showed lower concentrations of harmful substances in the body (dioxes in blood, harmful metals, and inflammatory response indicators), and the health impact assessment was similar to the incidence of the National Health and Nutrition Survey, indicating that there was no impact from resource recovery facilities until now.

The results of residents' perception of resource recovery facilities were as follows.

A total of 251 residents (77 in Gangnam, 100 in Nowon, and 74 in Yangcheon) living near resource recovery facilities showed that Gangnam, Nowon, and Yangcheon were slightly dissatisfied with the current environmental conditions, and that the degree of environmental pollution in the residential area was contaminated in all areas.

Through the health impact assessment project for residents in the area around resource recovery facilities over the past 20 years, awareness of the level of knowledge of resource recovery facilities, direct and indirect health damage, economic and material damage, air pollution, noise, and transportation inconvenience has been improved in a positive direction, and the quality of life has also improved slightly.

Nevertheless, awareness of the environmental conditions and the degree of environmental pollution in the residential area has been slightly dissatisfied in all areas surveyed, and there are particularly strong odor participants (Gangnam 7.6%, Nowon 5.2%, Yangcheon 2.9%), so continuous facility management is expected to be necessary.

Therefore, all residents were very sensitive to the neighborhood image and real estate, and real estate transactions in the area around the resource recovery facility are traded at relatively low prices due to concerns about noise, odors, and pollutants (dioxin) generated from the resource recovery facility, so the survey showed the status of this perception reflected in the resource recovery facility.

5. Conclusions

The annual greenhouse gas level generated by the operation of four resource recovery facilities in Seoul shows that only Yangcheon resource recovery facilities emit more than 800,000 tons of greenhouse gas on average, while the rest of the facilities emit more than 300,000 tons of greenhouse gas on average. Although the amount of greenhouse gases generated will vary due to the internal circumstances of the facility, the aging of operating devices, and other facilities, a considerable amount of greenhouse gases is still generated.

Given that Korea's annual greenhouse gas emissions averaged 700 million tons from 2016 to 2021, greenhouse gases generated by resource recovery facilities account for about 0.5% of the total emissions. However, this is an incinerator standard and considering that not only LNG but also electricity and water are used in utility usage, the amount of greenhouse gas generated will increase further. The amount cannot be ignored because there are 178 local government incinerators nationwide, assuming that all of them are in operation, it may appear to account for most of the total annual greenhouse gas emissions.

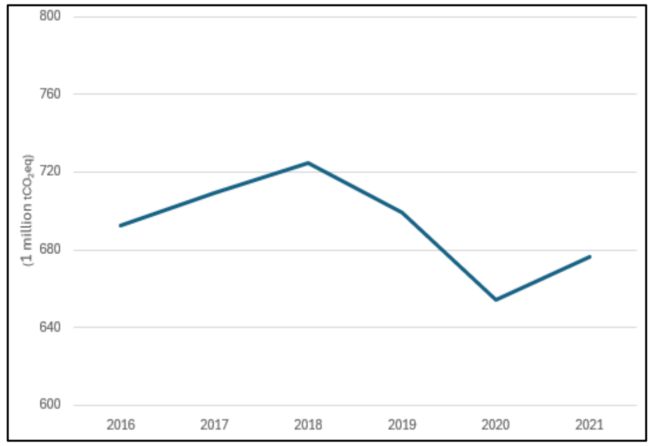


Figure 7: Total annual greenhouse gas emissions in Korea(2016-2021)

To date, the global average rising temperature is below 2°C. However, if these emissions are maintained as they are, continuous greenhouse gas emissions will accelerate the global average temperature rise and make it difficult to achieve 2050 carbon neutrality. Therefore, it is necessary to actively reduce the amount of greenhouse gas generated by the operation of incineration plant facilities.

To this end, I would like to propose a way for the Seoul resource recovery facility as follows.

First, the utility use of Yangcheon resource recovery facilities should be reduced. Although the facility site and facility capacity are the smallest compared to other resource recovery facilities, the amount of utilities used is the highest, so it is necessary to reduce greenhouse gas emission sources by reducing unnecessary LNG consumption and equalizing the average temperature of facilities in the future.

Second, in order to reduce greenhouse gases caused by fundamental incineration, other resource recovery facilities should also promote waste generation source reduction, separate collection and zero waste, and recycling, and promote zero-waist campaigns in connection with Seoul Metropolitan Government policies to encourage citizens' participation.

Specifically, the plan according to the resource circulation stage is as follows.

First, there are suppression of waste generation in the production stage, reduction of disposable products and other packaging materials at convenience stores and cafes, and second, in the discharge collection stage, collection support, improvement, and education of vulnerable groups such as the elderly and recipients of basic living are needed. Third, in the recycling stage, it is also important to improve the awareness that recycling due to energy recovery can return to another profit, such as strengthening the Producer Responsibility Recycling System (EPR) and improving the recycling profit structure, and fourth, in the final processing stage, measures such as prohibiting direct landfilling that generates odors and spreading the use of recovered energy can be the solution.

Lastly, according to the results of the resident health impact survey, the impact of the resource recovery facility on the human body is still insignificant, but if the household waste continues to increase or decrease over time, the impact of the exhaust gas will also exceed the limit and affect the human body, so residents should be alert and practice the lifestyle of reducing waste in their lives. In addition, awareness of resource recovery facilities is still not good, so to improve such negative perceptions, it is necessary to strengthen publicity on positive aspects such as waste heat recovery from resource recovery facilities, electricity generation, and resident convenience facilities around resource recovery facilities that can be used for leisure activities of residents, and to approach nearby residents as incentives.

Therefore, if these attempts continue, it can be expected to improve the bad image of the survival of resource recovery facilities and the construction of new resource recovery facilities, and if the environmental impact exceeds the Air Environment Standards Act, it can be expected to apply a hybrid solution that properly combines with the consent of residents through eco-friendly measures other than the construction of facilities such as waste export, recycling, and reuse.

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