

Seoul's Urban Environment

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Overview

The space where humans, animals and plants live consists of air, water and soil. Environmental policy refers to all laws, systems, organizations, financial resources and governance to control the discharge, clean up and monitoring of pollutants to protect this space from contamination.

Seoul's environmental policy can be classified into pollution control, water supply, sewage system, waste management and parks & landscape. The starting point of environmental policies in these areas can be found by looking at the changes of administrative organizations in Seoul and environment-related laws and regulations.

Water supply projects began during the Japanese colonial era and the relevant organizations existed in 1945 when Korea was

liberated. A waste management system was set up in 1950, when the Korean War began, to handle sanitation issues. The administrative organization for sewage system management was established in 1961, and public sewage treatment facilities began operations in 1976. Seoul's civil construction department began work on parks and landscaping in 1963, and an exclusive organization was formed in 1973. The management organization for air and water pollution and control of emission sources, the last of the 5 environmental policy areas, was established in 1968.

After thorough amendment and enactment of related laws and regulations in the early 1990s, environmental policy came to be divided into water quality, air quality, waste management, soil, underground water, noise & vibration, toxic substance management, parks & landscape, water supply, and sewage system, among others. In the 2000s, further areas were added, including energy, response to climate change, odor, and asbestos.

<Table 1> Changes to Seoul's Environmental Management Policy Areas

	Sectors of Environmental Management Policy
2000s to the present	Water Supply, Waste Management, Sewage System, Parks & Landscape, Air Quality, Water Quality, Soil, Underground Water, Noise & Vibration, Harmful Chemical Substances, Environmental Dispute Resolution, Environmental Impact Assessment, Odor, Asbestos, Energy, Response to Climate Change

1990s	Water Supply, Waste Management, Sewage System, Parks & Landscape, Air Quality, Water Quality, Soil, Underground Water, Noise & Vibration, Harmful Chemical Substances, Environmental Dispute Resolution, Environmental Impact Assessment
1980s	Water Supply, Waste Management, Sewage System, Parks & Landscape, Air Quality, Water Quality
1970s	Water Supply, Waste Management, Sewage System, Parks & Landscape, Air Quality, Water Quality
1960s	Water Supply, Waste Management, Sewage System, Parks & Landscape, Air Quality, Water Quality
1950s	Water Supply, Waste Management
1940s	Water Supply

Background

When Korea was liberated from Japanese colonial rule in 1945, there was no national government and the nation faced serious financial difficulties. In spite of this, drinking water was supplied to the people through a water supply plant constructed during the colonial era. During the Korean War, which began in 1950, waste management as a public cleaning project began to restore the destroyed city and improve sanitary conditions.

Korea in the early 1960s was politically chaotic due to fraudulent presidential elections on March 5th, 1960, the April revolution on April 19th the same year, and other political issues. Chaos ended with the military coup on May 16th, 1961. The government's

5-Year Economic Plan in 1962 sought to overcome deep-rooted poverty. Light industry led growth of the Korean economy in the 1960s, while the steel and heavy chemical industries did the same in the 1970s. The Gyeongbu (Seoul to Busan) Expressway, completed in 1970, enabled development of the distribution industry. Rural populations flocked to the cities to find better jobs. New urban districts in Yeouido and Yeongdong in the late 1960s were constructed to resolve the housing shortage, signaling the beginning of Seoul's urbanization. However, the dark shadow of pollution emerged from behind this industrial development and urbanization, leading to sewer system projects and management of pollutant discharges to improve air and water quality in the 1960s.

With the rapid development of scientific technologies in the 1970s, the mass production of vehicles and consumer electronics began and plastic started to replace heavier, weaker, and less enduring materials as paper, wood, glass, and metal. Oil consumption rapidly increased as it was used in vehicles and other products. The first oil crisis in 1973 and the second in 1978 served as important events to increase the momentum behind energy efficiency and the use of alternative energies. In the 1980s, Korea introduced district heating for more efficient use of energy. Development of the plastic industry not only contributed to improving convenience in daily life and reducing manufacturing costs, but also produced massive amounts of waste. In 15 years, Nanjido Landfill became a hundred-meter high mountain. As the toxicity of garbage worsened, it could no longer be used as fill for land development, as had been the case in the 1970s, but had to be degraded into troublesome garbage.

The endeavor for economic growth that started in the 1960s came to fruition in the 1980s and 1990s. Cars, color TVs, refrigerators, washing machines, and air conditioners, etc. became necessities for each home. While hosting the 1986 Asian

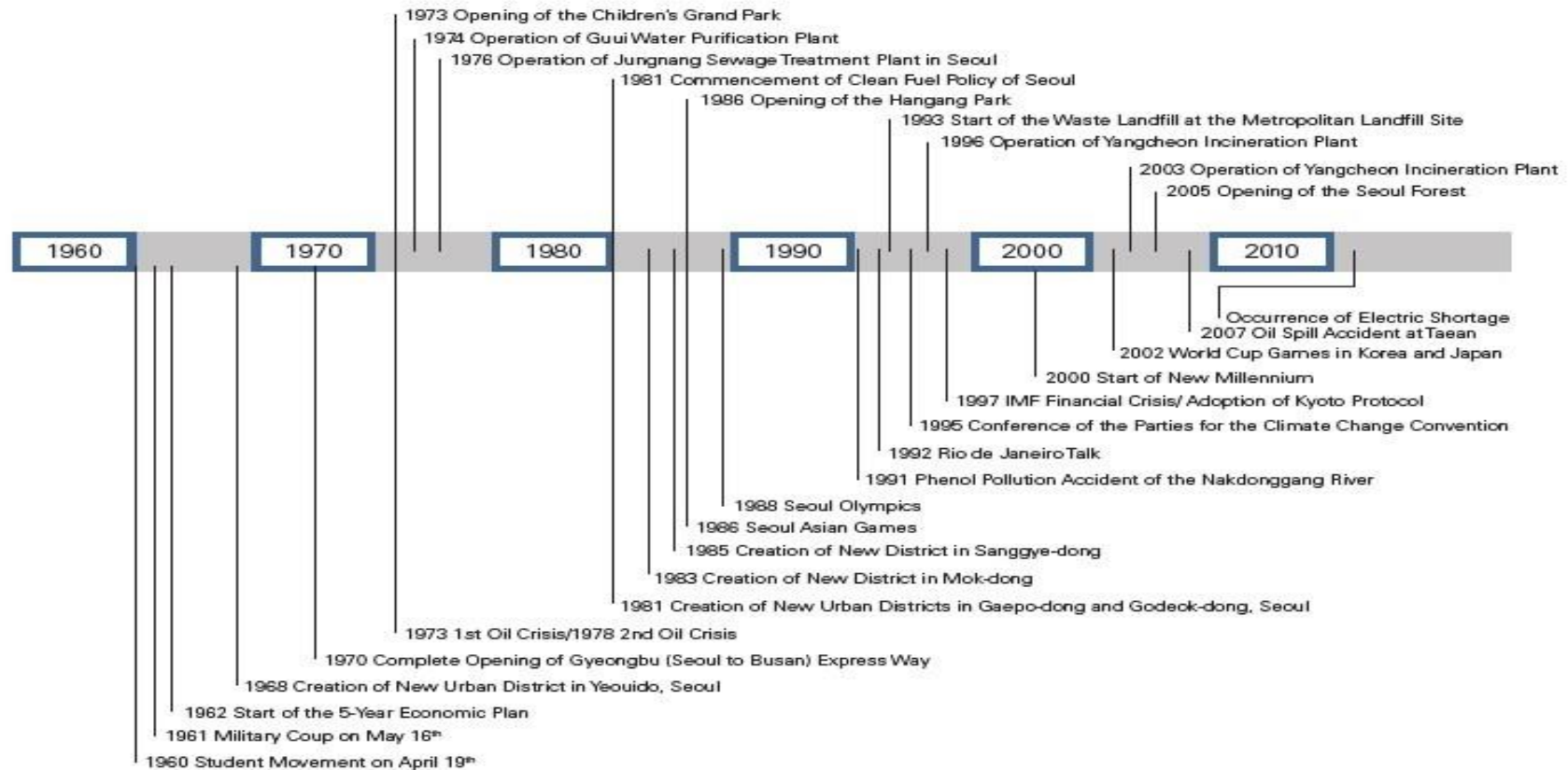
Games and the 1988 Seoul Olympics, Korea's global standing had improved and the people were confident. As interest in and expectations of a better quality of life and a cleaner environment increased, air quality, water quality, waste, parks & landscape, ecology, drinking water, underground water, soil, noise & vibration and harmful chemical substances were added to the purview of environmental management.

On the other hand, high expectations for quality of life and of the environment influenced opposition to the construction of various social welfare and sewage treatment facilities, landfills, incinerators, nuclear power plants and facilities to treat nuclear waste, and electrical towers, etc., making it difficult to secure the necessary infrastructure. The financial crisis in 1997 pushed the country into economic depression and made the future look bleak for society. But with hope for the new millennium in 2000 and successful hosting of the World Cup in 2002, the Korean economy was revitalized and environmental management was able to maintain its responsibilities of the 1990s.

One of the key features of environmental management in the 2000s was the addition of energy and response to climate change to environmental focus. Since the 1990s, the earth has experienced more frequent climate phenomena such as typhoons, heavy rain, heavy snow, heat waves, tropical nights, droughts, and melting polar ice. There was a variety of opinions about the main causes, with some insisting that environmental pollution was causing global warming and others stating that these events were natural, cyclical climate phenomena. But everyone agreed that these phenomena were occurring more frequently. To address this, many countries established a joint international response system through the Rio de Janeiro Earth Summit in 1992, the United Nations Climate Change Conference in 1995 and adoption of the Kyoto Protocol in 1997. These events discussed energy, energy conservation, alternative energies, response to climate change, and green growth, etc., and

Seoul added the areas of energy and response to climate change to its areas for environmental management.

<Figure 1> Seoul: Major Environmental Management Projects & Social Background



1973 Opening of Children's Grand Park
1974 Guui Water Purification Plant opens
1976 Jungnang Sewage Treatment Plant opens in Seoul
1981 Commencement of Seoul's Clean Fuel Policy
1986 Opening of Hangang Park
1993 Metropolitan Landfill Site opens
1996 Yangcheon Incineration Plant opens
2003 Air Quality Management in the Metropolitan areas
2005 Opening of Seoul Forest

1960 Student Movement on April 19th
1961 Military Coup on May 16th
1962 5-Year Economic Plan begins
1968 Creation of new urban district in Yeouido, Seoul
1970 Gyeongbu Expressway (Seoul to Busan) completed
1973 1st Oil Crisis/ 1978 2nd Oil Crisis
1981 Creation of new urban districts in Gaepo-dong and Godeok-dong, Seoul
1983 Creation of new district in Mok-dong
1985 Creation of new district in Sanggye-dong
1986 Seoul Asian Games
1988 Seoul Olympics
1991 Nakdonggang River: Phenol pollution incident
1992 Rio de Janeiro Earth Summit
1995 Conference of the Parties for the Climate Change Convention
1997 IMF Financial Crisis/ Adoption of the Kyoto Protocol
2000 Start of the new millennium
2002 World Cup Games in Korea and Japan
2007 Electrical shortage
Oil Spill at Tae-an

History

Legal System

We can see the structure of Seoul's administrative organizations and the process of development of environmental policy through Korean law and city ordinances.

