

2050 Seoul Climate Action Plan



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June 2021



Seoul's climate has changed significantly over the past century. The average temperature in the city is on the steady rise, and the frequency and severity of extreme weather events, including heat and cold waves, are growing as well. Such abnormal weather conditions are frequently seen across the globe as well.

We, in Seoul, have long recognized the dangers of climate change and taken strong climate action. Since first joined the C40 Cities Climate Leadership Group in 2007, we have been furthering climate action along with C40 Mayors and cities. Seoul hosted the C40 Mayors Summit in 2009, where C40 Mayors agreed to make our concerted climate efforts more concrete. The Seoul Metropolitan Government Ordinance on Climate Change that began enforcement in January 2009 gave further impetus to our own climate action. Seoul announced “the Promise of Seoul to tackle climate change” in 2015.

More recently, in December 2020, Seoul unveiled our draft 2050 Climate Action Plan, developed to be compliant with the highest ambition of the Paris Agreement - limiting global warming to 1.5°C. Our goal is to reach carbon neutrality by 2050. We prioritize cutting emissions from building, transport, and waste that are responsible for 94% of the city's GHG emissions. We are also making our city greener by expanding urban forests to absorb emissions as well as accelerating our transition to renewable energy.

We know that attaining carbon neutrality by 2050 is not easy, but we will be able to achieve the target as a majority of our ten million citizens stand with us. They share our concerns about the global climate crisis and have long been working with us to reduce our carbon footprint.

We made sure that we incorporate the voices of our citizens into this 2050 Climate Action Plan. We have set up the Climate Action Forum by inviting experts and civic groups, conducted three public surveys, and had public consultations to do so. We will ensure that we continue to engage our citizens in implementing the 2050 Climate Action Plan. We will also work with our fellow C40 cities. Together, we will be able to overcome this climate crisis.

Thank you.

Oh Se-hoon
Mayor of Seoul



Why carbon neutrality by 2050?

The Paris Agreement adopted at the 21st Conference of the Parties of the United Nations Framework Convention on Climate Change (UNFCCC) in 2015 required all parties to keep the global temperature rise well below 2°C above pre-industrial levels and to pursue efforts to further limit the increase to 1.5°C. The Intergovernmental Panel on Climate Change (IPCC) Special Report on Global Warming of 1.5°C approved in Incheon in 2018 provided scientific evidence that the globe must reach carbon neutrality by 2050 in order to limit global warming to 1.5°C.

C40 Cities Climate Leadership Group (C40) requires its member cities to develop the Paris Agreement aligned climate action plan with its Deadline 2020 program. Seoul officially declared its commitment to the Deadline 2020 at the Global Climate Action Summit held in San Francisco in 2018.

Why cities?

The Paris Agreement recognized roles of local governments in climate action. C40 also highlights the impacts of climate action from cities, where more than half of the global population lives and 70% of energy-related greenhouse gases are emitted. Local governments that are closer to everyday lives of citizens than other levels of government can deliver substantial reductions in GHG emissions.

Local governments in the Republic of Korea are taking strong climate action. 226 primary local governments across the nation declared climate emergency in June this year. In July, 80 local governments, including Seoul (17 metropolitan and 63 primary local governments) jointly declared their commitment to carbon neutrality by 2050 by launching the Carbon Neutral Local Government Alliance.

In clear recognition of the critical roles cities can play in tackling climate change, Seoul has long been taking sustainable energy and climate actions since the One Less Nuclear Power Plant launched in 2010. However, Seoul notes that the grave threats posed by climate crisis requires more ambitious and decisive actions than before. This is why Seoul decided to become carbon neutral by 2050 and develop the 2050 Seoul Climate Action Plan.

1

Climate Change and Seoul

Seoul's climate has changed significantly over the past century. The city's annual average temperature and rainfall are on the rise and it is experiencing more frequent extreme weather events, such as heat waves, cold waves and tropical nights. The city's high level of density could mean the impacts of climate change would be more severe in the city than in other parts of the country.



Geography and Climate Trends

Seoul is the capital of the Republic of Korea. The city's area is 605km², 0.6% of the nation's area. The distance measured from Seoul's eastmost to westmost points is 36.78km and 30.3km from north to south. Seoul is surrounded by mountains, including Yongmasan, Deokyangsan, Gwanaksan, Bukhansan and the Hangang River crosses the center of the city, flowing from the east to west. Seoul has 25 administrative districts (Gu) and the city borders two metropolises, the city of Incheon and Gyeonggi-do Province.

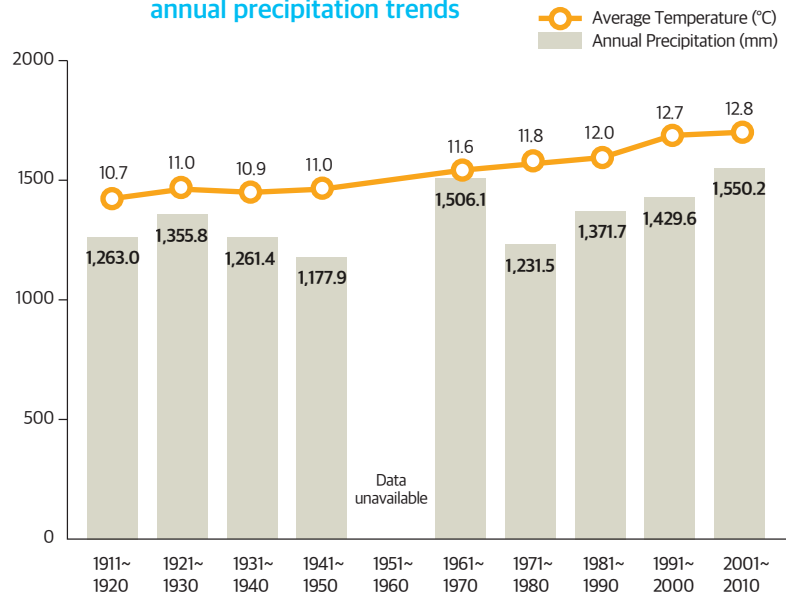
Seoul's climate has shown significant changes over the past century. The city's average temperature between 2001 and 2010 recorded 12.8°C, which is an increase of about 2.1°C compared to the figures between 1911 and 1920, and the 10-year average precipitation rose by 298.2mm during the same periods. Seoul is experiencing more frequent extreme weather events, such as extreme heat, cold waves and tropical nights.

If the current GHG emissions trends continue, Seoul's annual average temperature is predicted to rise by more than 4°C by the end of the 21st century. This means that Seoul's current average annual temperature of 12.8°C could be as high as 17.1°C by late 21st century (2071-2100).¹

Given the high level of density, the impacts of climate change are likely to become severe in Seoul than in other parts of the country.



[Table 1-1] Seoul's annual average temperature and annual precipitation trends



Source: Regional Climate Change Report (Seoul), KMA, 2011

Footnote 1. Seoul Climate Change Forecast Report (Korea Meteorological Administration, 2018)

Demographic and Household Trends



Seoul's population is about 10 million as of 2018, but it is estimated to decline by 16% by 2050 due to low birth rates. Also, the ongoing population aging is expected to bring major changes to population compositions per age group. In 2018, the ratio of people aged 65 and older was 14%, but it is projected to rise up to 39% by 2050, while the rate of children aged five and younger is estimated to shrink from 3.5% in 2018 to 2.7% by 2050.

Such demographic changes have complex impacts on energy consumption. Low birth rates, and ageing population could lead to lower demand for energy. The elderly in general show weaker economic activities than other age groups, and thus have lower needs for mobility and tend to consume less household energy. Also, greying population could increase the number of the vulnerable to the impacts of climate change.

The increase in single-person households could partially offset the reduced household energy consumption from low birth rates and ageing. According to the Statistics Korea, the ratio of single-person households in Seoul is estimated to grow from 31% in 2018 to 37% in 2050. As a general rule, regardless of the number of persons in a household, each household needs to consume certain levels of energy for necessities, such as heating, cooling, and operating basic household appliances. Therefore, if other conditions stay the same, the increase in single-person households could lead to higher energy consumption.

[Table 1-2] Forecasts of major population and household indicators

Indicators	2018	2050
Population	9,705,000	8,140,000
Rate of Ageing (65+)	13.9%	38.7%
Number of Households	3,792,000	3,604,000
Ratio of Single-Person Households	31.3%	37.1%

● Major Indicators and contents are based on 'The Long-term Strategy and Sectoral Approaches of Seoul for Achieving Carbon Neutrality by 2050' (Seoul Institute, 2020)

Economic Trends

Seoul’s economy is expected to keep growing centered around the service sector. However, the annual average growth forecast for 2050 is 1.8%, which means that the city is entering an era of long-term low-growth. The proportion of the service sector is predicted to rise from 91.2% in 2018 to 92.5% in 2050.

While energy demand from the manufacturing sector is expected to fall, that of the service sector is forecasted to rise substantially. Apart from the service sector’s growth, the digital economy, driven by the Fourth Industrial Revolution, is projected to significantly expand. Demand for emissions measurement networks, ICT facilities and data center will increase and these changes will further accelerate the electrification of buildings. Despite these transformations, power demand management using the Internet of Things (IoT) could reduce the increase in energy consumption.

In spite of economic growth, per capita vehicle-ownership is unlikely to rise significantly due to such factors as traffic congestion and ageing population.



[Table 1-3] Forecast of major indicators on economic structures

Indicators	2018	2050
Per Capita GRDP	33,000 USD	70,000 USD
Service Sector Share	91.2%	92.5%
Per Capita Vehicle Ownership	0.33 Vehicles	0.35 Vehicles



The devastating damage caused by the COVID-19 pandemic has exposed how unprepared humankind was for such a global shock. Unfortunately, the impacts of climate change would be far worse. It is critical that cities prepare for future shocks, including public health and climate crisis, and increase the resilience of their basic services and infrastructure. Strengthening the social safety net is also vital

Social Trends

because the disadvantaged groups are more vulnerable to threats from the climate crisis as well as infectious diseases.

COVID-19 has triggered an array of changes in many aspects of the society. Remote working and distance learning are expanding and demand for remote healthcare is on the rise as well. COVID-19 is working as a catalyst to accelerate the transformation into a digital society. In the meantime, growing non-face-to-face activities, such as work-from-home and distance learning, could lower commercial and transportation energy demand and raise higher household energy consumption. An increasing number of data centers driven by the growing information industry could increase energy consumption from the commercial sector. Given such trends, cities should consider further encouraging remote working and distance learning, and power data centers with renewable energy.

Another important social change includes growing action from businesses for clean energy, as shown by RE100. Also, investment in environmental social governance is likely to grow.

Furthermore, decentralized renewable energy sources are expanding, making local energy more important than ever. Strong citizen participation in local governance is needed to support such changes.

Greenhouse Gas Emissions

GHG emissions trends

GHG emissions in Seoul have been on the decline since the late 2000s. The city's total emissions in 2018 was 47,073 ktCO₂eq, down 4.8% from 49,445 ktCO₂eq in 2005.

Energy accounted for about 91% of the total emissions in 2018; waste 6.1%; Industrial Processes and Product Use (IPPU) 3.3%. Agriculture, Forestry and Other Land Use (AFOLU) absorbed 53 ktCO₂eq of GHG emissions.

Building and transport take up the majority of GHG emissions from energy consumption at 68.8% and 19.2% respectively.

Meanwhile, electrification of energy sources are accelerating, which in turn increases the proportion of indirect emissions (Scope 2) to the total footprint. More specifically, indirect emissions accounted for 39.9% of the total emissions in 2005, but they rose to 50.9% in 2018.

Methodology for GHG emissions inventory

In accordance with the Seoul Metropolitan Government Ordinance on Tackling Climate



Change, Seoul has commissioned calculation and verification of GHG emissions within its administrative boundaries to a professional organization since 2010.

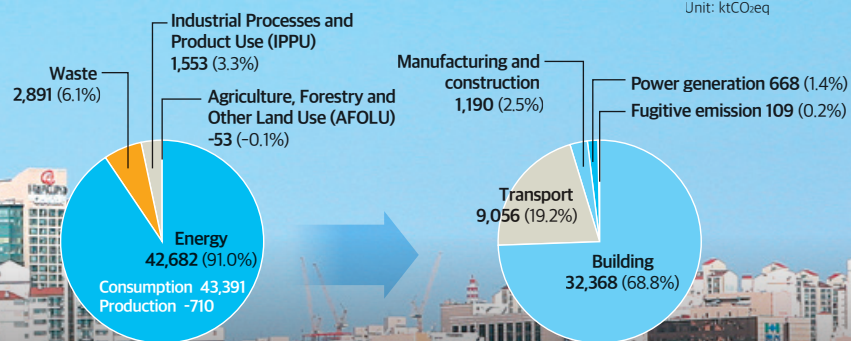
The Local Autonomous Government Greenhouse Gas Emissions Calculation Guideline by the Ministry of Environment and Korea Environment Corporation is used to calculate Seoul's GHG emissions, and the guideline is based on the 2006 IPCC Guidelines for National

Greenhouse Gas Inventories and other IPCC'S GHG emissions calculation methodologies.

Based on the aforementioned guidelines, the city calculates emissions of six main greenhouse gases (CO₂, CH₄, N₂O, HFCs, PFCs, SF₆). It covers Scope 1 and Scope 2 emissions and absorbed emissions. It also includes GHG emissions from waste treated outside the city.