The first environmental ordinance of Seoul was the Ordinance on Water Supply, enacted in 1949. The first national law on the environment was the Water Supply and Waterworks Installation Act in 1961, 12 years later. Seoul enacted an ordinance on special account installation for the sewage system in 1965, one year ahead of a related national law. Since then, however, the central government enacts laws and regulations and Seoul establishes ordinances to determine the needed details for implementation. When Korea was liberated from Japanese colonial rule in 1945 and the Korean War began in 1950, a national system had not yet been set up. Therefore, cities took the initiative to implement the projects necessary to provide the basic necessities for people, including drinking water, public cleaning and sewage systems. Since the 1960s when these national systems were structured, the central government has led the selection of issues and agendas related to the environment and established relevant systems.

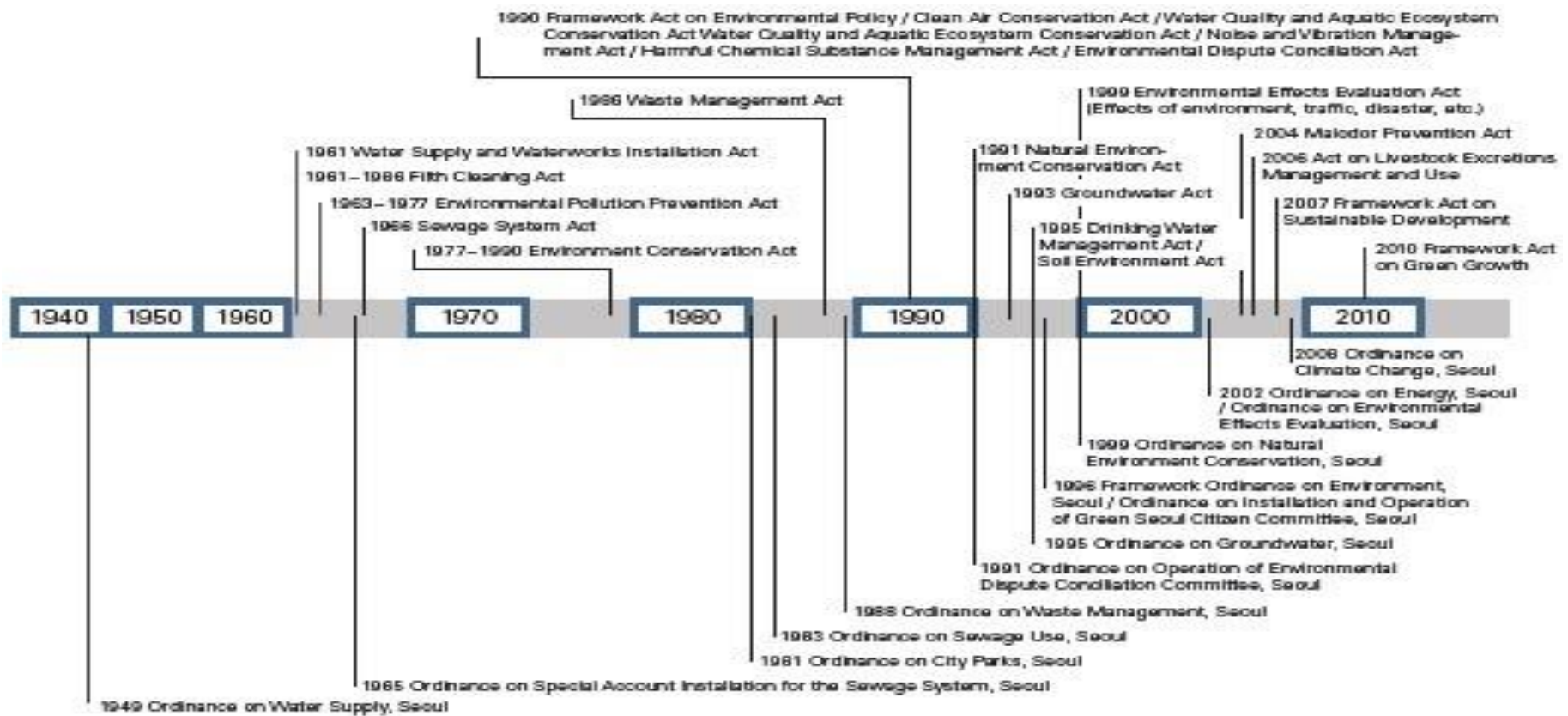
We can see the process of environmental policy development by area through the history of revision of relevant laws and regulations. The first environmental policy related to Seoul was on water supply (the Water Supply and Waterworks Installation Act in 1949) and waste management followed (the Filth & Cleaning Act in 1961). Policies on the emission of pollutants causing air and water contamination appeared during the 5-Year Economic Development Plan in the early 1960s (Environmental

Pollution Prevention Act in 1963) followed by the collection and treatment of sewage and waste water (Sewage System Act in 1966). In the 1970s, the Environmental Pollution Prevention Act was revised to become the Environment Conservation Act, which expanded environmental policy and introduced technical measures and a variety of regulations. In the 1970s and 1980s, the amount of waste increased rapidly as a result of economic growth, appearance of plastic products and increases in income. In that period, the laws and regulations related to waste management, divided into the Filth & Cleaning Act and the Environment Conservation Act, were integrated into the Waste Management Act (enacted in 1986).

In the 1990s, environmental management was subdivided by environmental media, and an environmental impact assessment system was introduced to estimate and minimize the effects of large-scale development projects on the environment, with the government beginning to mediate disputes. Environmental management specialized and expanded dramatically. In the early 1990s, basic laws such as the Framework Act on Environmental Policy (enacted in 1990) and the Natural Environment Conservation Act (enacted in 1991) were passed to set the direction for management in the main environmental areas and individual management laws were passed on water quality, air quality, waste, aquatic ecosystems, noise & vibration, harmful chemical substances, underground water, drinking water, soil, odor, in that order. The Environmental Dispute Conciliation Act was enacted in 1990 to mediate disputes in the nation over environmental damage. The Environmental Impact Assessment Act was legislated in 1999 to change the existing environmental management methods that controlled and monitored environmental pollution so that it did not exceed regulatory levels. According to the Act, environmental impact is to be evaluated during the preparation stage for government projects and private sector projects of a certain size to reduce the negative impact, modifying the project or establishing preventive plans as necessary, which in turn would be evaluated upon project completion.

In the 2000s, energy and response to climate change emerged as new agenda items in environmental management. The main tasks were to develop the technologies to reduce greenhouse gas (GHG) emissions, including carbon and methane gas, develop the technologies to increase energy efficiency, produce energy in new ways and set the conditions for developing such technologies. The central government enacted the Framework Act on Sustainable Development in 2007 and the Framework Act on Green Growth in 2010, and Seoul established its Ordinance on Energy in 2002 and its Ordinance on Climate Change in 2008.

<Figure 2> Development Process of Environment-Related Laws & Regulations



Administrative Organization

The environmental administrative organization of Seoul has steadily expanded in pace with increased administrative demands, subspecialized and extended environmental areas, and so on. In 1945, when Korea was liberated from Japanese colonial rule, Seoul had just one department (water supply) for environmental administration. In the 1950s, this grew to two departments

with waste management. There were five departments in 1961 when the sewage system was added, eight departments in 1968 when environment preservation was added and 14 departments in 1973 when parks & landscape projects and sewage system projects began. The number of departments taking care of environmental policies decreased to 7 in the 1980s, but expanded again in 1996 to 16 as environmental management subspecialized and related regulations and systems were improved. The expanded areas covered energy, response to climate change, and eco-friendly transportation, etc. in the 2000s, bringing the total number of related departments in Seoul to 20 by 2012.

There were a total of 40,267 civil servants in Seoul as of 2012, with 10,118 in the Seoul Metropolitan Government (SMG) and 30,149 in the 25 autonomous *gu*-districts. There were 5,914 employees working in environmental policy: 241 in the Climate Environment Division, 604 in the Blue City Bureau, 365 in the City Safety Office, 2,036 in the Water Supply Project Division and 2,668 in the autonomous *gu*-districts, making up 15% of the SMG's total manpower.

<Table 2> Changes to the SMG's Environmental Administrative Organizations

Year	Organization (Dept.)	Environmental Pollution Control	Waste Management	Sewage System	Water Supply	Parks & Landscape
1945	1				Water Supply Dept.	
1950	2		Sanitation Dept.		Water Supply Dept.	

1961	5		No change	Sewage Dept.	Biz. Service Dept. Facility Dept. Water Supply Dept.	
1963	7		No change	No change	Biz. Service Dept. Cashier Dept. Accounting Dept. Water Source Dept. Water Supply Dept.	
1968	8	Health Dept.	No change	No change	Biz. Service Dept. Accounting Dept. Water Source Dept. Water Supply Dept. Facility Dept.	
1969	9	Health Dept. 1	No change	No change	Biz. Service Dept. Accounting Dept. Water Source Dept. Water Supply Dept. Facility Dept. Electricity Generation Dept.	
1973	14	Environment	Cleaning Dept. 1	Administrative	No change	Landscape

		Dept.	Cleaning Dept. 2	Dept. Facility Dept.		Dept. Green Belt Dept. Park Dept.
1979	12	Environment Dept. 1 Environment Dept. 2	Cleaning Dept.	Sewage Dept.	Biz. Service Dept. Accounting Dept. Water Resource Facility Dept. Water Supply Dept. Electricity Generation Dept.	No change
1981	7	Environment Dept.	Cleaning Dept.	No change	Biz. Service Dept. Water Supply Dept. Water Source and Electricity Generation Dept.	Parks & Landscape Dept.
1983	9	No change	No change	Administrative Dept. Processing Dept.	No change	Park Dept. Green Belt Dept.
1989	12	No change	No change	No change	General Affairs Div. Facility Div.	Park Dept. Landscape

					Management Div. Production Div. Water Supply Div.	Dept. Green Belt Dept.
1992	15	No change	General Affairs Div. Project Div. Planning Div. Facility Div.	No change	No change	No change
1993	14	Environment Dept.	No change	No change	No change	Park Dept. Green Belt Dept.
1996	16	Planning Dept. Atmosphere Dept. Water Quality Dept.	Management Dept. Recycling Dept. Facility Dept.	No change	No change	Park Dept. Green Belt Dept. Planning Dept.
1998	15	No change	Management Dept. Facility Dept.	Sewage Dept. Flood Control Dept.	No change	No change
2003	16	Environment Dept. Atmosphere	Cleaning Dept.	No change	General Affairs Div. Management Div. Facility Div.	Park Dept. Landscape Dept.

		Dept. Water Quality Dept.			Production Div. Water Supply Div. Tap Water Div.	Democracy Park Seoul Forest
2007	20	Environment Dept. Water Quality Dept. Energy Dept. Project Dept. Management Dept. Transportation Dept.	Resource Recycling Dept. Clean City Dept.	No change	No change	No change
2008	18	Energy Dept. Low Pollution Dept. Transportation Dept. Environment Dept. Water	Environment Dept. Resource Recycling Dept. Clean City Dept.	Planning Dept. Facility Dept.	Management Div. Production Div. Water Supply Div. Facility Div.	Planning Dept. Park Dept. Landscape Dept. Natural Ecology Dept.

		Management Dept. River Dept.				
2009	18	Environment Dept. Climate Dept. Atmosphere Dept. Environmental Cooperation Dept. Water Management Dept. River Dept.	No change	No change	No change	No change
2010	18	Environment Dept. Climate Dept. Atmosphere Dept. Transportation	Resource Recycling Dept. Living Environment Dept.	No change	No change	No change

		Dept. Water Management Dept. River Dept.				
2012	20	Environment Dept. Energy Dept. Climate Dept. Transportation Dept. Water Management Dept. River Dept.	No change	No change	Management Div. Billing Div. Production Div. Water Supply Div. Facility Div.	Planning Dept. Park Dept. Landscape Dept. Natural Ecology Dept. Disaster Prevention Dept.

Governance

Until the 1980s, Seoul City planned and implemented its environmental policies from the aspect of administration. Beginning in the 1990s, however, many difficult projects were undertaken that could not be completed simply through administration.

For example, public consensus was needed before unpleasant facilities such as waste incinerators could be constructed, expert knowledge was needed for new and renewable energy projects and projects related to automotive fuel, and cooperation with citizens and industry was needed in the areas of energy, tap water, waste reduction, and purchase of eco-friendly products. International cooperation projects also increased as climate change-related issues could not be resolved by single cities or single countries.

Major internal cooperation projects for Seoul are the Green Seoul Citizen Committee and Seoul Action 21. For international cooperation projects, Seoul joined the ICLEI (Local Governments for Sustainability) and the C40 Cities Climate Change Group.

Green Seoul Citizens Committee

The Green Seoul Citizens Committee was launched on November 22nd, 1995 to discuss development-oriented policies and address the city's environmental concerns through voluntary participation of the public as the age of local autonomy began, emphasizing quality of life.

The committee is based on the Framework Ordinance on the Environment, and implements autonomous and independent activities through civil participation. Its governance model involves various entities in the public sector (the Seoul Metropolitan Government), the private sector (enterprises), and civil society working together. It functions as a policy advisory group and is involved in practical implementation of policies while sharing the vision of a sustainable future for Seoul and creating its social systems together.

The committee evaluates and advises on integration and adjustment of preservation and development in terms of sustainable civic administration, evaluates and advises on the sustainability of policies, plans and systems proposed by the mayor, fulfills the "Seoul Agenda 21" and its implementation, suggests directions and gives advice to facilitate the "Autonomous District Agenda 21", develops a coalition with citizens and attracts voluntary participation from the general public and the private sector in addressing climate change and carrying out cooperative activities to improve the environment, gives advice on establishment and adjustment of comprehensive environmental education plans and supports the development of training materials for education programs. In addition, the committee participates in environmental conservation programs to invite the general public and businesses to participate, and works to facilitate an eco-friendly culture.

The committee's main projects are evaluation of the sustainability of Seoul policies, monitoring of Seoul Action 21 implementation, supporting with selection of entries to contests on ways to involve the public better, organizing and running a citizens coalition for Seoul Agenda 21, and organizing and running the green start project for autonomous *gu*-districts, etc.

Seoul Action 21

"Seoul Agenda 21" refers to "the 21 local agendas" made by Seoul. In 1992, the Rio de Janeiro Earth Summit recommended that local governments make up their own "agenda 21" as action plans for protection of the environment in local units to facilitate global environmental preservation. The SMG included its "local agenda 21" made with the citizens in its "3 Year

Administrative Operation Plan" (1996~1998) which was declared and submitted to the United Nations. The "Green Seoul Citizen Committee of Seoul City" launched on November 22nd, 1995, was the basis for creating the "local agenda 21." The "Preparatory Committee for Seoul Agenda 21" was organized with 12 participants consisting of civic organization members, experts and SMG employees, and discussed facilitating the related systems, operating methods, and agenda-writing schedules, etc. through 18 meetings and public hearings. The draft of "Seoul Agenda 21" was prepared in 1997 and public consensus gained through workshops and public hearings, etc. Seoul Agenda 21 was announced on June 5th, 1997 in celebration of the 25th World Environment Day. A revised version was announced in March 2000.

The "Seoul Agenda 21" was comprised of eight areas, including visions, issues, principles, and activity targets. In order to achieve the goals of each area and contribute to the city's sustainable growth, the visions and activity goals of the "Seoul Agenda 21" needed to be closely connected with the SMG's administration. In line with this, the SMG developed "Seoul Agenda 21" into "Seoul Action 21" so that general citizens could participate in the plan.

Seoul Action 21 was an important plan to the era of governance in the sense that it was a cooperative action plan for Seoul's sustainable development. It suggested ideas that would preserve the environment, increase quality of life for the people of Seoul, and remain for future generations to enjoy.

There were 7 areas, 34 activity targets and 580 action plans in Seoul Action 21. To help the action plans be accepted into civic life, the SMG has hosted public contests for the practice of the Seoul Agenda 21 for non-profit private organizations.

<Table 3> Seoul Action 21: Activity Targets

No.	Area	Vision	Activity Targets
1	Environmental Management	Clean Water, Blue Sky, Pleasant Seoul	1-① Expand green spaces in permeable soil. 1-② Improve water quality in rivers and ensure their constant flow. 1-③ Conduct campaigns on water conservation. 1-④ Reduce fine dust generated by vehicle emissions. 1-⑤ Reduce indoor air pollution. 1-⑥ Make Seoul clean.
2	City Planning	Seoul as a Pleasant Ecological City Built through Participation	2-① Make Seoul an ecologically-oriented city. 2-② Increase the number of parks within a 5-minute walk from anywhere. 2-③ Encourage urban gardening by allocating 1% of the citizen autonomy budget. 2-④ Develop a Beautiful City Evaluation Index and apply it to city management.
3	Consumption	Sustainable Consumption, Seoul as a Safe City to Live	3-① Reduce general waste. 3-② Reduce food waste. 3-③ Purchase eco-friendly products and services. 3-④ Make sustainable consumption a way of life.

4	Transportation	Pedestrian-friendly Streets, Seoul with a Trusted Public Transit System	<p>4-① Make active use of public transit.</p> <p>4-② Enhance traffic culture.</p> <p>4-③ Supply green transportation and facilitate its use.</p> <p>4-④ Reduce traffic accidents.</p> <p>4-⑤ Improve the pedestrian environment.</p>
5	Industry Economy	Prosperous Seoul in Cooperation with Citizens & Enterprises	<p>5-① Increase the number of ecofriendly industry clusters.</p> <p>5-② Reduce the amount of CO₂ emissions to mitigate climate change.</p> <p>5-③ Decrease unemployment.</p> <p>5-④ Make Seoul a good city for foreign business people.</p>
6	Health	Lively, Healthy Seoul	<p>6-① Reduce smoking.</p> <p>6-② Maintain healthy weight.</p> <p>6-③ Create a safe drinking culture.</p> <p>6-④ Reduce stress.</p> <p>6-⑤ Keep mass provision of meals safe and sanitary.</p>
7	Social Equity	Seoul without Barriers & A Sharing, Joyful Spirit	<p>7-① Make Seoul a city where people can live in safety and happiness in their old age.</p> <p>7-② Make Seoul a city of easy access for wheelchairs.</p> <p>7-③ Make Seoul a city where anyone can live comfortably in pleasant housing.</p> <p>7-④ Make Seoul a city that ensures equality between men and women.</p> <p>7-⑤ Help people enjoy culture and arts to energize their lives.</p>

			7-⑥ Make Seoul a city filled with the sound of children laughing.
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ICLEI Activities

In May 1999, Seoul became a full member of the International Council for Local Environment Initiatives (ICLEI – Local Governments for Sustainability), which had been founded in 1990 to build up the autonomous environmental capacity of local governments. During the ICLEI World Congress in Belo Horizonte, Brazil, in June 2012, Won-soon Park, the Seoul Mayor, was elected chairman of the World Mayors Council on Climate Change (WMCCC), which is a gathering of leaders of major cities around the world. Mr. Park has contributed significantly to developing and implementing useful and substantive policies and alternatives to improve the ability to respond to climate change. In October the same year, a ceremony and seminars to mark the opening of the East Asian Headquarters of ICLEI took place, where local governments from 6 countries (Korea, China, Japan, Taiwan, Mongolia and North Korea) shared their views and discussed joint responses to environmental issues. A joint conference with WMCCC and the World Executive Committee of the ICLEI took place to discuss the scope of future WMCCC activities, membership system, and articles of association, etc. and the “Declaration of the Seoul Local Government on Energy and Climate” was signed, a document which was designed to facilitate substantive policies and set clear goals in responding to climate change. In addition, Seoul participated in the “Local Action Project for Biological Diversity”, an international ICLEI

cooperation project, and submitted a report of its assessment of the biological diversity of Seoul, and worked to establish and facilitate action plans to increase it.

C40 Activities

The C40 Climate Leadership Group is a voluntary consultative body organized by the world's largest cities to recognize the seriousness of climate change and respond effectively to it. Proposed in 2005 by Ken Livingstone, an ex-Mayor of London and launched in that city, it centers on the reality that cities make up only 2% of the world's land area yet are responsible for more than 80% of the world's greenhouse gases (the main cause of global warming) and endeavors to take actions to change this. Seoul joined in July 2006, shortly after the 4th mayor was elected by popular vote. The city also participated in the 2nd General Meeting in New York in May 2007 to sign an MOU to host the 3rd C40 Summit. It joined the C40 Steering Committee in April 2008, hosted the 3rd C40 Summit in May 2009, participated in the Carbon Disclosure Project in February 2011, participated in the C40 Steering Committee in New York in April 2011, introduced Seoul's eco-friendly transportation policy during the 4th C40 Summit in Sao Paulo in May 2011, participated in the C40 Steering Committee in London in October 2011, accepted the chair position of the Asian region for the Carbon Disclosure Project and participated in the C40 Steering Committee in Rio de Janeiro in June 2012.