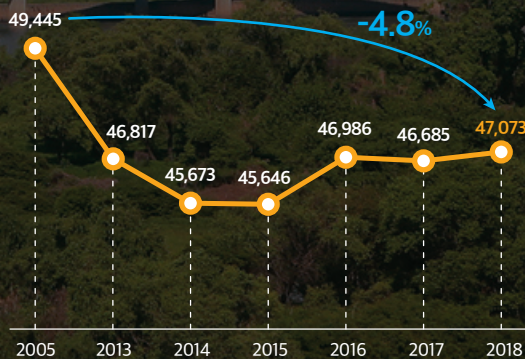
[Figure 1-1] GHG emissions by sector in Seoul (2018)

Unit: ktCO₂eq



[Figure 1-2] City-wide GHG emissions by year

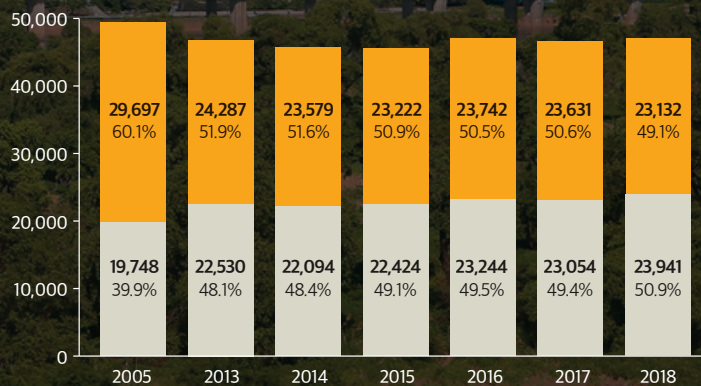
Unit: ktCO₂eq



[Figure 1-3] Direct and Indirect GHG Emissions by year

Unit: ktCO₂eq

Direct Emissions (rate)
Indirect Emissions (rate)





How Seoul Developed the 2050 Seoul Climate Action Plan

Current climate actions by Seoul and the central government are not sufficient to attain the ambitious carbon neutrality target. Transformative as well as holistic actions are necessary.



Highlights of Seoul's Climate Action

Hosting the 3rd C40 Mayors Summit

2009

C40 LARGE CITIES CLIMATE SUMMIT
SEOUL 2009



Phase 1 of One Less Nuclear Power Plant

2012



Phase 2 of One Less Nuclear Power plant

2014

Promise of Seoul announced at the ICLEI World Congress 2015 held in Seoul

2015



Solar City Seoul Master Plan

2017



Progress on climate action by Seoul

● One Less Nuclear Power Plant(2012~2020)

SSeoul first launched the One Less Nuclear Power Plant policy in 2012, which aimed to reduce energy demand and expand renewable energy production.

The initial target was to reduce energy use by 1GW, equivalent to the output of a nuclear power plant, in order to proactively tackle energy crisis and climate change. The city began the second phase of the policy in 2014 with the aim to produce and save 6,500,000 TOE of energy, equivalent to 3.25 nuclear power plants' output, and increase the city's energy independence rate to 20%.

The combined target of the first and second phase of the policy was to generate and save 6.5 million TOE of energy, and in fact the city

reached this target in 2020 with 6.87 million TOE of energy produced and saved.

However, the city missed the energy independent target by only reaching 13.9%. Key reasons for this include growing energy demand by commercial buildings, insufficient space for solar PV power generation and low profitability of fuel cell power.

This requires more aggressive building energy demand control measures, such as the introduction of GHG emissions cap for buildings. On the supply side, additional incentives to expand solar PV power generation by private buildings and improving economic feasibility of renewable power generation are needed down the road.

Though this policy was completed in 2020, its 25 measures that are still relevant are included in this climate action plan, such as building energy



efficiency improvements and the Eco-milage Program.

● Promise of Seoul (Since 2015)

Seoul announced the Promise of Seoul: Taking Actions against Climate Change in 2015, setting a target to cut GHG emissions by 40% by 2030 from the 2005 levels. The city combined it with its Climate Change Masterplan and took 89 climate actions by 2019. Seoul’s GHG emissions fell by 4.8% in 2018 from the 2005 levels, which is insufficient to achieve the 2030 target. Given that the national GHG emissions during the same period grew 29.7%, it could be said that Seoul’s climate efforts somewhat paid off.

However, Seoul found the limits in cutting building emissions as it lacked regulatory means to control emissions from existing and new buildings, where it is going to tighten the measures.

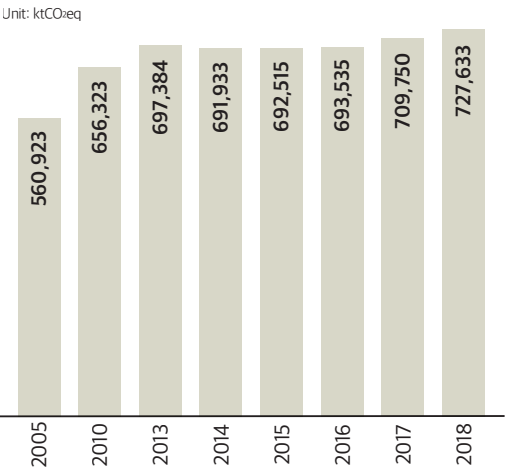
● Solar City Seoul (Since 2017)

In order to further expand solar PV capacity with the ‘Solar City, Seoul’ project, Seoul has also put in place seven major tasks and 59 projects. The total installed solar power capacity in 2019 was 250.1MW, ten times as high as the cumulative capacity of 22.6MW in 2011.

However, investment in solar PV has recently shrunk as its profitability weakened. That’s why Seoul actively seeks to expand its support for new solar technologies, such as Building Integrated Photovoltaics.



[Figure 2-1] National GHG emissions

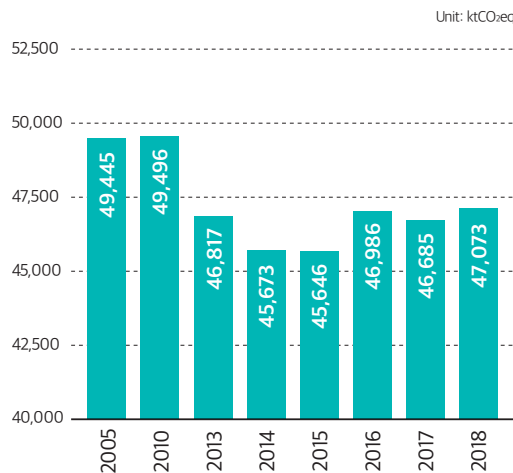


[Table 2-1] Installed Solar PV capacity in Seoul (Cumulative total, 2003-2019)

Total (Unit: MW)	Public	Schools	Private			
			Sub total	Balcony	Residence	Buildings
250.1	66.4	31.6	152.1	33.2	40.6	78.3



[Figure 2-2] City-wide GHG emissions



Climate action by the central government

The Korean government enacted the Framework Act on Low Carbon, Green Growth in 2010 as a legal basis for climate action, and introduced the Emissions Trading Scheme in 2015. In June 2015, the central government submitted its Nationally Determined Contribution (NDC) to the

UNFCCC to reduce GHG emissions by 37% from the business-as-usual (BAU, 850.6 MtCO₂eq) level by 2030. The target was later readjusted to a 24.4% reduction by 2030 from the 2017 levels with the amendments in 2019 to the Framework Act on Low Carbon, Green Growth.

In July 2020, the Korean government unveiled its New Deal, which includes Green New Deal. President Moon Jae-in declared in October that the country would go carbon neutral by 2050. The national government submitted its long-term low emissions development strategies (LEDS) to the UNFCCC in December 2020. However, a detailed roadmap on how the government is going to achieve this target is yet to be released.

Current policies - limitations and future directions

Current policies of the city and the central government are not sufficient to attain the ambitious carbon neutrality target. An integration of existing GHG emissions reduction policies and transformative new measures are necessary.

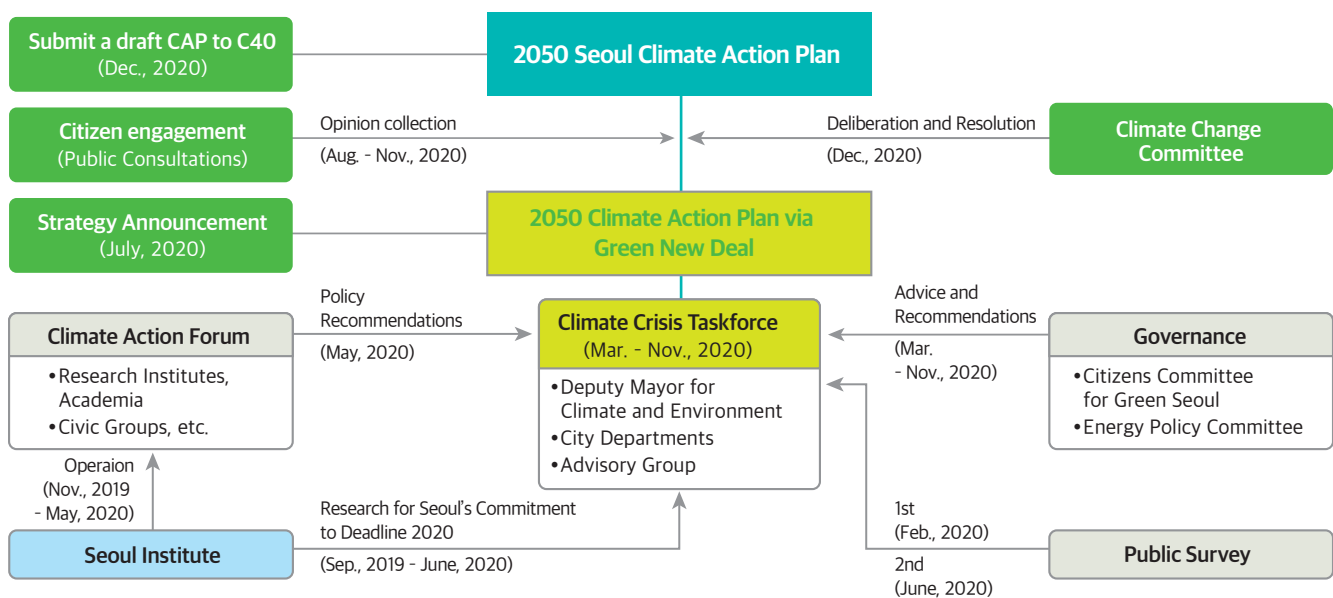
The public sector must lead in taking innovative measures and promote the private deployment of new technologies that are currently struggling due to weak infrastructure.

As for the private sector, fundamental changes to the regulatory scheme are required. The city has long encouraged citizens' voluntary reduction efforts, but has failed to maximize reductions because there was no legislation mandating energy efficiency management by large-scale buildings. Therefore, the city needs to take both regulatory and incentive measures for each sector of building, transport, energy and waste.

In order to ensure implementation of its measures, Seoul also needs to establish a system to holistically respond to climate crisis and embed climate change across the city government.

Development of the 2050 Seoul Climate Action Plan

How Seoul has developed its 2050 Climate Action Plan



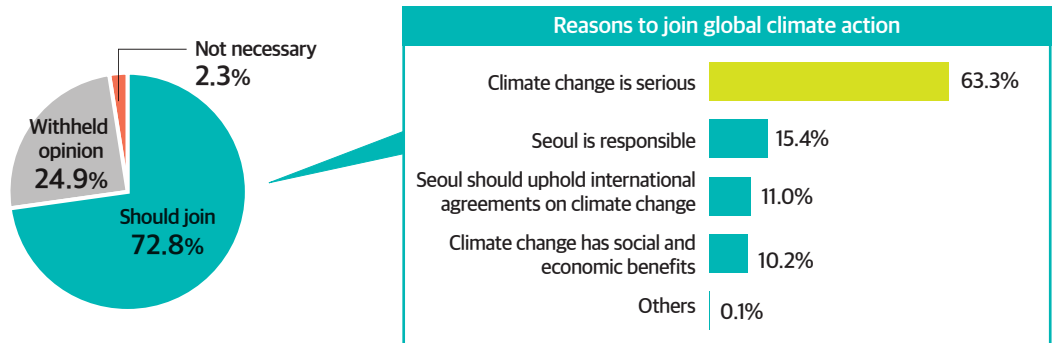
Climate Action Forum and Seoul Institute

The Seoul Metropolitan Government established the Climate Action Forum, consisting of 25 members from academics, civic groups and experts to identify effective measures and

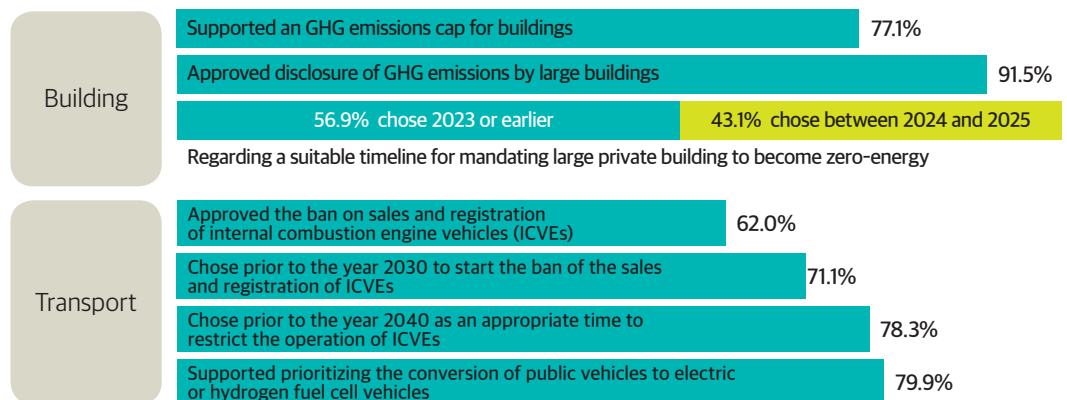
policies to be included in the 2050 Climate Action Plan. The Climate Action Forum was launched in November 2019 and held 16 meetings until May 2020 to propose 11 strategies and 28 major policies in four sectors – building, transport,



[Figure 2-3] Key results of the 1st survey



[Figure 2-4] Key results of the 2nd survey



waste and energy.

The Seoul Institute conducted the research from September 2019 to June 2020 to help Seoul develop the 1.5°C compliant climate action plan. The institute developed Seoul's GHG emissions pathways by 2050 and proposed key reduction measures to achieve the target, among others.