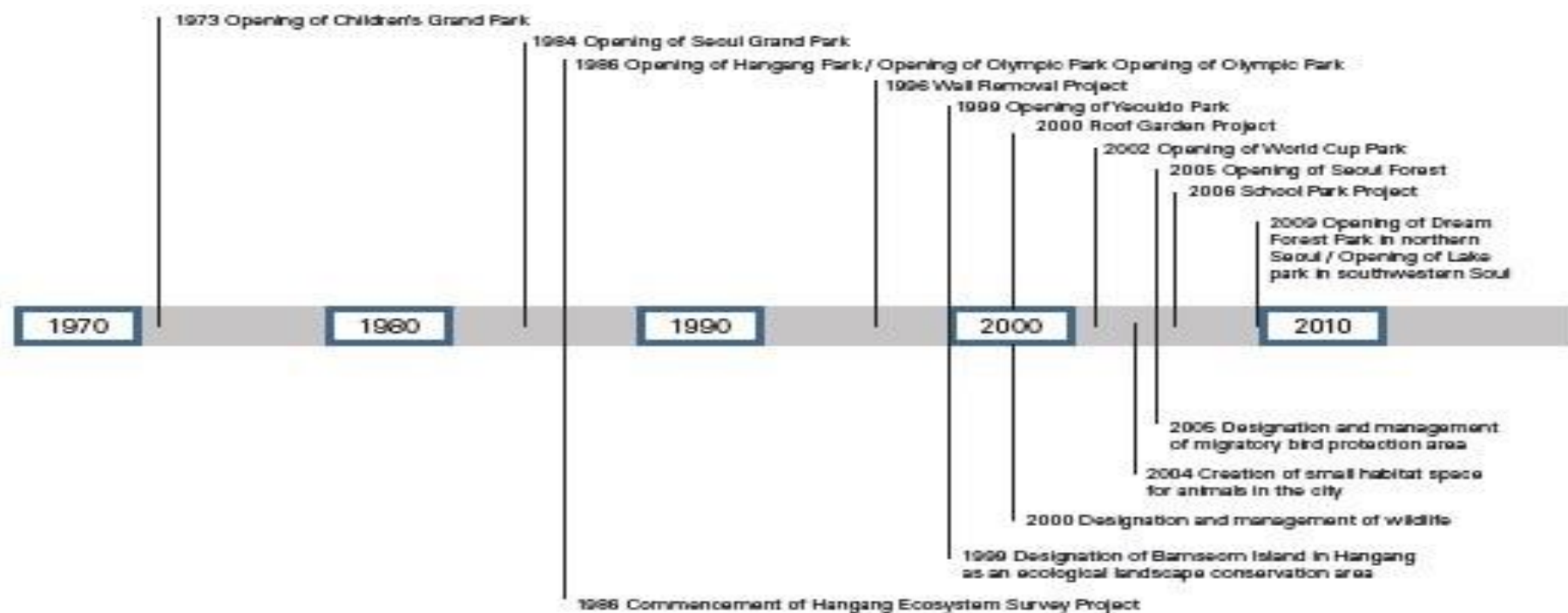
Important Policies & Details

Parks & Landscape

Main Parks & Landscape Projects by Period

The parks & landscape area of environmental management is divided into healthy green space, ecological preservation and park creation. In Seoul, most projects were creation and expansion of parks in the early stages, where much energy is still invested. The most important parks are Children's Grand Park (1973), Seoul Grand Park (1984), Hangang (Han River) Park (1986), Yeouido Park (1999), World Cup Park (2002), Seoul Forest (2005) and Dream Forest Park in northern Seoul (2009). The wall removal project in 1996, the roof garden project in 2000 and the school park project in 2006 were facilitated to create small parks in the surrounding areas. Activities to ensure a healthy ecosystem began with a survey of the Hangang ecosystem in 1987, but actual projects began in the late 1990s. Some examples of these projects are designation of Bamseom Island on the Hangang as an ecological landscape conservation area in 1999, designation and management of protected wild animals in 2000, creation of small habitats for animals in the city in 2004 and designation and management of protected migratory bird areas in 2005.

<Figure 3> Main Parks & Landscape Projects by Period



Designation of Ecological Landscape Conservation Area

Seoul enjoys a broad biodiversity and designates areas of ecological importance and special value for conservation for special management as a way of protecting them from contamination and damage. Seventeen locations of 4,807,327 m² have been designated in total: 1 area (Bamseom Island on the Hangang) in 1999, 1 area (Duncheon-*dong*) in 2000, 4 areas (Tancheon, Bangi-*dong*, Amsa-*dong* and Jingwan-*dong*) in 2002, 2 areas (Godeok-*dong* and Wonteo Valley of Mt. Cheonggyesan) in 2004, 1 area (Heoninneung) in 2005, 3 areas (Mt. Namsan, Samyukdae of Mt. Bulamsan and the rear yard of Changdeokgung Palace) in 2006, 2 areas (Mt. Bongsan and Mt. Inwangsan) in 2007 and 3 areas (downstream of Seongnaecheon, Mt. Gwanaksan and

Baeksasil Valley) in 2009. Capturing, harvesting, transplanting, damaging or killing wild animals or plants is strictly forbidden, as it is to install explosives, traps, snares, nets, trap pits, etc. or spray or inject toxic chemicals, agricultural pesticides, etc. to capture or kill wild animals or plants, change the structure of rivers, lakes, ponds, etc. or increase or decrease the water level or quantity, collect soil or stones, reclaim water and make a fire. Those who are caught violating these bans face a fine of up to KRW 2 million.

<Figure 4> Bamseom Island on the Hangang - the first designated Ecological Landscape Conservation Area



Designation & Management of Protected Wildlife

Species of high scientific or ecological value that are gradually disappearing in Seoul are designated as protected wildlife. These designations occur based on recommendations made through the Hangang ecosystem and forest ecosystem surveys, etc. conducted by the SMG, and the recommendations of environmental organizations and related professional agencies. The designation process also includes consultations and advice from experts. Thirty-five species of swallows, toads, roe deer, and other wildlife were the first to be designated and an announcement was made on November 15th, 2000. On October 25th, 2007, 14 species of wild animals and plants including squirrels and *onychodactylus fisheri* were added.

<Table 4> Designation of Protected Wildlife

Type (Species)		Designated in Nov. 2000 (35 Species)	Designated in Oct. 2007 (14 Species)
Mammals	5	Roe deer, badger, hedgehog, weasel	Squirrel
Birds	11	Great spotted woodpecker, yellow-rumped flycatcher, kingfisher, swallow, oriole, chickadee	<i>Dendrocopos kizuki</i> , <i>dendrocopos leucotos</i> , grey-faced woodpecker, reed warbler, black capped kingfisher
Amphibians,	7	Toads, salamanders, Dybowski's frog, red-	<i>Onychodactylus fisheri</i>

Reptiles		bellied frog, lined grass lizard, small stringy snake	
Fish	4	Yellow puffer, <i>microphysogobio jeoni</i> , roughskin sculpin, <i>repomucenus olidus</i>	
Insects	12	<i>Dorcus titanus castanicolor</i> , <i>luehdorfia puziloi</i> , <i>pseudothermis zonata</i> , large dragonfly, migratory locust, mole cricket, <i>rhoenanthus (potamanthindus) coreanus</i> , <i>dalla torre</i>	<i>Rhyothemis fuliginosa</i> , <i>papilio maackii</i> , <i>muljarus japonicus</i> , <i>cybister brevis</i>
Plants	10	<i>Acanthopanax seoulensis nakai</i> , <i>epimedium koreanum nakai</i> , <i>drosera rotundifolia L.</i> , <i>cypripedium macranthum Sw.</i> , <i>forsythia saxatilis nakai</i> , <i>patrinia saniculaefolia</i> , buckler fern	Pear-leaf selliquea fern, bladderwort, <i>glechoma grandis kuprian</i>

Creation & Expansion of Parks

Everyone wants to live in a pleasant environment with clean air, clean water, warm sunlight and green spaces. The metropolitan city of Seoul has over 10 million people and continues to grow, but the quality of life for its residents has not been enhanced significantly. More than 76% of the parks & landscape of Seoul is forest area concentrated on the outskirts. Thus, the space available for leisure and relaxation during daily life is insufficient, particularly in the city's CBD.

To address this lack of green and park spaces, Children's Grand Park was created in 1973, Seoul Grand Park in 1984, Hangang Park in 1986, Yeouido Park in 1999, World Cup Park in 2002, Seoul Forest in 2005, Dream and Forest Park in northern Seoul in 2009. At the same time, the city government created small parks in neighborhoods and working spaces through the Wall Removal Project in 1996, the Roof Garden Project in 2000 and the School Park Project in 2006. As a result, parks make up a total of 170 km², or 28% of the metropolitan area. By type, 38.56% of this area is urban nature parks, 23.21% is natural parks, 25.45% is neighborhood parks, 1.29% is children's parks and 1.40% reserved for cemetery parks.