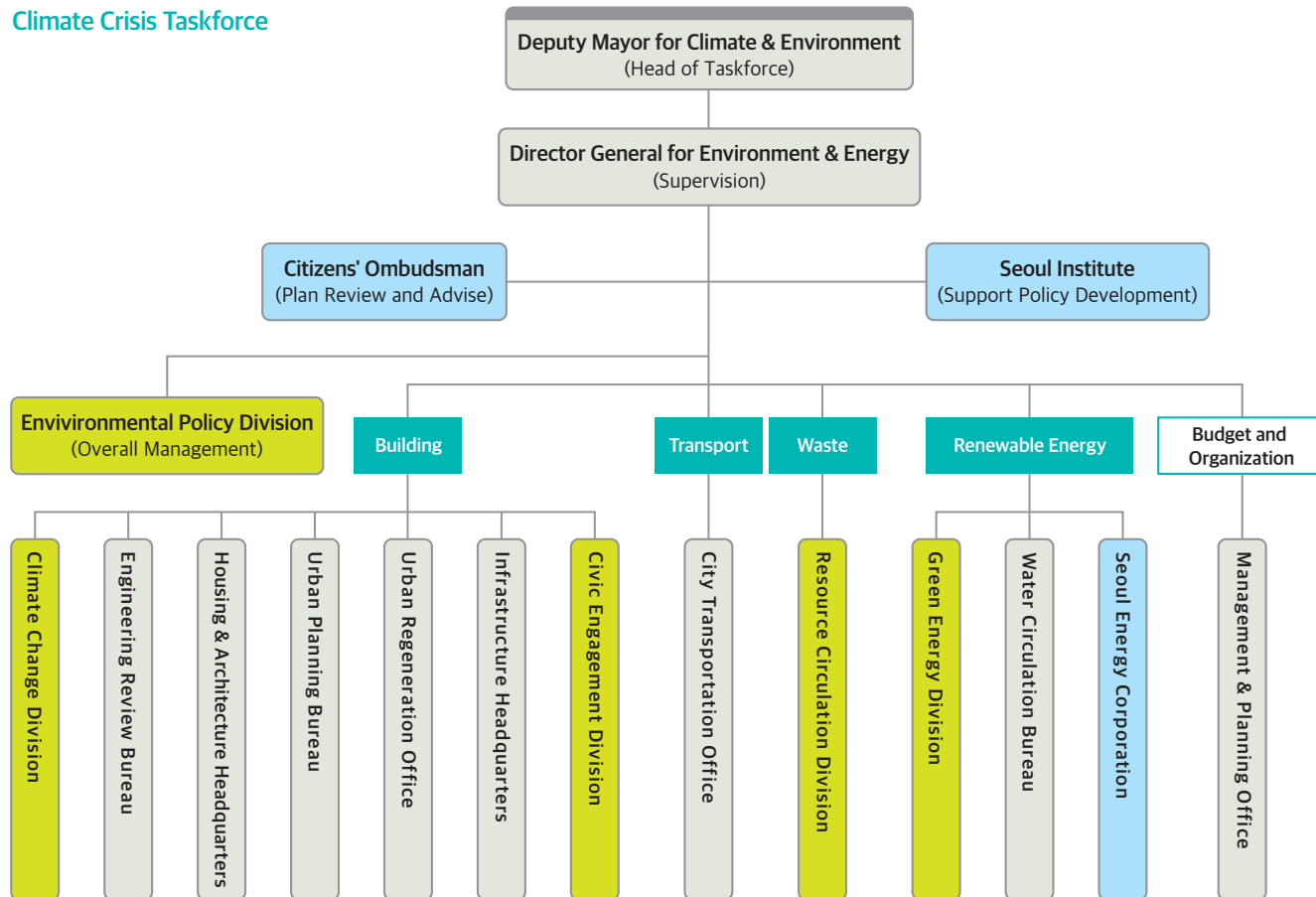
Public Consultation

Prior to developing the 2050 Climate Action Plan, Seoul conducted two online public surveys. The first survey conducted in February 2020 asked 1,200 citizens about their awareness of climate

crisis and the need for climate action. 92% of the respondents agreed that climate change is serious and 72.8% agreed that Seoul should join global efforts to tackle climate change. Also, 81.7% responded that Seoul needs to cut GHG



Climate Crisis Taskforce



emissions by over 80% at least.

The second survey asked 1,000 people about key GHG emissions policies in June 2020. The result of the survey is as shown in [Table 2-4]. Seoul incorporated the public opinions into the 2050 Climate Action Plan.

Climate Crisis Taskforce

In March 2020, Seoul set up the Climate Crisis Taskforce made up of related city government departments for indepth review of proposals and recommendations put forward by the Climate Action Forum and the Seoul Institute. Along with

a general meeting, taskforce meetings took place for each sector of building, transport, energy and waste. Each department was encouraged to identify the best measures for their sector. Citizen Ombudsmen² were also asked to take part in the taskforce meetings to listen to the opinions of citizens and experts.

12 Taskforce meetings were held until July, when the city first unveiled its Green New Deal strategy for the 2050 Climate Action Plan and 11 additional meetings were held afterwards to further discuss and prioritize sectoral measures, and explore best ways to implement them.

Footnote 2. Citizen Ombudsmen launched in 2019 are comprised of GHG emissions reduction experts.



Public launch of Green New Deal

In July 2020 Seoul had a press conference to publicly announce its Green New Deal, a strategy for 2050 carbon neutrality. The announced strategy was developed jointly with the Climate Action Forum, the Seoul Institute, and the Climate Crisis Task Force. At the press meeting, the city presented how the strategy would be developed into a 2050 climate action plan and how it is going to reflect public opinions in the plan.

Development of the Final 2050 Seoul Climate Action Plan

● GHG Emissions Reduction Metagovernance

Seoul set up the GHG Emissions Reduction Metagovernance following the July announcement to build a public consensus on the 2050 Climate Action Plan and ensure the

plan's implementation. The metagovernance's responsibility is to develop detailed action plan for emissions reduction. It consists of thirteen members from the Seoul Metropolitan Government, Seoul Metropolitan Council, heads of ten governance committees, including the Citizens Committee for Green Seoul, Energy Policy Committee, Construction Committee and Transport Committee, among others.

● Green New Deal Forum

The Seoul Institute hosted Green New Deal Forums six times to gather opinions from civil groups and experts on major policies to be included in the Seoul Climate Action Plan. Topics covered at the forums



include Green New Deal and the role of local governments in green new deal, and green new deal measures in forestation, resource circulation, energy, transport, and building.

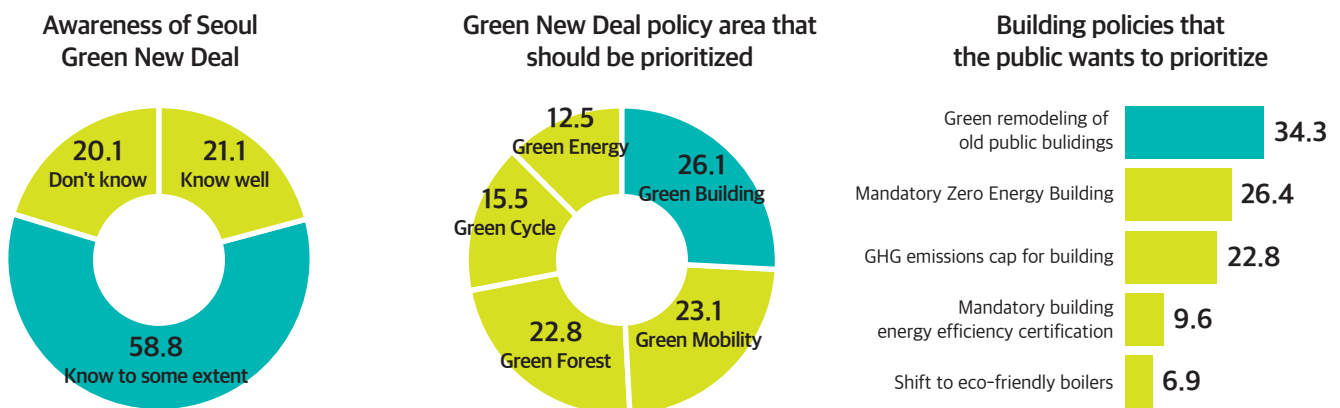
● Green New Deal Public Consultation

Seoul had public consultations to listen to citizens' opinions on its Green New Deal strategies announced in July and incorporate them into the final climate action plan.

22 administrative districts each hosted public forums to gather opinions of civil servants and citizens, and conducted surveys on Seoul's green new deal policies to see citizens' level of policy awareness and preferences. Based on the results, Green New Deal public consultation was held in October 2020 and the collected public opinions at the meeting have been reflected into this 2050 Seoul Climate Action Plan.



[Figure 2-5] Key results of the 3rd survey (Unit: %)

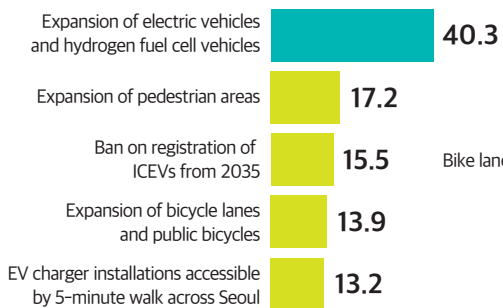




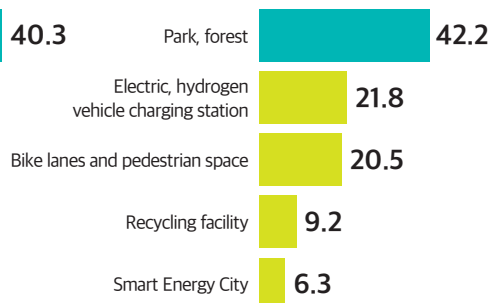
Green New Deal Forums hosted by district offices



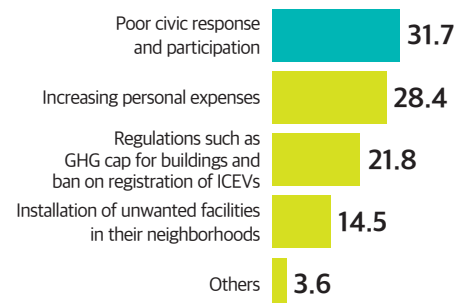
Transport policies that the public wants to prioritize



Installations that the public wants in their neighborhood



Concerns about Green New Deal



3

How Seoul is Accelerating Its Climate Change Targets

Seoul laid out its vision as a sustainable city, where people, nature and future co-exist and set itself a target for carbon neutrality by 2050 to join the global efforts to keep global warming to 1.5°C.



GHG Emissions Reduction Target

Carbon neutrality by 2050

Seoul laid out its vision for the city as a sustainable city, where people, nature and future co-exist and set itself a target to reach carbon neutrality by 2050 to join the global efforts to keep global warming to 1.5°C.

While keeping its previous target for reducing emissions by 40% by 2030 from the 2005 levels, the city set new targets to achieve 70% reductions from the 2005 levels by 2040 and become carbon neutral by 2050. This will lead to per-capita emissions down from 4.7 tons in 2017 to 2.9 tons in 2030.

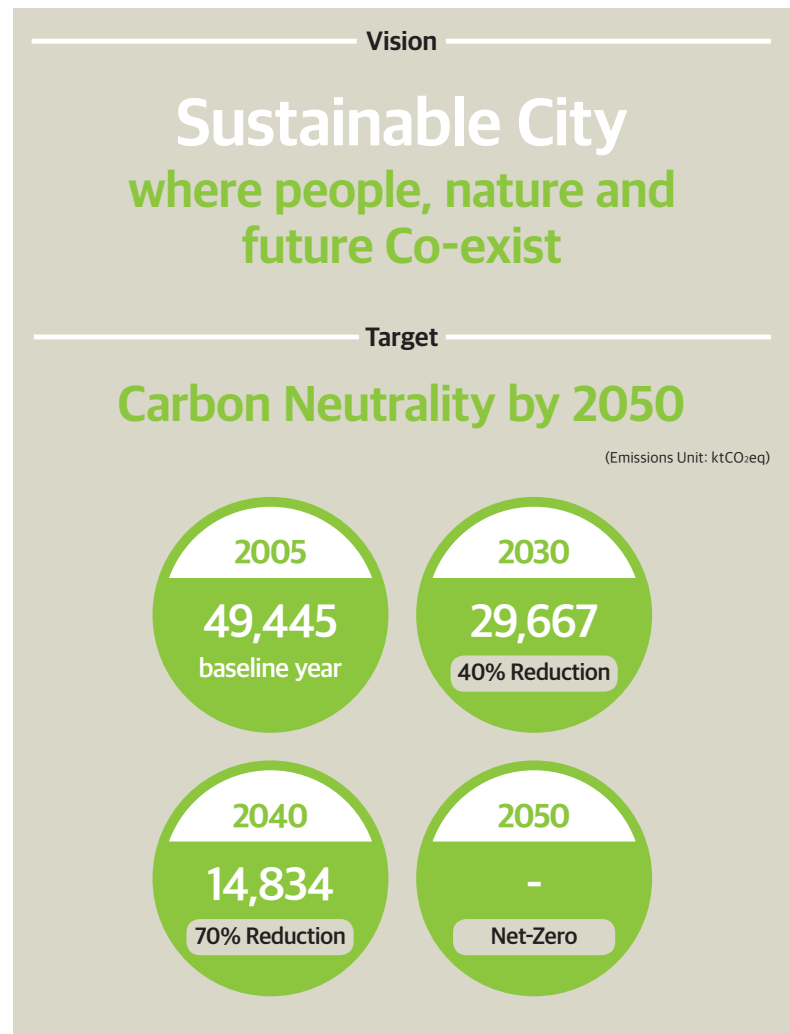
Even after Seoul's GHG emissions reduction measures are all taken by 2050, there will still be residual emissions. Seoul included such residual emissions in the emissions reduction scenarios when setting its targets.

Seoul plans to offset the remaining emissions through projects cutting emissions outside the city. Such carbon offset projects will begin in the mid-2030's and gradually expand afterwards.

Seoul is going to offset about 20% of its GHG emissions reductions needed to reach carbon neutrality by 2050 through carbon credits, among others. Seoul will make sure that its measures for carbon neutrality will be implemented as intended and keep track of residual emissions.

Methodology for Seoul GHG emissions pathways

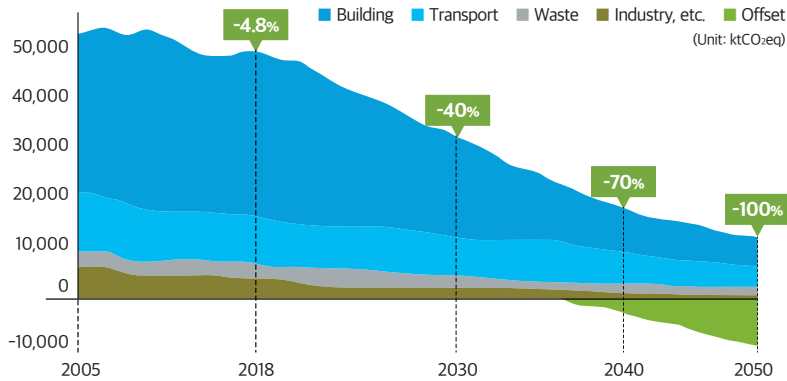
Seoul Institute established econometric models by each sector and summed the forecast values of



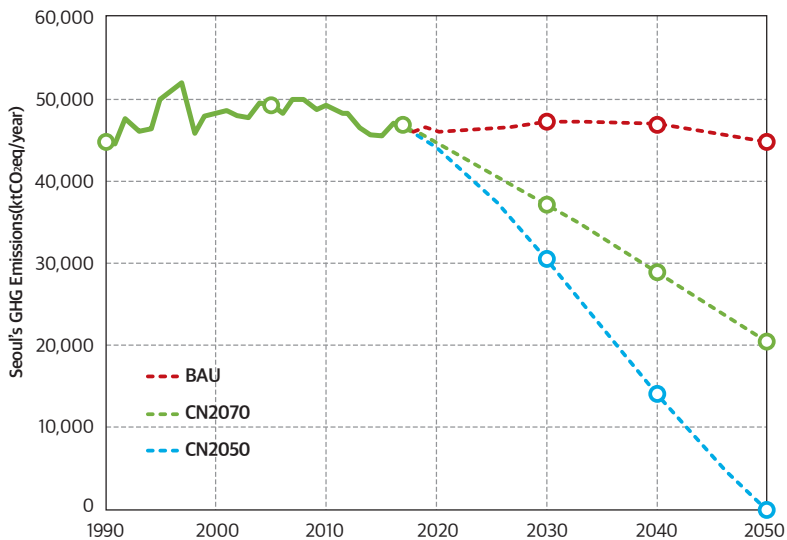
each sector to develop Seoul's long-term GHG emissions pathways.

For the energy sector, after forecasting energy demand via multiple regression analysis by each sector, GHG emissions were predicted

[Figure 3-1] Seoul GHG emissions pathways by sector



[Figure 3-2] Seoul GHG emissions pathways



[Table 3-1] Seoul's GHG emissions scenarios

Scenario	Characteristics	Methodology
BAU	Continue as is	Multiple regression analysis
CN2070	Carbon Neutral by 2070	Backcasting considering reduction potential per sector
CN2050	Carbon Neutral by 2050	Backcasting considering reduction potential per sector

by applying emissions factors for each energy source.

Major explanatory variables considered in the model include demographic structure, such as low birth rates, population ageing, growing single-person households; economic structure, such as gross regional domestic product (GRDP), per-sector GRDP, government spending, income, building stock; transportation trends, such as the number of vehicles, driving distance, mileage; climate trends, such as prices per energy sources, the number of cooling and heating degree days, and the number of days with heat waves and average temperatures. Three scenarios were made as shown in the [Table 3-1], to develop Seoul's long-term GHG emissions pathways.

The BAU scenario is calculated using multiple regression analysis under the presumption that past trends shall continue. The carbon neutrality 2070 scenario is based on Seoul committing itself to global efforts to limit the global temperature rise to below 2°C above to pre-industrial level.

According to the IPCC, the net GHG emissions (value obtained by subtracting the amount absorbed from the total emissions) must be zero by 2070 in order to achieve the 2°C goal. Carbon neutrality 2050 scenario is based on Seoul committing to the highest ambition of the Paris Agreement, limiting global warming to 1.5°C from the pre-industrial level.

The IPCC made it clear that GHG emissions must be net-zero by 2050 if we are to contain the temperature rise to 1.5°C. The two carbon neutrality scenarios have the explicit targets and clear timelines, so backcasting was used as a tool to develop GHG emissions pathways.

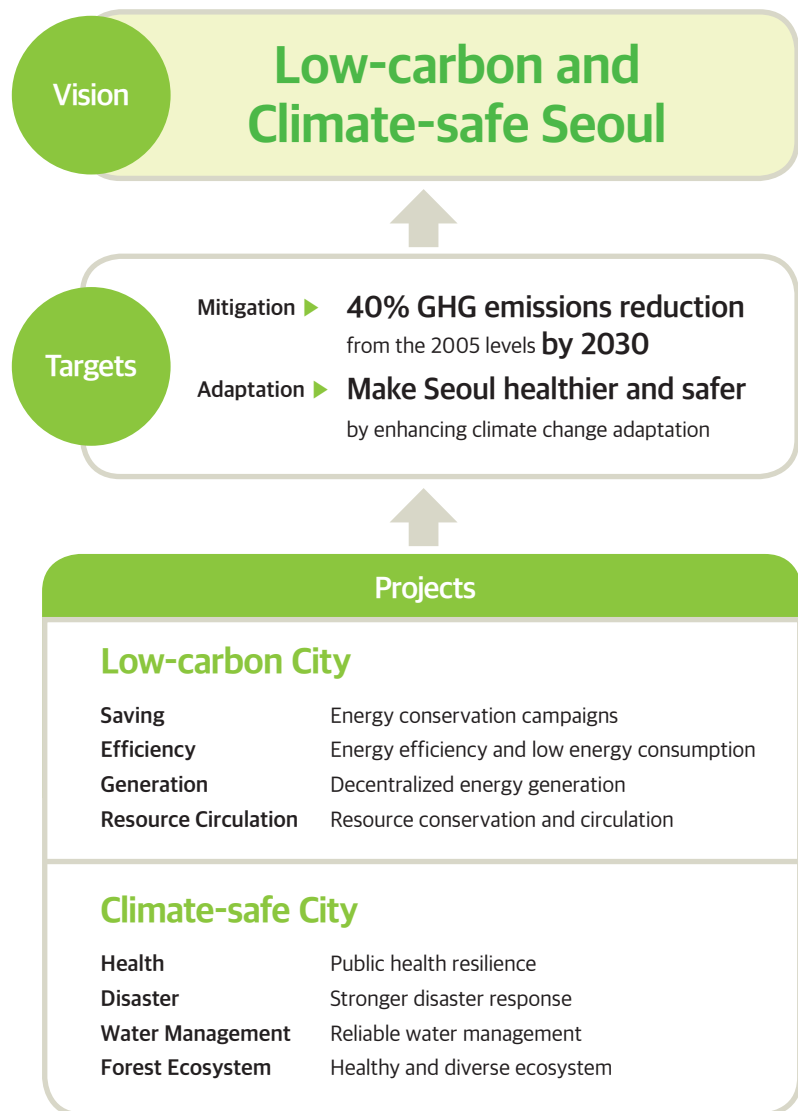
Climate Change Adaptation Target

Seoul is required to develop and implement a climate change adaptation plan every five year by the Framework Act on Low Carbon, Green Growth. Currently, the city has in place the second Climate Change Adaptation Plan (2017-2021). Also, Seoul has put in place Climate Change Masterplan (2017-2021), which includes both its mitigation and adaptation measures.

Seoul's target for adaptation is a healthier and safe city. By achieving both mitigation and adaptation targets, Seoul aims to become a low-carbon, climate-safe city.

Seoul is going to develop its Climate Change Adaptation Plan (2022-2026) and the Climate Change Masterplan (2022-2026) in 2021, when the city is going to set new adaptation targets for 2050 and assess climate risks.

Vision and targets for Seoul Climate Change Masterplan



Co-benefits of Carbon Neutrality by 2050

Air quality benefits

Many of the major air pollutants and greenhouse gases in Seoul overlap. Energy accounts for 91% of the total GHG emissions, while it also takes up a large proportion of air pollution in Seoul. More than 95% of precursors of PM2.5, such as nitrogen oxides, sulfur oxides, and black carbon, are emitted from the energy sector. Therefore, if Seoul achieves its carbon-neutrality

target by 2050, the city's air quality will be improved.

Air quality benefits that the city expects from attaining the 2050 carbon neutrality are shown in [Table 3-2]. Seoul will be able to cut GHG emissions 80% by 2050 from 2005 levels on its own and offset the remaining 20%. This way the city will reach carbon neutrality by 2050. Along the way, emissions of air pollutants, including

[Table 3-2] Air quality benefits from carbon neutrality by 2050

Policy	GHG emissions (above 2005 levels)	PM2.5 emissions (above 2016 levels)	NOx emissions (above 2016 levels)	SOx emissions (above 2016 levels)
BAU	-5%	-16%	-22%	7%
Carbon neutral	-100% (Offset Included)	-54%	-61%	-59%



[Table 3-3] Industrial economic benefits (Annual average)

Category		Seoul		Nationwide	
		Million KRW /year	Million USD /year	Million KRW /year	Million USD /year
Energy Sector	Production Inducement	17,947,246	16,310	35,019,141	31,824
	Added Value Inducement	5,546,019	5,040	10,020,442	9,106
	Employment Inducement	121,179 of Jobs /year		188,277 of Jobs /year	
Waste Sector	Production Inducement	41,401	38	66,298	60
	Added Value Inducement	18,609	17	25,315	23
	Employment Inducement	385 of Jobs /year		494 of Jobs /year	

nitrogen oxides, sulfur oxides and fine particulate matters are expected to fall by 50~60% from the 2016 levels by 2050.

Industrial economic benefits

Seoul's carbon-neutrality would have ripple effects on the industrial economy. To measure the effects, the interindustry analysis was used and Seoul's sectoral budgets and the input-output data provided by the Bank of Korea were used as input data.

The industrial economic benefits are as shown in the [Table 3-3]. The energy sector's carbon-neutrality measures are estimated to generate an annual average of 16.3 billion USD (17.9 trillion KRW) in production inducement and create an annual average of 121,000 jobs. From the waste sector, 37.6 million USD (41.4 billion KRW) worth production inducement and 385 job creations are expected.





[Table 3-4] Socio-economic benefits

Policy		Impacts			
		Average temperature rise (Compared to pre-industrial levels)	Health benefits	PM10 emissions	socioeconomic loss from climate change
A	BAU	4°C	Maintain the status quo	Maintain the status quo	6.4 billion USD (7 trillion KRW) per year
B	Carbon neutral	1.5°C	8% reduction in premature deaths	80% or more reduction	913 million USD (1 trillion KRW) per year

Socio-economic benefits

The Seoul Institute used the Contingent Valuation Method (CVM) on the results of the public surveys of 1,200 citizens to analyze socio-economic benefits. The analysis found that a Seoul citizen would be willing to pay a monthly average of 13.6 USD (14,954 KRW) for carbon

neutrality and the total socio-economic benefits to come from carbon-neutral policies were worth 1.36 billion USD (1.5 trillion KRW) on an annual average.



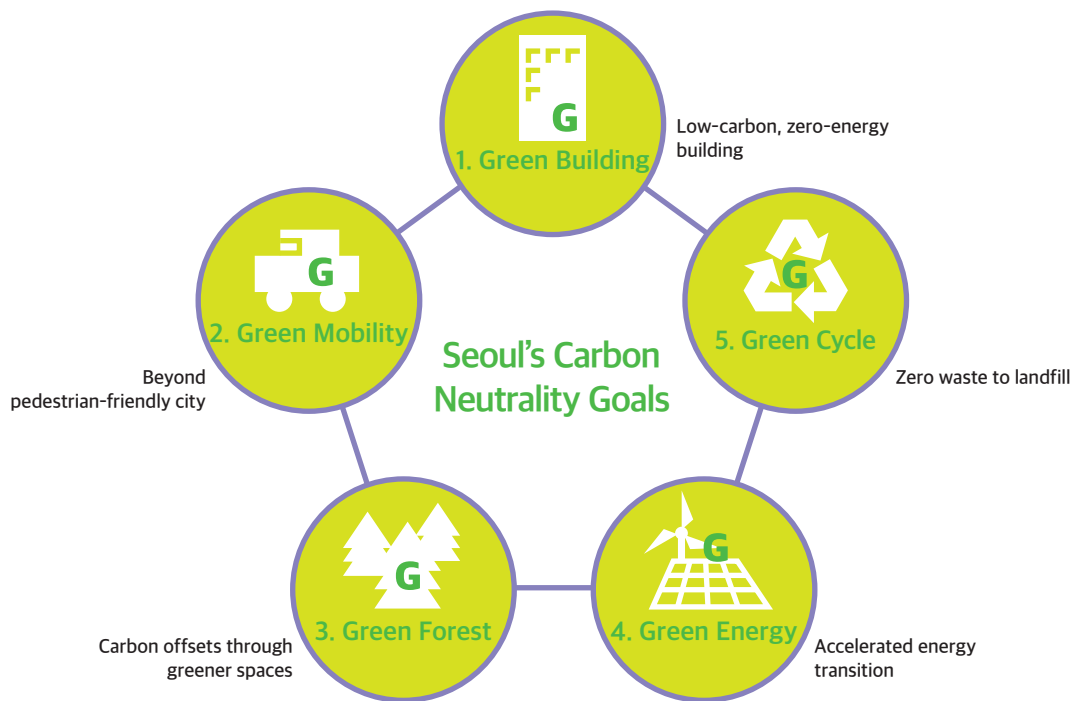
How to Reach Carbon Neutrality by 2050

Policy actions have been prioritized based on GHG emissions impacts by each sector. The focus will be placed on the three key emitters: building (68.8%), transport (19.2%), and waste (6.1%). At the same time Seoul is going to expand urban forests to absorb emitted greenhouse gases and accelerate its transition to renewable energy. This is how the city intends to maximize GHG emissions reductions.