<Figure 5> Examples of Parks in Seoul



Children's Grand Park (Completed in 1973)



Hangang Park (Completed in 1986)



World Cup Park (Completed in 2002)



Seoul Forest (Completed in 2005)

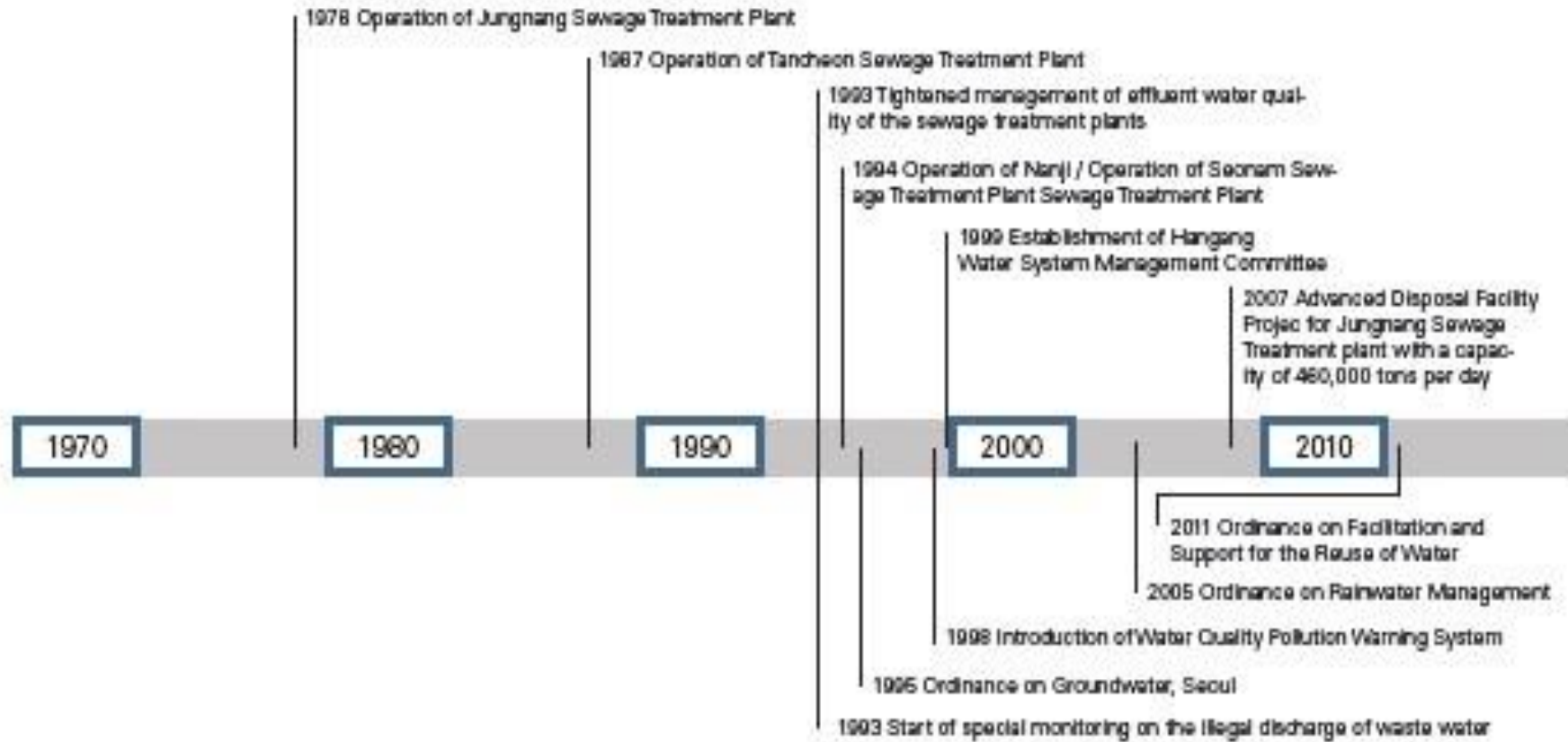
Water Management

Main Water Management Projects by Period

Seoul's water management is divided into public sewage treatment, water quality monitoring of the Hangang and its tributaries, underground water management, rainwater management and management of wastewater discharging sources. Public sewage treatment started in 1978 when the Jungnang Sewage Treatment Plant began operations. Tancheon Sewage Treatment Plant

was constructed in 1987, and Nanji and Seonam sewage treatment plants in 1994. Their performance has gradually improved so that they have discharged treated sewage water with BOD lower than 20 mg/L since 1993. As the management of effluent water quality has tightened since 2000, the BOD level of treated sewage of the Jungnang Sewage Treatment Plant is maintained at less than 10 mg/L. Water quality monitoring for the Hangang and its tributaries began in the early 1980s. At that time, however, this was only through occasional surveys. Regular water quality monitoring at specific locations and for specific items began in the 1990s. Underground water management also began in the 1990s. In the 2000s, rainwater management (related ordinance enacted in 2005) and a water utilization promotion project (related ordinance enacted in 2011) began. Management of wastewater discharging sources began when the Environmental Pollution Prevention Act was legislated in 1963 and gradually strengthened, with the Environment Conservation Act in 1977 and the Water Quality Conservation Act in 1990 enacted. Because of the increasing unauthorized, illegal and opportunistic discharges of wastewater during the night, holidays and the rainy season, monitoring of wastewater discharging facilities is frequent.

<Figure 6> Main Water Management Projects by Period



Sewage Treatment

As the contamination of public waters caused by sewage emerged as a problem, Seoul constructed the Cheonggyecheon (stream) Sewage Treatment Plant in 1976, the first in the nation and able to handle 150,000 tons of sewage per day. The Jungnang Sewage Treatment Plant was built in 1979 and could handle 210,000 tons/day. The Seonam, Nanji and Tancheon (stream) sewage treatment plants followed. To secure the financial resources needed for sewage treatment, Seoul began

imposing a sewage fee in 1984 on the basis of the "polluter pays" principle.

Seoul began expanding the 4 plants in 1992 to cope with the increasing amount of sewage as the city's overall conditions changed. With the targeted capacity of an extra 2.7 million tons per day realized in 1998, total facility capacity reached 5.81 million tons per day. As regulations on effluent water from these plants have steadily tightened, Seoul has upgraded the facilities accordingly. However, the cost of constructing advanced disposal plants is enormous, so the city gives priority to increasing the capacity of existing plants first, and adds advanced facilities later if the expanded capacity is insufficient. Seoul completed phase 1 of a project to introduce advanced disposal facilities to the Jungnang Sewage Treatment Plant to bring its capacity to 460,000 tons per day in 2007, and constructed additional facilities to supplement capacity at the Tancheon, Seonam and Nanji sewage treatment plants.

The network of sewage pipes, leading from discharging sources to the sewage treatment plants, had reached a length of 10,487 km as of the end of December 2012. From its designation as the nation's capital 600 years ago until the modern era, Seoul's sewer system was constructed and expanded with a focus on management of rainwater. At times, sewage leaked out of broken pipes or joints to contaminate underground water, soil and streams. In the meantime, large amounts of underground water flowed into the pipes so that the treatment plants sometimes processed relatively clean water, thereby lowering their operational efficiency. To cope with such situations, Seoul began in 1992 to install certain kinds of endoscopy cameras (CCTV) inside the sewage pipes to monitor for problems, using the information in maintenance and repair of the pipes.

<Figure 7> Main Waterways & Seoul's Public Sewage Treatment Plants



Rainwater Management

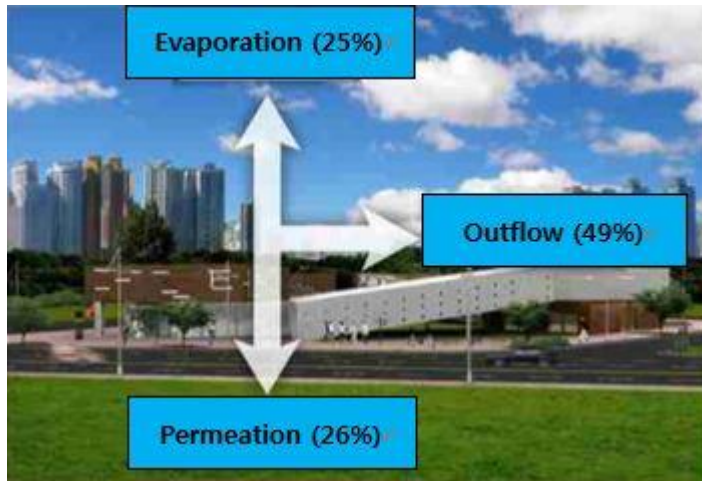
In 1962, when urban development began in earnest in Seoul, rainwater began to flow into the waterways as impervious areas, where rainwater could not penetrate the ground, expanded. Thus, areas along the rivers and streams and low-lying ground were habitually flooded during localized torrential downpours. Paving the bottoms and sides of the waterways with concrete could serve to keep the water flow quick enough to prevent flooding, but this decreased the underground water and depleted

the springs. Accordingly, it became difficult to ensure sufficient water resources during the dry season, with the dry river and stream beds resulting in the frequent occurrence of heat islands.

The SMG began rainwater management projects in the 2000s to address these problems. Systems were begun by enacting ordinances on water management in 2005 and on facilitation and support for the reuse of water in 2011, establishment of a basic plan for water management in 2013, and projects to collect and use rainwater since then. As of 2012, there were 141 locations for rainfall storage and permeation including Mt. Mangwusan Rainfall Storage and Gangil District Rainfall Storage, totaling a capacity of 339,662 m³. There are 490 locations with rainwater recycling facilities including the new Seoul City Hall office building, the Dongdaemun Design Plaza, Gangnam Segokrien Park, etc. totaling a capacity of 107,671m³. The SMG provided financial support for installation of 125 of these facilities (capacity: 2,020 m³). It also recommends the installation of rainwater permeation and recycling facilities for projects subject to environmental impact assessments, and making such installation mandatory for large-scale housing development projects.

<Figure 8> Flow of Rainwater in Seoul & Sample Rainwater Management Project

Evaporation/Outflow/Permeation



Flow of rainwater in Seoul (2010)



Rainwater recycling facility in a park

Water Supply

Main Water Supply Projects by Period

Water supply management can be largely divided into tap water production, maintenance of distribution pipelines, and management of tap water quality. A water supply system was introduced to Seoul in 1908, during the late Joseon period, by

an American technician named Henry Collbran, the 100th anniversary of which Seoul celebrated in 2008. In 1949, the Water Supply and Waterworks Installation Act of Seoul was passed. Since construction of Guui Water Purification Plant in 1974, a total of 6 plants (Gwangam, Amsa, Yeongdeungpo, Ttukdo and Gangbuk being the other five) have been built and are in operation. The membrane filtration process was introduced in 2011 to make the water cleaner tasting. Major maintenance of the water distribution pipeline began in 1984, replacing 13,122 km of the total 13,668 km of deteriorated pipelines by 2012. Thanks to this replacement, the tap water flow rate in the city improved remarkably between 2000 and 2012, from 72% to 94.5%. The quality of tap water is maintained through management of water supply sources, expansion of the items for inspection (from 28 in 1990 to 163 in 2012), and quality checks of household tap water, etc.