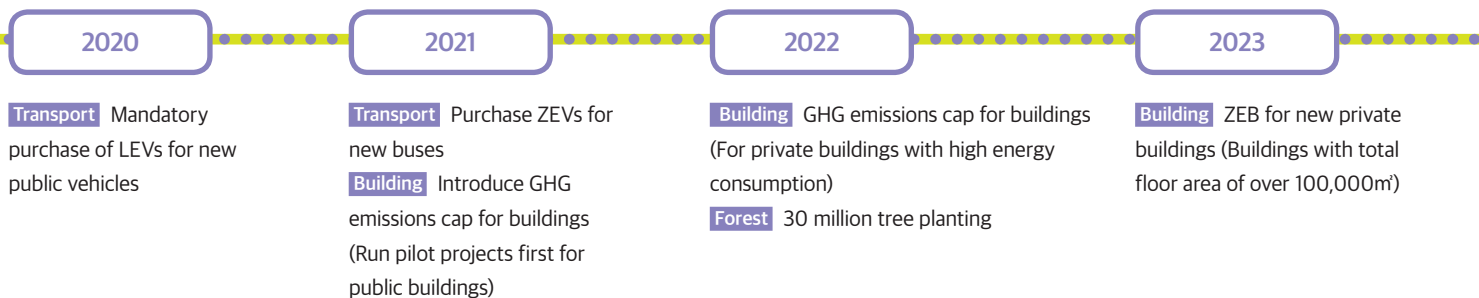
4

OVERVIEW

2050 GHG Emissions Reduction Strategy, Seoul Green New Deal



[Figure 4-1] Seoul's carbon neutrality roadmap by 2050



In order to reach carbon neutrality by 2050, Seoul set a policy goal for each of the five sectors of building, transport, waste, energy and forest as portrayed above. The main goal for the building sector is to shift all the building stock in the city to low-carbon zero-energy buildings. As for the transport sector, the city aims to convert all internal combustion engine vehicles into zero-emissions vehicles, such as electric and hydrogen fuel cell cars as well as to transform transport infrastructure to promote green mobility, such as walking and cycling. In the energy sector, Seoul is going to accelerate the shift to renewables from fossil fuels for power generation, such as solar PV and hydrogen fuel cells. The city seeks to promote materials circulation and reduce waste to landfill to cut waste emissions, while making the city greener by expanding parks and green spaces to offset emissions and enhance the city's climate resilience.

Policy actions have been prioritized based on GHG emissions impacts by each sector. The focus will be placed on the three key emitters: building (68.8%), transport (19.2%), and waste (6.1%).

At the same time Seoul is going to expand urban forests to absorb emitted greenhouse gases and accelerate its transition to renewable energy. This is how the city intends to maximize GHG emissions reduction. Seoul is also going to connect its adaptation with mitigation actions to boost policy effectiveness.

Seoul is planning to speed up its efforts to reach carbon neutrality by 2050 through Green New Deal projects. Key

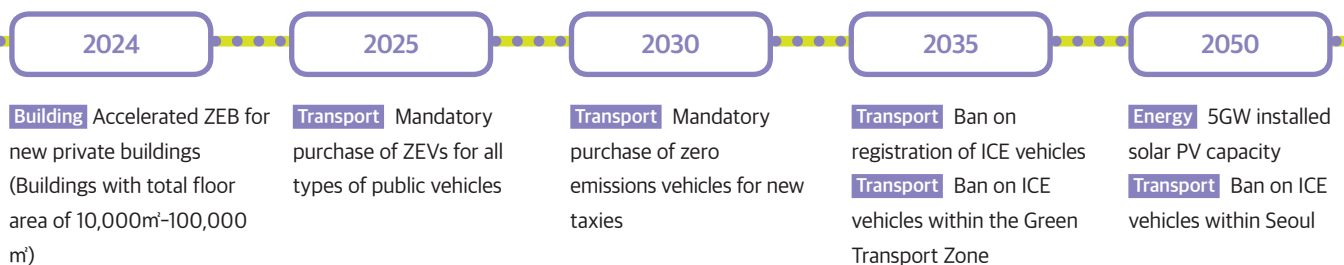
Green New Deal measures include green remodeling of old public buildings, full conversion of city vehicle fleet into electric or hydrogen fuel cell vehicles, expansion of urban forests, solar PV power generation in public buildings and zero waste to landfill, among others.

Seoul set policy priorities through the Climate Action Forum and Climate Crisis Taskforce, public surveys and research, as explained earlier. The selected priority policies are included in this climate action plan.

Key challenges Seoul could face while implementing its carbon neutrality policies are a lack of legislation and budgets.

Having identified these challenges early on, Seoul has been closely working with the central government and the National Assembly. The city recommended changes to legislation for carbon neutrality to the Ministry of Environment and other related government organizations in July 2020. Also, Seoul shared the details of its 2050 carbon neutrality strategies with the lawmakers of the relevant committees (the Land, Infrastructure and Transport Committee; the Trade, Industry, Energy, SMEs and Startups Committee; the Environment and Labor Committee). In October this year, the city proposed the directions of regionally-balanced Green New Deal at the Conference of Mayors and Governors hosted by the President of the Republic of Korea.

In addition, Seoul is striving to secure funding by making the case for carbon neutrality to the Environment and Water Resources Committee of the Seoul Metropolitan Council.



BUILDING



Vertical garden inside the Seoul City Hall

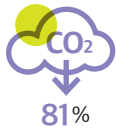
Transition to Zero Energy Building



8,571
New jobs
by 2022



787 million USD
(875.7 billion KRW)
in Investment
by 2025



81%
GHG emissions reduction
by 2050 (from 2005 levels)



Mandatory ZEB
for New public buildings
(Over 500m²)
from 2021



1,532
Public buildings
Green remodeling
by 2050

Building accounts for 68.8% of the city's 2018 GHG emissions. Therefore, it is critical to tackle building emissions to reach carbon neutrality. The total floor area of buildings in Seoul is steadily increasing and, as of 2019 44% of the building stock is old, aged 30 years or above, which makes it more difficult to cut GHG emissions.

Seoul is going to expand green-remodeling of old buildings while mandating new buildings to be zero-energy. Also, the city is going to introduce GHG emissions cap for public buildings to later expand it to include private buildings. The other key actions include mandatory energy performance certification

for existing buildings and disclosure of building energy performance information for real estate transactions.

Green remodeling of old buildings

● Green remodeling of old public buildings

Seoul is going to remodel 1,532 old public buildings by 2050. More than 30-year-old 401 municipal buildings with a floor area of over 1,000m² and 1,131 nursing homes, daycare centers and health-care centers that were built 20 years ago and earlier will be retrofitted.

These buildings' energy efficiency will



Municipal library remodeled greener

[Table 4-1] Planned green remodeling of old public buildings

Category		Sub Total	2020~2022	2023~2050
City-Owned Buildings		401	12	389
District-owned buildings for vulnerable groups	Senior Citizen Center	673	49	624
	Daycare Center	433	204	229
	Health Center	25	8	17
Total		1,532	273	1,259

(Unit: number of buildings)

be improved to the level of zero energy building (ZEB), while user convenience will also be enhanced. This will cut down energy consumption and GHG emissions while creating jobs.

Seoul is going to recruit the Seoul ZEB Master Planners to foster green remodeling of 1,532 old public buildings by 2050. The master planners will provide advice and consulting from the design stages, and oversee the overall management of the green remodeling projects.

● Upgrading old houses into green homes

Seoul is going to improve energy efficiency of old housing through its Home Improvement Program that partially finances repairs of old houses located within the Home Improvement Support Zones.

There are 135 Home Improvement Support Zones as of 2020, and 30 new zones are to going to be added in 2021, providing much needed support to a total of 165 zones. In the past, the support mainly focused on fence



Old house retrofitted for energy efficiency

improvements, which had little impact on energy efficiency. However, more emphasis is going to be placed on energy efficiency retrofits, such as installation of insulation windows and switching to eco-friendly boilers. The city is going to provide additional funding for installation of energy efficiency certified products.

● Building Retrofit Project (BRP) for private buildings

Seoul's BRP program provides low-interest loans for energy efficiency improvements of private buildings. The loan used to be given to buildings, but it is going to be expanded to include houses. The loan's current interest rate of 0.9% will go down to 0% from 2021 with the city's financial support. Seoul also plans to provide subsidies to buildings that acquire an energy efficiency rating as a result of its BRP program.

● Green remodeling of SH public housing

Seoul Housing & Communities Corporation (SH) oversees construction, management and rental



BRP project to provide loans for energy efficiency projects in private buildings is being carried out.

of public housing in Seoul. 70,669 SH public houses are over 20 years old. The SH is going to improve energy efficiency of these buildings by switching to high-efficient boilers, LED lightings and water-saving equipment.

Mandatory ZEB for new buildings

The Ministry of Land, Infrastructure and Transport presented its roadmap to mandate ZEB² by 2030 by developing the Second Green Building Framework Plan in 2019.

Seoul is going to accelerate the shift to ZEB earlier than the timeline of the central government.

● ZEB for public buildings

The central government requires new public buildings with a floor area of over 1,000m² to obtain ZEB certification after 2020. In line with this, Seoul is going to require all public buildings with a floor area of 1,000m² and above to be ZEBs. Additionally, the city will start mandating public buildings with a floor area of more than 500m² to be ZEBs from 2021, four years earlier than the central government's timeline of 2025.

● ZEB for private buildings

Seoul plans to bring forward its ZEB timeline a couple of years ahead of the central government's.

While the central government's roadmap aims for new large buildings to be ZEBs from 2025, Seoul is planning to amend the Seoul Environmental Impact Assessment Standards and the Seoul Green Building Design Standards in order to mandate ZEB for all private buildings with a floor area of over 100,000m² from 2023 and buildings with an area of 10,000m² from 2024. ZEB timeline for new apartment buildings will also be brought forward one to two years from the government roadmap, which requires ZEB for apartment complexes with over 1,000m² households from 2023 and for apartments with more than 300 households from 2024.

Footnote 2.

Zero Energy Building (ZEB):
A zero energy building is a green building that minimizes energy load and produces enough renewable energy to minimize its own energy consumption

[Table 4-2] Roadmap for mandatory ZEB for new buildings

Non-residential	2023	2024	2025~2029	Residential	2023	2024	2025~2029
Over 100,000m ²	←			Over 1,000 households	←		
10,000m ² ~100,000m ²		←		300~1,000 households		←	

Government
--- roadmap



BIPVs used in FKI (Federation of Korean Industries) Tower.

GHG emissions cap for buildings

This is one of the key policies to cut building emissions. This will impose emissions caps on buildings according to a unit area.

Seoul is going to launch a pilot emissions cap for public buildings in 2021 and expand the cap to include private building from 2020 with revisions to relevant laws and regulations. The cap for each building is to be linked to Seoul's GHG emissions targets and be set for buildings types.

and sizes. Research is currently underway to identify the best ways to introduce the cap.

Disclosure of GHG emissions from buildings with high energy consumption

Seoul began disclosing GHG emissions data of 324 high energy consuming buildings in 2020. Until then, the disclosed information was mostly about buildings' energy consumption. Seoul has recently changed the measure to include GHG

[Table 4-3] Roadmap for GHG emissions cap for buildings

	From 2021	From 2022	From 2023
Public Building	[Phase 1] Pilot project for municipal buildings with an area of over 1,000m ²	[Phase 2] Municipal buildings with an area of over 1,000m ²	[Phase 3] Gradual expansion to include city-funded agencies, district offices
Private Building	[Preparation] Lay a legal ground by revising Green Building Establishment Support Act	[Phase 1] Pilot project for high energy consumption buildings	[Phase 2] Start with buildings with an area of over 10,000m ² for gradual expansion

emissions data, such as total emissions, average emission volume and per-area unit emissions.

Mandatory energy performance certification for existing buildings

Seoul plans to mandate an energy performance certificate for buildings. On a pilot basis, 401 municipally-own buildings with a floor area of over 1,000m² are required to obtain an energy performance certificate by 2022.

Seoul is going to mandate public buildings and high energy consuming buildings to obtain energy performance certificate by 2024. The mandate will be expanded to include private buildings with a floor area of over 1,000m² from 2025 and for buildings with an area of over 500m² from 2030. By 2050 the certification will be mandated for all buildings and sales of

buildings that fail to meet the minimal standards will be banned. Buildings certified with low ratings will be ordered to improve energy efficiency.

Energy performance report mandated in real estate transactions

Seoul is going to mandate submission of a building energy performance report in property transactions in order for buyers or tenants to make informed choices.

Currently, real estate agents are not required to ask sellers to submit the report, therefore the city is going to pursue legislation changes to make it mandatory for all buildings with a floor area of over 500m². This change is expected to pave the way for energy efficient buildings to be valued in real estate dealings.

Apartment complexes designed with energy-efficient equipment and green spaces.



TRANSPORT

Green Mobility

Transport is responsible for 19.2% of Seoul's GHG emissions. Despite Seoul's continuous policy efforts to promote zero-emission vehicles, there are few electric and hydrogen vehicles on the road. As of December 2020, only 0.8% or about 25,000 vehicles of all the 3,150,000 registered vehicles in the city are electric and/or hydrogen vehicles.

The deployment of electric and hydrogen vehicles for taxis and city buses, which citizens frequently use and have, in general, long mileages, is still in its initial stage. More specifically, 15.6% of the municipal fleet, 1.8% of the city buses and 0.8% of the taxis on the road are electric and/or hydrogen cars.

Key actions

Seoul aims to shift all vehicles that operate within the city to zero-emission vehicles (ZEVs) by 2050. The shift will first be mandated in the public sector while charging infrastructure will be expanded to enhance drivers' convenience. Registration of internal combustion engine vehicles (ICEVs) will be banned from 2035. ICEVs will be gradually restricted from entering the

Green Transport Zone³ and later the entire city area.

Accelerating shift to LEVs and ZEVs

●Mandatory ZEVs for public vehicle fleet

Starting from 2020 the Seoul Metropolitan Government and its agencies must purchase only low-emission vehicles (LEVs), including hybrid as well as electric and hydrogen cars, when procuring new government passenger cars. Starting from 2025, regardless of vehicle types, only ZEVs must be purchased for the public fleet. The mandate could be waived when no hydrogen or electric vehicles exists for the vehicle type needed to be purchased.

Any replacement of city buses for new ones must be with either electric or hydrogen buses from 2021. The city plans to deploy a total of 3,900 electric buses and 1,000 hydrogen buses by 2025.

As for taxis, Seoul plans to replace all of them with ZEVs by 2040 to cut GHG emissions from taxis to zero.



8,358

New jobs
by 2022



2.8 billion USD
(3.2 trillion KRW)

in Investment
by 2025



61%

GHG emissions reduction
by 2050 (from 2005 levels)



Over 50%

ZEVs for new registration
by 2030



Ban on registration
of ICE Vehicles
from 2035

Ban on operation
of ICE Vehicles
from 2050

[Table 4-5] Registered vehicles in Seoul

(Unit: number of vehicles)

Total	Gasoline	Diesel	Gas	Hybrid	Electric or Hydrogen
approx. 3,160,000	1,630,000	1,110,000	270,000	120,000	25,000



Footnote 3. Seoul designated the city center (16.7km²) as Green Transport Zone to promote green mobility.



1. Exclusive bus lanes
2. Hydrogen fuel cell bus
3. Hydrogen fuel cell taxi
4. Charging station for hydrogen fuel cell vehicles





●No diesel for public fleet

Seoul plans to phase out diesel vehicles from the public sector by 2025. City buses, taxis, airport buses and other publicly-run vehicles that are currently powered by diesel will be banned. The city will demonstrate leadership to foster a clean vehicle market by inducing engagement from the private and vehicle manufactures.