<Figure 9> Main Water Supply Projects by Period



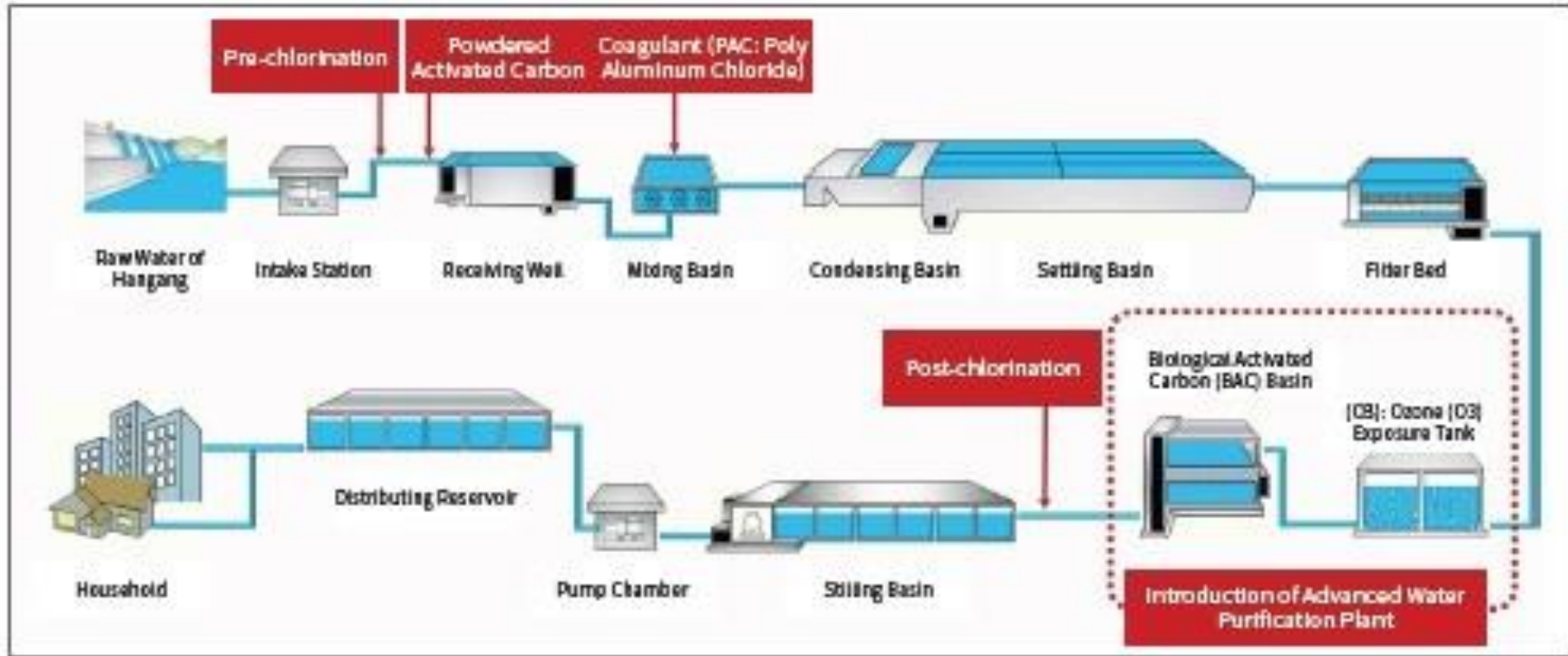
Production of Tap Water

The first water supply system in the city was the water purification plant constructed at Ttukdo Reservoir, which was completed on September 1st, 1908 by Collbran and another American, Harry Bostwick, who were authorized by Emperor Gojong to work on the water supply system project. Production capacity was 12,500 tons per day, which supplied 125,000 people with water. Three purification plants were operating in 1946 (Ttukdo, Noryangjin and Guui, with a total capacity of 150,000 m³ per day) and five in 1977 (with Bogwangdong and Yeongdeungpo added for a total capacity of 2.17 million m³ per day) in 1977. In 2004, Seoul closed the deteriorating and outdated Guui 1 & 2, Noryangjin, Sinwol, Seonyu and Bogwangdong water purification plants, leaving six plants in operation (Gwangam, Amsa, Guui, Ttukdo, Yeongdeungpo and Gangbuk).

As of 2012, the water purification and production capacity was 4.35 million m³ per day, supplying water to 10.44 million people: a 100% supply rate.

Prior to 1992, there was no reserve capacity for water supply plants, causing operational difficulties. However, sufficient purification facilities began operating in 1998 and stability of supply has been possible since then, with no areas lacking running water. In 2012, 1.20 billion tons of tap water was used, for an average of 3.216 million tons per day.

<Figure 10> Tap Water Production & Supply in Seoul



Maintenance of Feed Pipes

There are a total of 13,801 km of water distribution pipes in Seoul. By 2012, 13,122 km of 13,668 km of deteriorated pipeline had been replaced, with only the pipelines (43 km) in areas planned for redevelopment remaining as they were. The effects of this maintenance can be seen in the flow rate, which refers to the amount of water generating revenue as a proportion of the water produced in the purification plants. A high flow rate means there is little leakage of tap water between production

and supply. This flow rate increased remarkably from 72% in 2000 to 94.5% in 2012. As it increased, the budget could be reduced for raw water, chemicals, power, etc., due to the more efficient water supply management. In 2012, the water flow rate was increased by 1.0%, which equated to a reduction of KRW 6.842 billion in production costs (based on unit sale price).

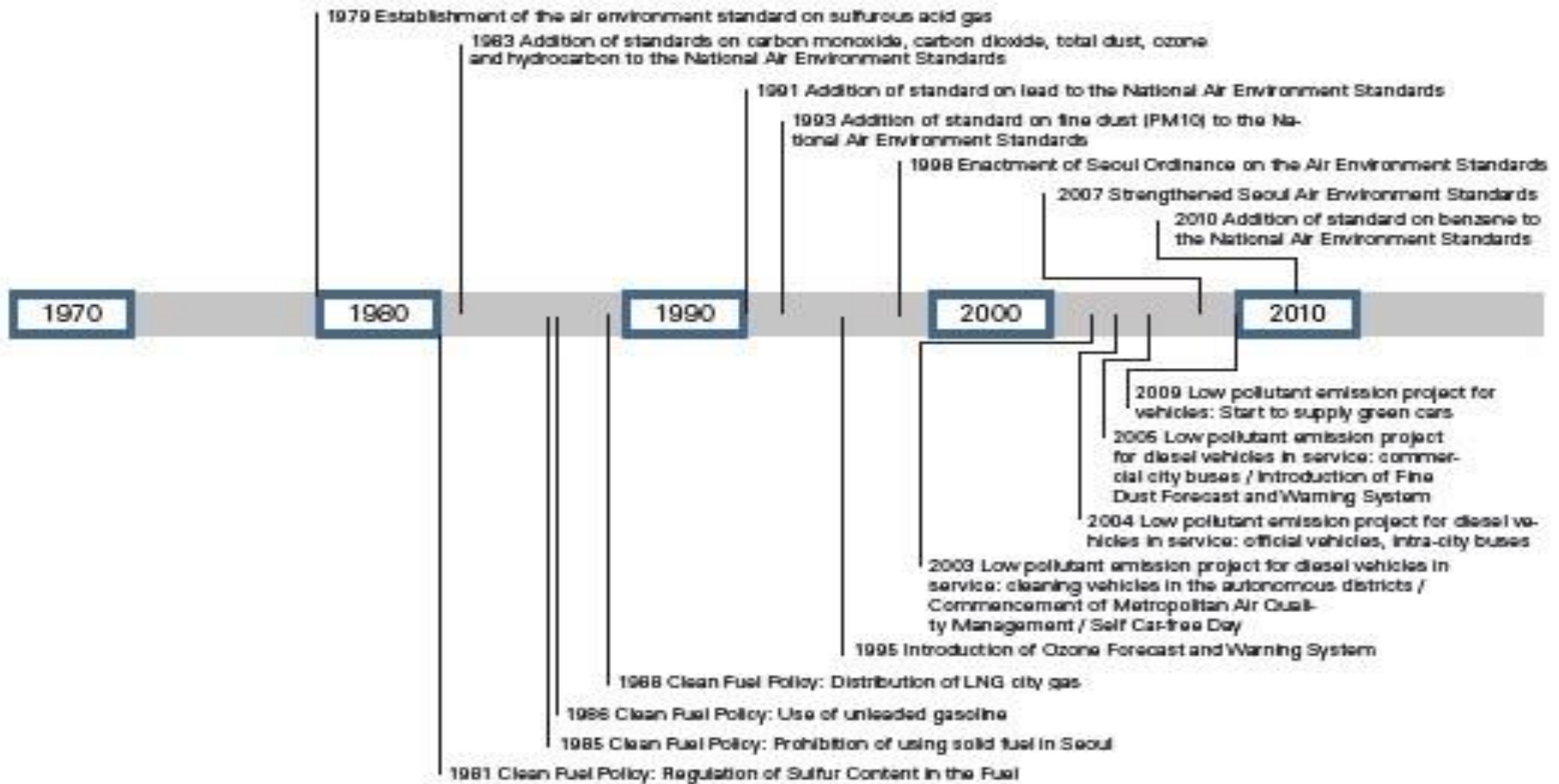
Management of Air Quality

Main Air Quality Management Projects by Period

Air quality management is largely divided into establishment of environmental standards, fuel control, vehicle low-emission projects, transportation demand management, and establishment of the foundation for air quality management. Seoul began establishing air environment standards from 1979 on sulfurous acid, followed by standards on carbon monoxide, nitrogen dioxide, total dust, ozone, hydrocarbons, lead and fine dusts, in that order. Standards for benzene were added in 2010. The SMG began applying its own air quality standards in 1998. Fuel control in Seoul began with regulation of sulfur content in 1981, followed by regulation of solid fuels (later banned) and policies on the use of unleaded gasoline, beginning the distribution of LNG (city gas) in 1998. To suppress vehicle emissions, the SMG began vehicle low-emission projects for diesel engines in cooperation with the metropolitan area in 2003, introduced a voluntary "Weekly No-Driving Day" also in 2003, and began to supply electric vehicles (EVs) in 2008.

Measuring stations systematize management of air quality, an ozone warning system was introduced in 1995, and a fine dust forecast and warning system in 2005 as a measure of defense against poor-quality air situations.

<Figure 11> Main Air Quality Projects by Period



Low Vehicle Emissions

The low emission projects in Seoul include one on diesel vehicles, another on supply of "green" cars and yet another involving the installation of natural gas fueling stations. The project to cut emissions from diesel vehicles began in 2003 with replacement of engines of 135 2.5-ton diesel city garbage trucks with LPG engines as a pilot. In 2004, emission reduction devices were installed on about 880 city vehicles and intra-city buses. With these projects going full swing for city buses and commercial vehicles from 2005, city policies applied to 248,779 vehicles by the end of 2012: Diesel Particulate Filter (DPF) devices were attached to 82,115, engines converted for 67,834 to run on LPG, DOC devices attached to 53,054 and the remaining 45,776 vehicles scrapped. EVs were an interesting fundamental solution to air pollution, and since 2009, the SMG has facilitated their supply and worked on establishing the needed fueling station infrastructure for use as part of the testbed. Seoul also has implemented projects with two-wheeled EVs as a start, followed by low-speed EVs, modified EVs, high-speed EVs, electric buses, hydrogen fuel cell vehicles, and "online" EVs. Recharging stations have been installed outside public buildings such as City Hall and *gu*-district offices, as well as parks. A "Smart Recharging System" has also been developed so that EV users can pay for recharging easily.

Weekly No-Driving Day

The Weekly No-Driving Day campaign involves citizens deciding on their own which day of the week (Monday to Friday) they do not drive. Begun under the name "Self-Car-free Day" in July 2003, its objectives were to decrease the number of non-

commercial cars with less than 10 seats on the road and encourage people to use public transit instead, as a way to lessen air pollution to levels found in advanced countries. Paper stickers were issued first in July 2003, followed by electronic tagging in January 2006, which replaced paper stickers in July 2007. As of 2012, 1,080,793 vehicles were participating in this campaign.

<Figure 12> Weekly No-Driving Day



The Weekly No-Driving Day campaign involves citizens deciding on their own which day of the week (Monday to Friday) they do not drive.

Residents are urged to join this campaign and use public transit more to reduce energy consumption in the age of high oil prices, ease heavy congestion and restore the air to its pleasant origins.

Air Quality Forecast & Warning System

The ozone warning system was introduced in July 1995 to minimize the impact of ozone on human health and living environments, address public concerns about air pollution and enhance the level of environmental awareness. Warnings are issued to residents in each of five areas (CBD, northwest, northeast, southwest, and southeast) when the ozone (O₃) concentration is higher than a certain level in their area, or will be, in consideration of air flow. Warnings, alerts, and alarms are issued according to the standards set for the region where the ozone standard was breached.

<Table 5> Criteria for Ozone Warning & Recommended Actions from the Public

Stage	Issuance Criteria	Actions by the Public
Warning	Ozone concentration in morning air is higher than 0.12 ppm	<ul style="list-style-type: none">-Abstain from outdoor exercise.-The elderly, children and those with health conditions to abstain from outdoor activities.-Refrain from unnecessary driving and use public transit instead.
Alert	Ozone concentration in morning air is higher than 0.3 ppm	<ul style="list-style-type: none">-The elderly, children and those with health conditions to abstain from outdoor activities.-Kindergartens and schools to keep their students indoors.-Vehicles advised to pass around the region where the alert has been issued.

Alarm	Ozone concentration in morning air is higher than 0.5 ppm	<ul style="list-style-type: none"> -The elderly, children and those with health conditions to refrain from outdoor activities. -Kindergartens and schools are advised to close. -Vehicles are advised not to enter the region where the alarm has been issued.
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There are three categories of forecasts in the fine dust forecast and warning system: warnings and alarms. As air pollution worsened and public concern about fine dust grew due to the rapid growth in the number of vehicles, the SMG introduced this system, the first of its kind in Korea, on February 1st, 2005 as a way to minimize harm to health and contribute to reducing pollution. The fine dust forecast is created by estimating tomorrow's dust concentration and relaying that information to residents as they make their outdoor plans. The forecast categories are Good (0~30 $\mu\text{g}/\text{m}^3$), Normal (31~80 $\mu\text{g}/\text{m}^3$), Potential Irritation for Sensitive Persons (81~121 $\mu\text{g}/\text{m}^3$), Poor (121~200 $\mu\text{g}/\text{m}^3$), Very Poor (201~300 $\mu\text{g}/\text{m}^3$) and Dangerous (300 $\mu\text{g}/\text{m}^3$ ~). The forecast is disseminated using the forecast computer systems after referring to the weather forecast by the Korea Meteorological Administration and verifying its accuracy. Detailed forecasts are also released at regular times (morning, mid-day, evening and midnight) when average concentration over 2 hours is estimated to be higher than "Potential Irritation for Sensitive Persons." If the fine dust concentration is higher than a certain level, a warning or alarm is issued that advises people to stay indoors, abstain from driving, or cease construction work that generates dust. City workers may also be advised to wash down the roads with water and schools to close.

<Table 6> Criteria for Issuance & Cancellation of Fine Dust Warnings & Alarms

	Issued When	Cancelled When
Warning	Fine dust concentrations are higher than $200\mu\text{g}/\text{m}^2$ per hour, averaged over 2 hours	Fine dust concentrations fall to lower than $100\mu\text{g}/\text{m}^2$ per hour on average
Alarm	Fine dust concentrations are higher than $300\mu\text{g}/\text{m}^2$ per hour, averaged over 2 hours	Fine dust concentrations fall to lower than $200\mu\text{g}/\text{m}^2$ per hour on average

Waste Management

Main Waste Management Projects by Period

Waste management in Seoul is largely divided into construction of treatment facilities, separating recyclables and food waste from regular trash, introduction of a volume-based waste fee system (VBWF) and promotion of reuse.

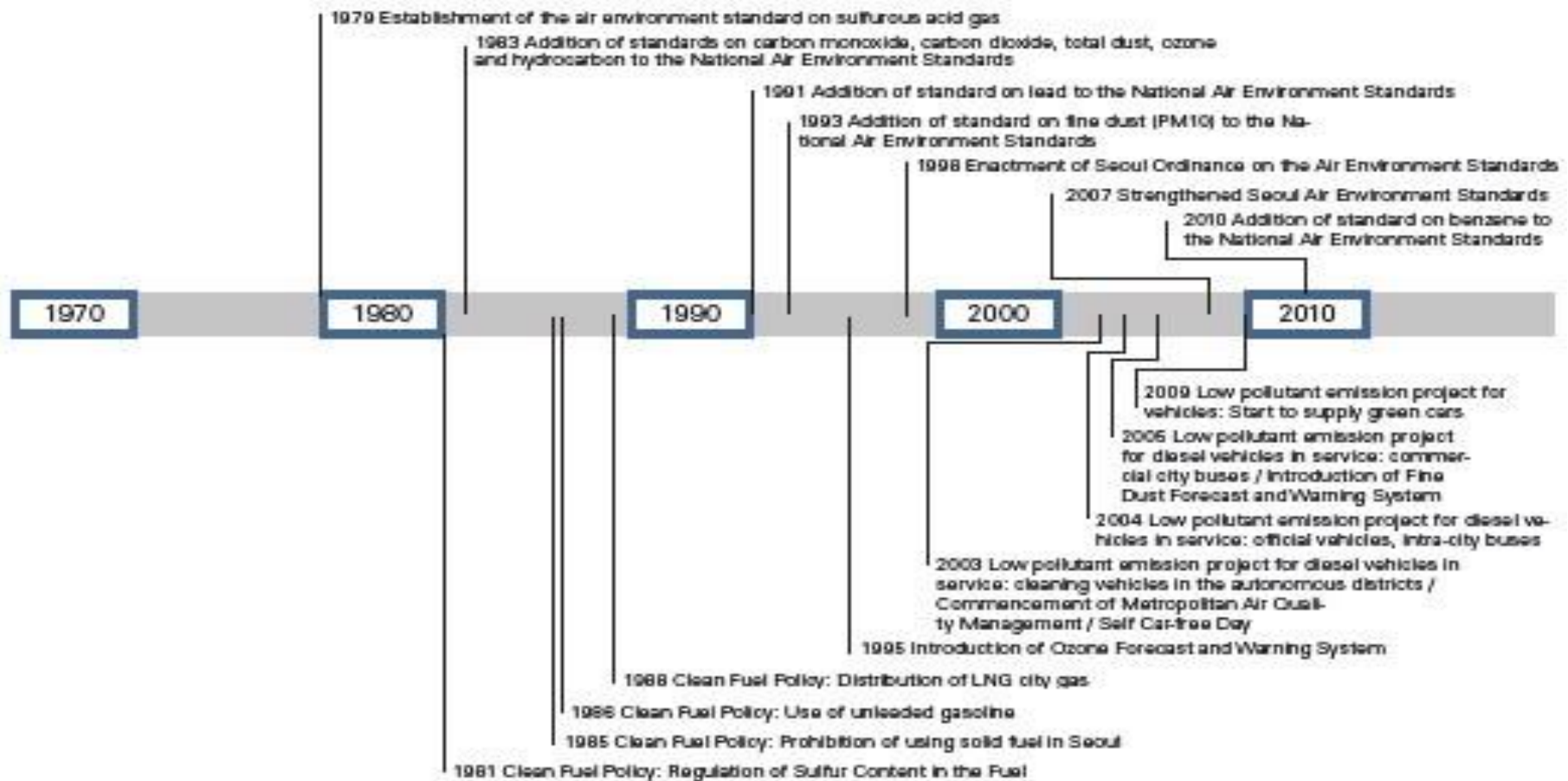
The first waste handling facility in Seoul was the Nanji Landfill, used from 1978 to 1993. Since 1993, waste has been handled at a joint metropolitan landfill site in Incheon, jointly constructed by the central government and the SMG. The first waste

incineration facility with high-tech features was Yangcheon Incinerator, constructed in 1996. Since then, Nowon facility was finished in 1997, Gangnam in 2001 and Mapo in 2005. While Mapo facility was built to handle household waste from Mapo-*gu*, Jung-*gu* and Yongsan-*gu*, the other 3 have processed household waste from neighboring autonomous *gu*-districts only since 2007, at which time the Mapo facility also expanded its coverage.

The collection of recyclables in Seoul began in 1990 from apartment complexes before being extended to single-family homes and commercial sites. At the beginning, significant amounts of garbage were mixed in, so the SMG introduced the VBWF system. Fees are levied according to the amount of waste produced, while the collection of recyclables remained free. The VBWF system contributed much to the acceptance of the need to separate recyclables properly. However, other problems soon appeared: there was enough perishable food waste from the recyclables to contaminate water and create strong odors in the facility vicinities, and it was difficult to find sufficient demand for the recyclables, as their supply increased remarkably in a short time. Food waste was then banned from landfills in 2005, and was collected separately. The Expanded Producer Responsibility system, introduced in 2003, helped increase the demand for recyclables.

In addition, Seoul opened a "sharing marketplace" in 2003 to support the exchange of second-hand goods, and began a metal recycling project in 2009 to handle metals and plastics, etc. from disassembly of small home appliances and devices such as mobile phones, electric fans, and landline telephones.

<Figure 13> Main Waste Management Projects by Period



Construction & Shared Use of Incineration Facilities

In 1991, Seoul established plans to construct 16,500-ton capacity incineration facilities in 11 locations around the city. In 1992, a project was commenced to construct 4 of them over 13 years: Yangcheon in 1996, Nowon in 1997, Gangnam in 2001 and Mapo in 2006. The total processing capacity of the 4 facilities were 2,850 tons per day.

However, the utilization rate was very low. In 2005, Yangcheon operated at 33% of its daily operating capacity, Nowon at 19%, Gangnam at 24% and Mapo at 59%. Coverage was broadened from 2001 to include the neighboring autonomous *gu*-districts, from which Yangcheon, Nowon and Gangnam facilities began to receive waste, while the Mapo facility, which had already been treating waste from Mapo-*gu*, Jung-*gu* and Yongsan-*gu*, began to receive from more autonomous *gu*-districts as well.