●CNG, electricity, hydrogen for city cleaning vehicles

Seoul is planning to switch cleaning vehicles, such as road sweepers and waste collecting vehicles, to run on CNG, electricity and/or hydrogen. Road sweepers that are mostly powered by diesel at the moment will be replaced with CNG, electric and/or hydrogen vehicles by 2025. As for the waste collection vehicles, 50 will be first shifted to CNG vehicles by 2022 and the rest will be gradually transitioned to clean vehicles.

●ZEVs for private fleet

Seoul is taking various policy measures to reach its targets of deploying 200,000 EVs and 24,000 FCEVs by 2025. The city is continuing its efforts to expand charging infrastructure.

Seoul is aiming to install 5,000 fast chargers in



1. Hydrogen fueling station
2. EV charger

[Table 4-6] Plans to expand charging networks for ZEVs

Category	By 2022	By 2035
No. of charging points for EVs	8,387	200,000
No. of charging stations for FCEVs	4	30

places and sites that are highly accessible by the public, while supporting installations of slow chargers at multi-family housing buildings. Also, the city is working with the private sector to keep increasing the number of charging stations for FCEVs across the city. In addition, Seoul is providing subsidies for purchases of ZEVs to promote their deployment in the private sector.

● Ban on new registration of ICEVs from 2035

Given that vehicles' service life is about 15 years, Seoul is going to make recommendations to the central government to prohibit new registration of ICEVs in Seoul starting from 2035. The city will ask for revisions in the Motor Vehicle Management Act to provide the legal basis to enforce the ban. If everything goes as planned, there will be almost no ICEVs left in Seoul by 2050.

Road space reallocation for Green Mobility

● Road space reorganization

Seoul is going to reallocate road space to reduce car lanes for green mobility. A total of 22 roads (28.62km) will be reorganized by 2025. Car lanes will be reduced to less than four per the affected roads and the reduced lanes will be turned into

space for walking and cycling.

Also, the city is planning to build Cycle Rapid Transit (CRT) in key areas of the city and is going to increase the number of public bikes called "Ddareungi" to about 40,000 and bike stations to 3,040 to ultimately put the bikes within five-minute walking distance by 2021. Seoul aims to increase the number of daily bike traffic volume to 2.3 million and expand the CRT network to 623 km.

● Less personal vehicle use

Seoul is going to tighten its management for of transport demand by enforcing traffic inducement charges through a data-based monitoring system. Also, the city is planning to improve the way parking fees are charged at public parking lots to increase the fees in areas that are highly accessible to subway stations and public transport.

Zero Emission Area (ZEA)

Seoul designated the city center (16.7km²) as the Green Transport Zone to promote green mobility. Seoul is going to ban all ICEVs from entering the zone from 2035, and add more such zones into Gangnam and Yeouido. From 2050, all conventional vehicles will be banned in the entire city. Detailed roadmap for this plan is as illustrated below.⁴

[Table 4-7] Roadmap for ban on ICEVs in Seoul

Category	2020	2025	2030	2035	2045	2050
Green Transport Zone	Ban Grade5 vehicles	Ban Grade4 vehicles		Ban all ICEVs		
Seoul	Ban Grade5 vehicles (in Winter)	Ban Grade5 vehicles (at all time)	Ban Grade4 vehicles			Ban all ICEVs

Footnote 4. Seoul rates vehicles into five grades depending on their emissions, fuel types and age. The city is going to expand driving restrictions based on this rating.

WASTE

Waste Reduction and Zero Waste to Landfill



Waste accounts for around 6% of Seoul's total GHG emissions, and 78% of waste emissions come from landfills. The growing number of single-person households and the increasing online shopping due to the COVID-19 pandemic are expected to increase municipal waste generation.

First of all, the city is going to work towards source reduction and zero waste to landfill by promoting reuse, recycle, and upcycle.

Seoul is going to aggressively reduce the consumption of disposable items and packaging towards Zero Waste Seoul. The city is going to open new Re&Upcycle Centers to foster reuse, recycle and upcycle cultures. Also, Seoul is planning to enhance its capacity to process waste generated within the city on its own as part of its efforts to reach zero waste to landfill by 2026. In addition, the public sector will lead procurement of reused and recycled goods and support development of new waste treatment technologies to foster the resource circulation industry. Lastly, the city will maximize reduction of waste generation at source to provide sound ground for resource circulation.

Reuse-Recycle-Upcycle

Following the opening of the Seoul Upcycling Plaza in 2017, Seoul is working toward creating an upcycling cluster, which will house space to support start-ups as well as space for visitors.

The next step is to open one Re&Upcycle Center in each District to support recycle and upcycling businesses. At the centers recycled and upcycled products will be sold, and environmental education will be provided, among others.

Also, the city is going to reduce the use of disposable goods by promoting the culture of no-disposable plastic packaging throughout the



process of distribution and consumption.

Seoul is going to foster disposable packaging-free stores across the city and ban disposable cups at all cafes in the city by 2025.

Zero waste sent direct to landfill

Seoul aims for zero municipal waste sent direct to landfill by 2026. The city is going to build a new incinerator by 2026. Also, existing incinerators will further be opened for communal use by several districts. The city is also planning to open new public recycling centers to promote recycling and cut municipal waste generation.

Resource circulation industry

Seoul is going to ensure that the public sector will take the lead in procuring recycled goods to foster the recycling market. Recycled items made out of waste vinyl in particular will be promoted to be consumed locally.

Also, the city is planning to increase its financial support for research and development of new resource circulation technologies to help boost business and productivity of recyclers and strengthen the competitiveness of the overall recycling industry.



1,624

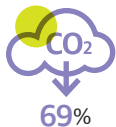
New jobs
by 2022



453 million USD

(507.4 billion KRW)

in Investment
by 2025



69%

GHG emission reduction
by 2050 (from 2005 levels)



0%

Zero waste to landfill
by 2026



1 store

A plastic packaging-free
store in each Dong
by 2025

ENERGY



Solar PV panels on the roofs of Gangseo farmers' market

Accelerating Energy Transition



7,150

New jobs
by 2022



122 million USD
(136.9 billion KRW)

in Investment
by 2025



3,265,000 TOE

Renewable energy
by 2050



5 GW

Solar PV capacity
by 2050



1 GW

Fuel cell power
by 2050

Civic engagement is at the center of Seoul's efforts to expand renewable energy supply. As of 2020, there is 305MW of installed solar PV capacity and 142MW of installed fuel cell power capacity.

Growing solar PV capacity requires new sites, both public and private, for additional installations.

As for fuel cells for buildings, increasing operation rates and profitability is needed, while for large-scale fuel cell power generation, adequate places to install the systems are needed to be secured.

Seoul is expanding renewable power, notably solar PV and hydrogen fuel cells, to accelerate the transition from fossil fuels to clean sources. As for other renewable sources, including solar heat and geothermal, the city is going to raise their economic feasibility by supporting technological development.

Seoul intends to increase installed solar PV capacity to 5GW by 2050.

The city is going to continue its search for new sites for additional solar PV power and support

development and commercialization of new solar PV technologies.

Also, Seoul aims to raise installed fuel cell power capacity to 1GW by 2050 by raising its operation rate and profitability as well as identifying adequate sites for additional installations.

Seoul seeks to build a smart energy city that optimizes energy production and consumption using ICT and IoT.

Solar PV

Seoul is going to increase solar PV deployment in buildings via mandatory solar PV installations in new buildings.

Starting from 2023, large new buildings will be required to be certified as ZEBs. They will also be required to meet over 10% of its energy demand with solar PV power. The city is going to gradually expand this to include other types of buildings and increase mandatory solar capacity.

The city is also expanding its support for solar PV power. It has expanded beneficiaries of its solar PV panel purchase subsidies from

[Table 4-8] Installed solar PV and fuel cell capacity in Seoul

(Cumulative, Unit: MW)

Category	2011	2013	2015	2017	2019	2020
Solar PV	22.6	51.5	91.7	150.7	250.1	305.3
Fuel Cell	2.6	4.9	46.2	134.4	135.1	141.7



Fuel cell power plant

rooftops and roofs to grounds and walls, while also providing private subsidies for installations of building integrated photovoltaics (BIPVs) by 2022. BIPVs has integrating photovoltaics modules into the building envelope, such as facades, windows, and roofs, enabling them to be installed in various parts of buildings and improving aesthetics of the city.

Seoul is engaging citizens in finding new site for additional solar PV installations while

leveraging municipal sites for large-scale solar power generation. The city has expanded the beneficiaries of its feed-in-tariff (FIT) scheme beyond grid solar power to include onsite solar in order to create a test bed for nascent solar PV technologies.

With abovementioned measures, Seoul ultimately aims to reach 5GW installed solar PV capacity by 2050.

Solar panel waste is expected to be generated

in large numbers after 2025 in Seoul. The city is going to increase its public communication on how waste solar panels can be properly discarded for recycling as a growing number of solar panels are being installed across the city. Currently, households or businesses report solar panel waste generation in their properties to their district office for collection and transport to recycling centers.

Fuel cells and other renewables

Seoul is planning to call on the state government to change legislation to increase profitability of fuel cell power generation. The city will ask for legislative changes to allow fuel cell power produced by buildings to be sold for commercial purposes and to recognize fuel cells as emergency power generators for medium- to large-scale buildings. In addition, the city will also request regulation revisions to provide benefits to communities located near large-scale fuel cell power plants. Moreover, Seoul is going to leverage public facilities, such as water recycling centers and railway depots, to attract private fuel cell power generation.

Seoul's target for installed fuel cell power capacity is 1GW by 2050.

Aside from solar PV and fuel cells, Seoul is tapping into other clean energy sources, such as small hydro power, and waste water heat. Seoul is also planning to generate small hydro power using surplus water of Hangang River and recover waste

water heat to cool and heat buildings.

Smart energy city

Seoul wants to become a smart energy city by optimizing energy generation and consumption using ICT, IoT and other new technologies.

The city is going to open 'Seoul Energy Information Center' by the end of 2021. The center will help improve energy efficiency by providing visualized energy data and enabling management of GHG emissions by buildings.

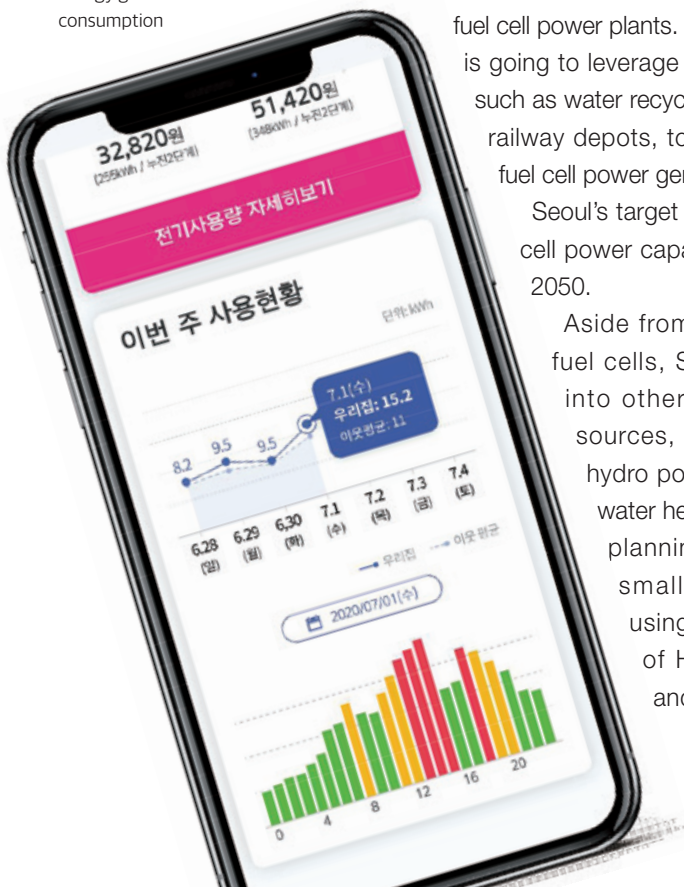
In addition, Seoul is planning to simulate future energy generation and consumption using big data analysis, and support private-led energy efficiency service development that uses new technologies such as Open API.

Also, the city is going to complete its pilot project currently underway in two Districts to develop a smart energy city model by 2023 and increase the number of Districts to which a smart energy city model will be applied.

The pilot project being conducted in Seodaemun-gu District is testing a differentiated electricity billing depending on households' consumption patterns tracked in real-time using ICT and IoT. In Magok District, where apartment buildings are densely located, residents are going to jointly build and operate a 1MW solar PV power generator. Demand Response(DR) is going to be introduced for apartment complexes. The incentives provided under the DR will be funded by profits from solar PV electricity generation, making it sustainable to generate and consume energy.

Lastly, the city is going to show leadership by applying smart energy technologies to the public sector to transform the local energy market in ways citizens become energy prosumers who trade as well as generate energy.

An app that helps manage energy generation and consumption



FOREST

Green Space and GHG Offsets

Seoul aims to cut GHG emissions by 80% from 2005 levels by 2050 with the policies covered in the previous sections. Seoul needs to offset the remaining 20% of emissions to reach net-zero emissions by 2050. Increasing green spaces in the city will help cut particle pollution and reduce heat island effects as well as offset GHG emissions.

Seoul is going to create urban forest by planting 30 million trees together with citizens to expand carbon sink. The city is planning to secure carbon credits through carbon offset projects outside the city (neighboring cities and

other countries) from 2030.

Urban forests and parks

Seoul seeks to make the city greener by creating urban forests to help address various environmental problems. The city is going to create a 100,000m² forest to ease urban heat island effect and to promote air circulation. An urban forest will also be created along the city's iconic Hangang River and streams. The size of each forest will be 295,000m² and 530,000m² respectively. Empty or idle spaces in industrial communities will be turned into an urban forest



Trail created at Seongnaecheon Stream



321

New jobs
by 2022



70.3 million USD

(78.6 billion KRW)

in Investment
by 2025



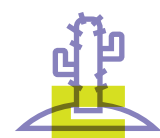
20%

GHG offsets
by 2050 (from 2005 levels)



3 million

Tree planting
by 2022



Desertification prevention
in Northeast Asia



Trail right next to
Gyeongchun Railroad

and will help reduce air pollution. A forest will also be created in the 1.5km-long section of Sejong-daero street, providing greener space for walking. The total size of forests to be created along streets will be 6,000m².