The key issue was gaining the consent of residents and consultative groups in the 4 regions hosting these incineration facilities. About 160 meetings were held with resident groups for the Gangnam facility until an agreement was reached on joint use on May 7th, 2007. It took 9 years to reach agreement on the joint use of Yangcheon facility. After having around 150 meetings with the resident groups for Yangcheon facility, the joint use of all 4 facilities had been agreed on by May 10th, 2010.

These agreements were a great achievement. First, the number of autonomous *gu*-districts using the 4 incineration facilities greatly increased. In spite of the completion of Gangnam and Mapo facilities, there were just 6 districts using them prior to these agreements. However, after they were signed, this number expanded to 20 districts by 2010. This again expanded to 22 districts by 2014, with Dongdaemun-*gu* joining in 2012, and Gwanak-*gu* in 2013. Operation rates improved from 19~59% (33%

average) in 2006 to 77~92% (85% average) in 2012.

<Table 7> Overview of Seoul's Incineration Facilities

	Yangcheon	Nowon	Gangnam	Mapo
Facility Capacity	400 tons/day (2 incinerators)	800 tons/day (2 incinerators)	900 tons/day (3 incinerators)	750 tons/day (3 incinerators)
Construction Period	Dec. 1992 ~ Feb. 1996	Dec. 1992 ~ Jan. 1997	Dec. 1994 ~ Dec. 2001	Dec. 2001 ~ May 2005
Area	14,627m ²	46,307m ²	63,813m ²	58,435m ²
Construction Cost	KRW 32.1 billion	KRW 74.3 billion	KRW 115.5 billion	KRW 171.2 billion
Type of Incinerator	Stoker	Stoker	Stoker	Stoker + Rotary Kiln
Air Purification Facilities	-Wash tower -Semi-dry reaction tower -Bag filter -SCR catalyst tower	-Electric precipitator -Wet wash tower -Bag filter -SCR catalyst tower	-Wash tower -Semidry reaction tower -Bag filter -SCR catalyst tower	-Semi-dry reaction tower -Bag filter -SCR catalyst tower -Police filter

Subsidiary	-Swimming pool	-Swimming pool	-Swimming pool	-Sauna
Facilities	-Fitness center	-Fitness center	-Fitness center	-Fitness center
	-Reading room	-Cultural lecture room	-Cultural lecture room	-Driving range
	-Auditorium	-Reading room	-Reading room	-Reading room

Separate Collection of Recyclables

The waste generated by households is separated for disposal into household waste and recyclables. Clothing or other items may be added depending on the region. Recyclables are further divided into paper packs, glass bottles, metal cans (made of steel, aluminum or other materials) and synthetic resins (plastic, PET bottles and Styrofoam) on which there are separate disposal marks according to government guidelines. The SMG added used clothing and bedding to the recyclable category and began collecting them from March 1999.

Recyclables are to be discarded in transparent plastic bags and put in front of the door of each household for collection on specified dates and times designated by each autonomous *gu*-district. The autonomous *gu*-districts collect 10~15% of all recyclables in Seoul, while 85~90% is reportedly collected by private companies. Besides in front of household doors, most of the discarding locations are designated. In Seoul, apartment complexes use designated locations while most non-apartment households place their recyclables in front of their doors.

The collected recyclables are then transported to sorting facilities and divided into paper, plastic, glass, metal and debris. They are then sold and the debris incinerated or buried in landfill. Fourteen sorting facilities are operated by the autonomous *gu-*districts, while others are operated on consignment by private companies. The Expanded Producer Responsibility program introduced in 2003 has contributed greatly to ensuring sufficient demand for low-value items such as plastic containers. Under the program, producers must collect some of their packaging materials, with the obligatory amount increasing each year.

Scrap Metal Recycling Project

Seoul began its scrap metal reuse project on June 11th, 2009, which was the first such program in the nation. Using this as momentum, the Ministry of Environment, the Ministry of Trade, Industry and Energy and other ministries announced policies on scrap metal recycling. To implement its own policy, Seoul revised the Ordinance on Waste Management in June 2009 to remove the disposal fee for used small home appliances. It also supplied 6,165 collection boxes exclusively for these small appliances in community centers and apartment complexes. Occupants of detached housing were allowed to put their small appliances in front of their doors on the day designated for recycling.

Seoul handled 8,820 tons of discarded home appliances and 1.41 million discarded mobile phones from 2009 to December 2012. These items were disassembled and the materials sold for KRW 6.968 billion, of which KRW 758 million was donated to the Community Chest of Korea and the Seoul Scholarship Foundation. Seoul established the Seoul Resource (SR) Center to process discarded home appliances and mobile phones, and offered stable employment to 53 people from socially

disadvantaged groups, such as those with disabilities and the homeless. Discarded home appliances and mobile phones are collected through joint campaigns with the autonomous *gu*-districts, and the SR Center disassembles them primarily by type of material, which it sells to metal resource collection companies. Rare metals and other valuable components of mobile phones are collected through a melting process after detaching the batteries.

<Table 8> Overview of the Seoul SR Center

	Description
Location	(Within the car service center) 73-36 Songjeong- <i>dong</i> , Seongdong- <i>gu</i> , Seoul
Building Area	Ground Floor: 810 m ² (general steel frame structure)
Purpose of Building	Workspace, warehousing, offices, meeting rooms, lounges, shower facilities, etc.
Processing Capacity	3,600 tons of discarded home appliances/year 700,000 used mobile phones/year
Employed	53 people in total (19 low-income, 6 with disabilities, 3 single parents, 7 homeless, 6 retirees, 12 others) ※ Authorized as a social enterprise by the Ministry of Labor in December 2011

Results

Parks & Landscape

Parks & landscape policies of Seoul are implemented in two axes: ecological conservation and expansion of parks & landscape. Seoul created Hangang Park, World Cup Park, Seoul Forest and Dream Forest Park in northern Seoul, among others, as part of its decision to increase the city's park area, which expanded around 12% (152 km² in total area to 170 km²) between 1995 and 2011. The share of Seoul made up by park areas increased about 4% during the same period, from 24.2% in 1995 to 28.1% in 2011.

<Table 9> Results of Park & Landscape Management in Seoul

	1995	2002	2005	2009	2011
Seoul's Total Area (km ²)	627	605	605	605	605
Parks Area (km ²)	152	158	164	169	170
Parks Area (% of Seoul)	24.2	26.1	27.1	27.9	28.1

Water Quality

Waterways in Seoul consist of the Hangang (River) and several tributaries flowing into it. Therefore, the water quality of the Hangang going through Seoul depends on its quality before it reaches Seoul, the water quality of the tributaries flowing into the Hangang and the water quality of effluent water from the 4 sewage treatment plants. Since the 1990s, the central government has worked to improve the Hangang and its tributaries in terms of water quality, in cooperation with the autonomous *gu*-districts along the Hangang and non-governmental water quality monitoring organizations. However, it has not been easy, as shown in Jamsil, which had a BOD content of 2.0 mg/L in 1995 and 1.9 mg/L in 2008. Thanks to the step-by-step results of the advanced sewage treatment plant projects which began in 2007, however, water quality improved dramatically by 2011: in the Jamsil area and the upper region of the Hangang, BOD levels decreased to 1.1 mg/L; in the Noryangjin area, they lessened to 2.8 mg/L; and in the Gayang area, the lower region of the Hangang, they were 2.7 mg/L.

<Table 10> Biological Oxygen Demand (BOD) of the Hangang (mg/L)

	1995	2002	2005	2008	2011
Jamsil	2.0	1.8	1.4	1.9	1.1
Noryangjin	3.8	3.3	3.1	4.0	2.8
Gayang	4.4	3.4	2.9	3.6	2.7

Tap Water Production Capacity

Seoul's main concern regarding water supply projects in the 1990s was ensuring sufficient production facilities to supply water for residential, commercial, industrial and public uses (fire-fighting, etc.). In the 2000s, the main objectives were to reduce leakage, increase water flow rate (supplied amount/produced amount x 100) and produce high quality tap water. As a result, the water flow rate, which had been a low 61.9% in 1995 greatly improved to 93.5% by 2011. As efficiency improved, total production in 2011 needed to be only 66% of the amount produced in 1995. To increase water quality, the number of items for inspection more than doubled between 1995 and 2011, from 53 to 155.

<Table 11> Tap Water Management in Seoul

	1995	2002	2005	2008	2011
Production Amount (bil. tons)	1.81	1.379	1.278	1.211	1.187
Water Flow Rate (%)	61.9	79.2	88.0	91.7	93.5
No. of Items in Water Quality Inspections	53	105	145	145	155

Air Quality

To suppress emissions and improve air quality in the city, Seoul has implemented a variety of policies such as banning the use of solid fuels, improving fuel quality, lowering the emissions of diesel vehicles, and instituting a Weekly No-Driving Day. However, the remarkable achievement was in control of fine dust (PM₁₀), which was reduced from 68 $\mu\text{g}/\text{m}^3$ in 1997 to 41 $\mu\text{g}/\text{m}^3$ in 2012. Improvement with concentrations of nitrogen dioxide, however, was slower. Together with ultra-fine dust (PM_{2.5}), reducing nitrogen dioxide is likely to emerge as a new target in air quality management.

<Table 12> Air Quality in Seoul

	1997	2001	2005	2009	2012
Fine Dust ($\mu\text{g}/\text{m}^3$)	68	72	58	54	41
Sulphur Dioxide (ppm)	0.011	0.005	0.005	0.005	0.005
Nitrogen Dioxide (ppm)	0.032	0.037	0.034	0.035	0.030

Waste Management

The core areas of waste management in Seoul were construction of incineration facilities and expansion of recycling. The main

projects were the construction of 4 incineration plants and establishing their joint use with the neighboring autonomous *gu*-districts, separating recyclables before disposal through introduction of a volume-based waste fee system, and separate collection and recycling of food waste. As a result, the recycling rate, which had been 33.5% in 1997, significantly improved to 65% by 2012, while the incineration rate, which had been 4.6% in 1997, also improved to 27% by 2012 (with waste heat converted to usable energy). On the other hand, the frequency of landfill use dramatically decreased from 61.9% in 1997 to 8% in 2012.

<Table 13> Household Waste Management in Seoul

	1997	2001	2005	2009	2012
Recycling (%)	33.5	47.5	64.3	67.0	65.0
Incineration +Energy Recycling (%)	4.6	6.9	10.2	18.8	27.0
Landfill Usage (%)	61.9	45.7	25.5	14.2	8.0

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