Seoul is also planning to create large-scale urban forests whose area could be up to 30,000m², and keep increasing green spaces in the city.

Desertification prevention in Northeast Asia

Even after all forests will have been created, there will still be remaining emissions till reaching carbon neutrality, therefore Seoul is going to

conduct carbon offset projects outside the city, including other cities and countries. Forestation in local cities can be a priority as it will help reduce air pollution.

Seoul has already carried out such a project in Mongolia to help the country combat desertification by planting 80,000 trees in the 100ha of area between 2016 and 2020. Seoul is going to support the maintenance of the trees between 2021 and 2023.

Seoul plans to continue such forestation in local cities as well as other countries and to secure carbon credits to tackle residual emissions in the mid to long term.

CITIZEN PARTICIPATION



1. Solar PV panels installed in apartment buildings.
2. Power saving bulletins installed by Energy Independent Villages.
3. Bike parade held marking the opening of new bike lanes in Jongno district.
4. Chargers for Seoul Car-sharing (Nanum Car).



GHG Reductions Together with Citizens

Citizen participation is critical in implementing the 2050 Seoul Climate Action Plan. Seoul has long strived to develop and implement its climate policies together with citizens. Seoul's previous such policies, the "One Less Nuclear Power Plant" and the "Promise of Seoul" were successful in large part because of citizen participation.

As described earlier, this climate action plan has been developed through various efforts to gather public opinions and is the result of such efforts. Seoul will keep making sure that citizens are engaged in the plan's implementation and communicate this plan through various means, including conventional and social media.

Also, the Eco-Mileage program and Energy Independent Village initiatives will be continued to further promote citizens' participation in implementing this plan.



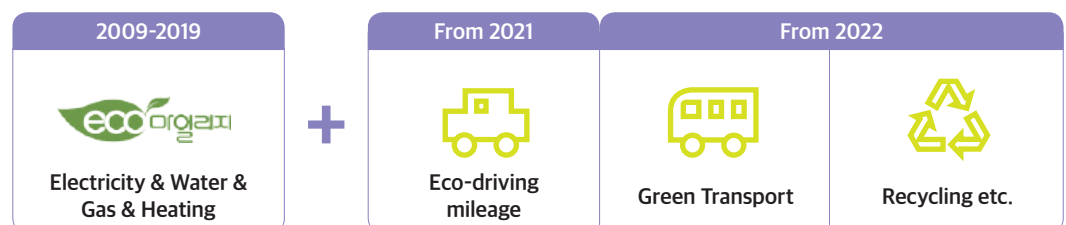
Eco-Mileage Program

Eco-Mileage is a flagship program that directly engage citizens in energy conservation by providing incentives for their energy-savings. Seoul is going to keep expanding this program to encourage further energy savings. The types of energy covered by this program's mileage currently are electricity, water, gas, and heating, but it will be integrated with other mileage programs for bicycles, vehicles, and recycling to provide stronger incentives.

Energy Independent Village

Seoul has designated and supported Energy Independent Villages since 2012 as part of its wider efforts to engage citizens in its environmental policies. As of 2019 there are 201 energy independent villages in Seoul and the city plans to increase the number to 300 by 2022 and expand its support to the villages.

Eco Mileage Integration Plan



5

How Seoul is Adapting to Climate Change

Seoul develops its climate change adaptation plan and prioritizes policies based on climate impacts and risk assessments. The city is combining its adaptation and mitigation policies to maximize effectiveness.



OVERVIEW

How Seoul is Enhancing Climate Change Adaptation

[Table 5-1] Priority actions for climate change adaptation



Public health Protection

- Protect public health from heat waves
- Prevent Infectious disease and reduce air pollution



Stronger disaster response

- Prevent storms and floods
- Respond to heavy snow and cold waves
- Prevent and respond to forest disasters



Stable water management

- Stable water management
- Water quality and water ecosystem management



Healthier ecosystem

- Biodiversity conservation
- Green space expansion



Seoul develops and implements climate change adaptation plan every five year, and the policy measures included in the plan are based on climate impacts and risk assessments.

Seoul conducts the climate risk assessments using the Vulnerability Assessment Tool (VESTAP) developed by the Ministry of Environment. VESTAP is designed to assess climate exposure, sensitivity and adaptability. Climate factors and socio-economic statistics of each district (Dong) in Seoul are used as input data for the assessment.

The Climate Change Adaptation Plan (2017-2021) developed in 2017 was based on the assessment of the impacts of climate change on health, disasters, water, forest and ecosystem by 2050. The assessment was conducted following IPCC's RCP 4.5 and RCP 8.5 scenarios.

The climate impacts and risk assessments found that health impacts from heat waves and flooding risks from heavy rains would be the biggest in Seoul. Meanwhile, water

management was raised as an important adaptation issue due to irregularities in the intensity and frequency of rainfalls, and the loss of ecosystem caused by urban development was identified as another critical issue.

Based on such results, Seoul developed its adaptation plan for health, disasters, water, and forest & ecosystem to reduce the city's climate vulnerability in these areas and the priority actions by each sector are as shown in the [Table 5-1].

When Seoul is going to develop the Climate Change Adaptation Plan for 2022 to 2026 in 2021, the city will put forward mid- to long-term adaptation actions based on climate impacts and risk assessments, and will make sure that the measures will be in line with the 2050 carbon neutrality target. The actions expected to have the biggest impact will be prioritized, and adaptation will be linked with mitigation to maximize effectiveness.



PUBLIC HEALTH

Strengthen Health Resilience to Climate Change



[Table 5-2] Key measures for public health protection

Heat waves

- Cooling shelters
- Protection of vulnerable people to heat waves

Infectious diseases

- Infectious disease response system
- Food poisoning prevention and response

Air pollution

- Protection of vulnerable populations from air pollution
- Air pollution monitoring and prevention

Seoul strives to minimize the impacts of climate change on vulnerable populations and enhance the city's adaptability to extreme weather events. Measures to protect the public health from climate impacts are largely categorized into addressing direct impacts of climate change, mainly heat waves and indirect impacts of climate change, such as infectious diseases and air pollution.

Heat waves

Seoul designates institutional buildings, such as senior citizen centers, welfare facilities, community service centers and municipal offices as cooling shelters to protect the most at-risk populations from heat waves and operate them from May to September every year. The city

operated 2,026 cooling shelters in 2020 and is going to increase the number of the shelters to 2,500 in 2021 to improve access, and expand its financial support for the cooling shelters' utility bills.

Also, the city runs Heat Waves Disaster Response Headquarters in the summer, and the headquarters send out text messages, informing the public, the most at-risk and outdoor workers, of prospective high temperatures.

Seoul also has a system in place to protect the slum residents and the homeless during the summer. The city staff visit those living alone, people with disabilities and/or chronic illnesses to check their health conditions.

Besides, the city hands out guidelines on health protection from heat waves to its citizens

Promoting 'Seoul Care' to the public





Promoting mask-wearing to the public to prevent COVID-19 infection

and outdoor workers, and provides heat wave forecasts. Seoul also inspects construction sites to see if they take necessary measures to protect the health of their workers from scorching heat.

Infectious diseases

Seoul has long operated the infectious disease monitoring system to respond to possible spread of infectious diseases. With the COVID-19 outbreak, the city is putting into best efforts to protect public health from the ongoing COVID-19 pandemic by requiring mask wearing and ordering social distancing, among others.

Seoul also strives to prevent other infectious diseases, as well. It is strengthening its response to food poisoning and control on places with high risks.

Air pollution

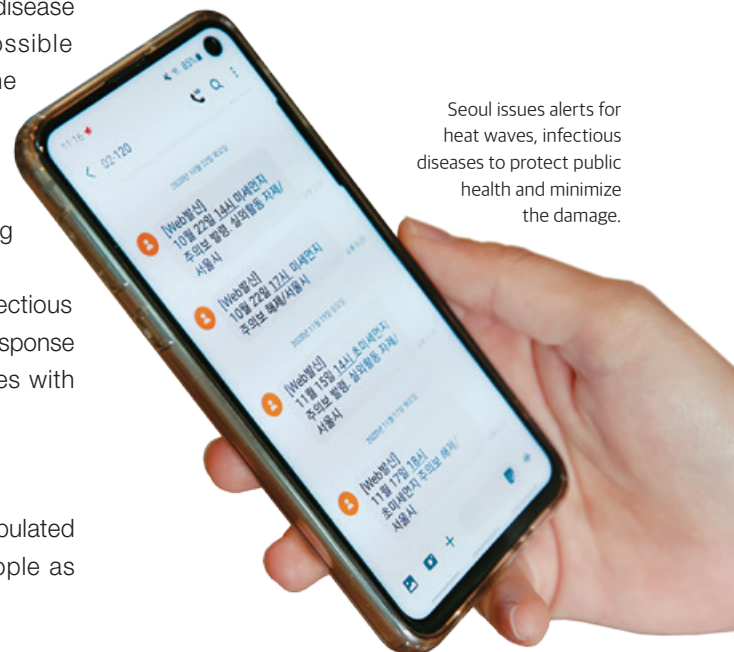
Seoul has designated areas that are populated with large numbers of vulnerable people as



On-site inspection of fine dust

particulate matter extensive control areas to reduce their exposure to air pollution. There are three such areas in the city as of 2019, and their numbers are going to increase by 3 each to a total of 12 by 2022.

Also, Seoul runs air pollution forecasts and alerts to protect the public health. There are 50 air quality monitoring networks across the city and the city is upgrading the monitoring equipment to provide more accurate information to the public.



Seoul issues alerts for heat waves, infectious diseases to protect public health and minimize the damage.

DISASTERS

Strengthen Resilience to Disasters



[Table 5-3] Key measures for flooding and cold waves

Storms and floods

- Strengthen emergency response to storm and flood damages
- Enhance restoration capability of vulnerable populations
- Improve safety of flood-prone communities
- Improve infrastructure to better respond to heavy rain

Heavy snow and cold waves

- Reduce damages from heavy snow and establish safety system
- Strengthen snow removal system by areas
- Improve adaptability to cold waves and climate disasters

Seoul has the forecast and alert system for storms, floods, heavy snow and cold waves, and quickly respond when the disasters occur.

Storms and floods

Key actions Seoul takes in this area include strengthening emergency responses, enhancing restoration capabilities of neighborhoods and increasing safety of communities that are prone to floods.

Seoul has several storm and flood control facilities and equipment. There are a total of 524 automatic storm and flood alert systems, electric message boards, and warning lights as of 2020, and their numbers are going to keep growing where needed. There are also disaster maps that enable quick evacuation from flood zones.

Seoul provides financial support to vulnerable groups to help them get insured for potential storm and flood damages. With the city government support, about 5,000 people got insured in 2020, and for 2021 the city aims to insure another 4,000 low-income people.

The city designates flood-prone areas and improve their infrastructure, such as sewage pipes and pump stations, and install sewage and rainwater storage facilities in the areas.

Heavy snow and cold waves

Seoul is increasing installations of automatic snow removal liquid spraying devices to prevent the formation of ice on roadways. Seoul installed the devices at 11 places in 2020 and is going to add them to a total of 15 places in 2021.



1



2

1. Roads with heavy rain
2. Access limit to Cheonggyecheon Stream in response to flood risks

Also, the city runs public-private snow removal teams. 16 district offices operated them in 2020, and 20 districts are going to run them in 2021.

In addition, Seoul puts cold wave management system in place in winter and takes measures to protect homeless people from cold waves.

WATER MANAGEMENT

Establish a Stable Water Management System



[Table 5-4] Key measures for water management

Stable Water Management

- Increase safe water reuse
- Supply municipal water in case of a drought

Clean and Healthy Water

- Reduce pollutants from streams and rivers

Water management policies focus on stable management of water quantity and quality to prepare the city for water shortages and enhancing response to floods. Measures to restore the water cycle distorted by urbanization are in place.

Water quantity management

Seoul is planning to expand water reuse facilities, including rainwater reuse facilities, and increase supply of graywater and reclaimed water. The city will expand secondary observation facilities to monitor the water level and emergency water supply facilities to use underground water resources in sustainable manners. Seoul is going to thoroughly detect leakages from water pipes and upgrade old water pipes.

Water quality management

Seoul is going to build detention tanks in nine detention basins by 2027 in order to prevent

water pollution caused by combined sewage overflows (CSOs). The city is going to install initial rainwater treatment equipment at all the municipal sewage treatment centers by 2030. In addition, Seoul is going to tighten its control of nonpoint source pollution to reduce water pollutants flowing into the Hangang River.

Water cycle restoration

It is important to restore water cycle distorted by urbanization. Policy direction in this area is reducing impermeable surfaces and expanding spaces that can facilitate natural water cycle.

Seoul has enacted the Ordinance on Water Cycle Restoration and developed the rainwater management plan. The city has created Rainwater Villages afterwards, where residents harvest rainwater using permeable pavement, infiltration trenches, rainwater storage tanks and underground rainwater tanks. From 2016 and 2019, the city has created 13 such villages.





Ttukdo ARISU Water Purification Center

FOREST AND ECOSYSTEM

Strengthen Health and Diversity of Ecosystem



[Table 5-5] Key measures for forest and ecosystem

Forest Disaster Prevention

- Establish a system to prevent forest disasters
- Improve forest resilience

Biodiversity Preservation

- Strengthen monitoring of species vulnerable to climate change
- Preserve and restore ecosystem

Improve Functions of Green Spaces

- Prevent damage to park facilities from water storms and floods
- Expand urban green spaces
- Promote urban farming

Seoul seeks to enhance the city's climate change adaptability by restoring forests, expanding green spaces, and promoting urban farming. Key policies in this areas include preventing forest disasters, such as wildfires and landslides, preserving biodiversity and improving functions of urban green spaces.

Forest disaster prevention

Seoul runs the Forest Fire Prevention Headquarters, the Special Units for Forest Fire and a dedicated investigation team to ensure proper prevention and prompt response to forest fires.

Also, the city's Landslide Prevention Units manage landslide-prone areas and the city is planning to set up the integrated slope management system to prevent landslides.

Meanwhile, Seoul is going to continue its forestation projects, create wildlife habitats, control forest pest and expand hiking trails in order to improve forest resilience.

Biodiversity preservation

Seoul develops and implements the Biodiversity Action Plan, monitors bioindicators and create biodiversity networks in order to preserve biodiversity.

Meanwhile, the city is expanding green areas along the streets to ease urban heat island effect and implementing Eco-School Projects that leverage idle spaces in schools for green rooftops, green walls, and gardens.

Urban green space

Seoul has created three so-called Carbon-Offset



Roof garden of Samgaksan Middle School.



1



2

1. Seoullo 7017, a sky park transformed from an overpass highway.
2. Metro Farm at Sangdo Station

and the businesses participating in this carbon-offset forest project secure carbon credits and help the city adapt to the impacts of climate change by planting trees in the forests.

Also, Seoul strives to promote urban farming by developing urban plant factory models and fostering urban farmers at schools. The vertical gardens that the city is planning to create are expected to reduce urban heat island effect and particle pollution along with green walls, green rooftops and green streets.

Forests at the Hangang Park and on Bukhansan Mountain together with businesses and citizens to help cut GHG emissions and expand the functions of urban green spaces. Both the city

MID- TO LONG-TERM TASKS

Climate Change Adaptation

[Table 5-6] Mid- to long-term tasks

1	Improve Vulnerability Assessment Tool	<ul style="list-style-type: none"> ● Develop a vulnerability assessment tool for smaller administrative districts (Dong or detailed lattice unit) ● Engage local governments and stakeholders in vulnerability assessment
2	Mainstream Climate Change	<ul style="list-style-type: none"> ● Operate a governance system joined by citizens, experts, businesses and stakeholders to embed climate change across city government policies
3	Develop Ecosystem-based Adaptation Plan	<ul style="list-style-type: none"> ● Develop EbA approaches, including EbA urban planning tool ● Develop a mid- to long-term plan and a roadmap
4	Connect Climate Mitigation and Adaptation	<ul style="list-style-type: none"> ● Develop projects connecting mitigation and adaptation ● Develop a mid- to long-term plan, including a roadmap
5	Develop Early Warning System	<ul style="list-style-type: none"> ● Establish early warning system for climate risks

Apart from the actions presented in this plan, Seoul has identified mid- to long-term tasks that it does not yet have a detailed roadmap for and require additional review for their feasibility. They are as shown in the [Table 5-6].

Improve vulnerability assessment tool

There is room to improve the Vulnerability Assessment Tool (VESTAP) used by the Ministry of Environment to assess local governments' climate vulnerability as it does not currently reflect detailed conditions and contexts of the city.

The VESTAP is designed to assess and forecast climate change vulnerability by the district (Gu) unit, but it needs to be improved to allow assessment by smaller administrative district units (i.e. Dong or lattice unit). Dongs within one Gu have varying characteristics. One dong is close to Hangang River, another is near mountains, and the other is near roads. This means even one district has varying vulnerabilities to climate change.

In the meantime, local governments and other stakeholders also need to take part in the vulnerability assessment. This way the assessment can better reflect local conditions and contexts, and the local governments can develop and implement their adaptation plan that is more in line with their needs.

Build governance to mainstream climate change

Unfortunately, climate change is barely or not holistically considered in developing policies for urban planning, transport, energy supply and industrial economy, when such policies have huge impacts on energy production and consumption, our daily lives, and climate change vulnerability.

Therefore, Seoul is working toward embedding climate change across the city government. The city is going to establish governance that sets agenda and develops policies together with citizens, experts, businesses, and other stakeholders. This will help better coordinate climate policies among city departments and build consensus on its policies to increase policy effectiveness. Seoul is going to improve its adaptation plans and policies based on the governance.

Develop Ecosystem-based Adaptation plan

Ecosystem is an important link between environment and human society. Ecosystem can act as a natural buffer from extreme weather events caused by climate change, while rapid ecological changes and loss could aggravate economic damages caused by climate change.

In this sense, Seoul is going to review various Ecosystem-based Adaptation (EbA) approaches that use ecosystem services as part of a holistic adaptation strategy to later include them into its own climate change adaptation plan.

Connect climate mitigation and adaptation

Climate adaptation goes increasingly hand in hand with mitigation globally to improve sustainability. In fact, such efforts are notable in agriculture and forest sectors and cities increasingly link the two through policies like green building and urban forest.

Seoul first combined its mitigation and adaptation plans into the Climate Change Masterplan in 2017 to maximize synergy between the two. Seoul is going to further develop policies that could address mitigation and adaptation at the same time and improve legislation and secure funding toward this end. The city is going to develop a roadmap and strategy for this in the mid- to long-term.

Develop early warning system

Climate change can be prevented as well as responded. Preventing it is a lot more efficient than putting into resources for recovery after the damages have been done. As climate change accelerates, the damages from climate variability will grow, making prevention even more important.

In this sense, Seoul is going to consider if it could develop an early warning system to detect and predict rapid changes in climate and environment and provide such information to the public in advance.



6

How Seoul is Ensuring Equity and Implementation

Seoul advocates the right of all to live without climate crisis and recognizes the need to prevent and reduce inequities arising from climate crisis. The best way to deliver equity is an immediate and effective climate action.

Equity

Immediate and effective climate action

Seoul advocates the right and freedom of all to live without climate crisis and recognizes the need to prevent and reduce inequities to arise from climate crisis. Prevent and manage inequalities from climate crisis should be a focus, and the best way to deliver equity is an immediate and effective climate action.

Investment and funding for climate action

Fully taking responsibility, as the capital city and a big consumer, for climate crisis faced by the country, Seoul is going to secure and channel funds to climate action and equity. The city is going to support sustainability efforts by its 25 district (Gu) offices, and see if it can support climate action by developing cities and countries to fully taken on its responsibility for climate crisis. Also, Seoul is going to see if it should secure funding to relieve damages from climate crisis.

Reduce systemic climate inequity

● Energy welfare, a first step to identify and manage groups that are faced with climate inequity

Seoul has long provided energy welfare support to guarantee basic energy use to the recipients of the National Basic Livelihood Security benefits. Seoul's ordinance defines support for energy supply, renewable energy installations, energy efficiency improvements, and research for energy welfare as welfare projects. The Seoul Energy Welfare Civic Fund

launched in 2015 is used for such energy welfare projects on low-income households. Some of the examples of support provided to the energy poor include energy efficiency retrofits, energy-efficiency home appliances, and domestic solar PV panels. Since 2018, the city has provided emergency welfare funds worth up to 2,700 USD (300 million KRW) to low-income households to purchase cooling devices and pay for medical expenses as part of its emergency welfare measures for heat waves.

● Policies for the vulnerable

Seoul is going to continue research and policies focusing on the disadvantaged groups, the elderly and people with underlying diseases that are most vulnerable to climate inequity. The city will make sure that these at-risk populations can be prepared for and respond to climate disasters by promptly providing information and support in case of emergency. Seoul is also going to continue its adaptation measures for heat waves, ultraviolet, infectious diseases, heavy snow, cold waves and forest disaster prevention, among others.

● Improve systematic inequity

Beyond welfare policies for the vulnerable groups, Seoul is going to work toward correcting systematic inequality, as too often adverse effects of climate change disproportionately hit the low-income communities. The city recognizes the need to continue its policies to guarantee the most basic needs for all. The city is going to keep implementing and monitoring relevant

policies.

● Enhance procedural equity

Much of the discussions on climate crisis and climate action is often held among the current generations when the decisions made by them will largely affect the lives of future generations. Seoul has recently stepped up its efforts to engage the youths in its policy development and implementation and is going to continue such efforts in its journey toward the carbon neutrality by 2050.

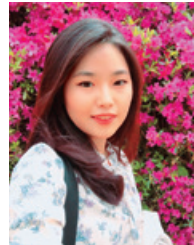
Clean air for all

Air pollution also worsens inequality. Low-income populations and people with underlying diseases are often at the highest risks of particle pollution as they tend to live in neighborhoods that are exposed to severe levels of air pollution. One of the most acutely felt climate and environmental issues in Seoul is air pollution. Seoul is going to keep its efforts to link its climate and air quality actions.

Equal access to ecosystem services

Unlike other countries where income inequality often results in unequal access to green spaces, Seoul has many people hiking thanks to its mountainous geography. Seoul is going to continue its policies to expand green and park spaces and make them barrier-free to ensure equal access to the green areas.

How young generations think about 2050 Seoul Climate Action Plan



Jiyeon KIM

"I welcome Seoul's plan to consider banks' divestment efforts from coal when it selects a bank to manage municipal funding. It is crucial that the city halve its GHG emissions by 2030 to reach net-zero emissions by 2050. As additional actions the city many need to consider, I would like to propose municipal tumbler services, enhanced climate education among civil servants, and promotion of vegetarian diets and local food purchases."



Yebin YANG

"I call on the city government to step up its communication efforts to build a wider consensus on climate crisis and Green New Deal policies.

I also call for a system where general citizens and future generations are provided with transparent information and engage in decision making processes. As for adaptation, more policies are needed for the vulnerable populations."



Sunghwan HONG

"With the current emissions trends, we only have seven years left till we can limit global temperature rises to 1.5°C. We need stronger targets than net-zero emissions by 2050. The city needs to research the public's unease and depression caused by climate crisis to come up with measures in this area. Also, more work needs to be done to preserve the ecosystem, as climate crisis is linked to ecosystem crisis."

Implementation

Holistic climate action

While the Climate & Environment Headquarters of the Seoul Metropolitan Government is the leading department of the city's climate action, Seoul is going to holistically manage and coordinate its climate policies developed and implemented by various departments.

At the same time, the city will continue to run the GHG Emissions Reduction Metagovernance comprised of city staff, experts, businesses, and citizens to keep listening to and incorporating stakeholders' advice and public opinions into its climate policies.

Key issues the Metagovernance is going to cover include ways to mainstream climate change across municipal policies, accelerate distributed energy generation, and further engage citizens in climate action. Most importantly, they will also discuss how to assess various benefits of climate action and to equally distribute those benefits.

The Climate & Environment Headquarters, made up of 8 divisions and 250 staffs, will continue to lead the city's climate action.

Recognizing that the efforts of the headquarters alone are not sufficient, it worked with various city departments through the Climate Crisis Taskforce to develop this climate action plan. Cooperation with other departments will continue in implementing the plan.

The Seoul Metropolitan Government's organization is as shown in the chart and almost all departments are involved in implementing the climate action plan.

Seoul alone cannot fully implement the climate action plan. As described earlier, the roles of the central government, the

National Assembly and the Seoul Metropolitan Council are crucial. They are asked to change legislation to implement some of the key actions proposed in this plan. Since Seoul's GHG emissions reduction scenarios were developed based on the central government's policies, inaction by the state government can undermine Seoul's own climate action. Seoul will make sure that it keeps working with other levels of government and stakeholders in implementing this plan.

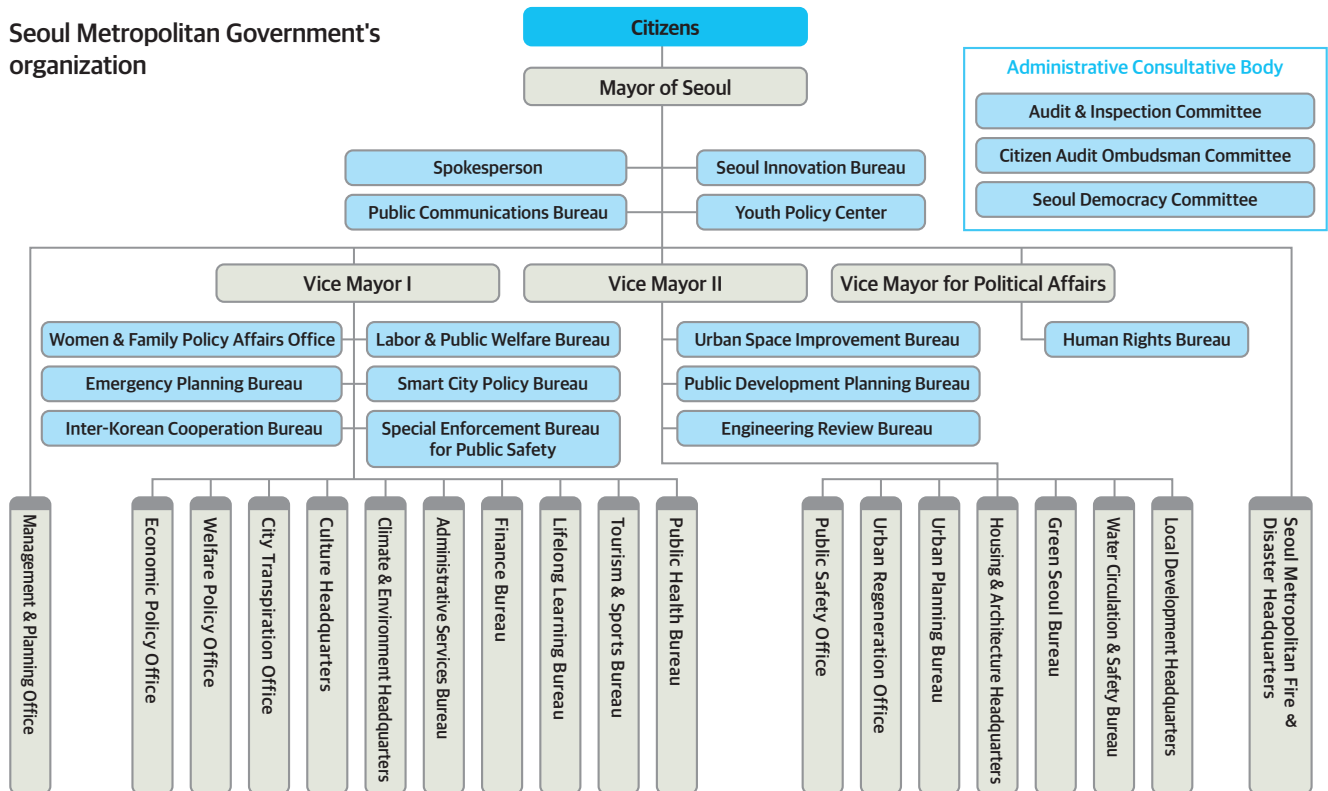
Lastly, Seoul is also going to cooperate with municipal agencies to help them implement the actions in this plan. Seoul is considering a similar cooperation for its climate action with the trilateral research collaboration for clean air between the Seoul Institute, the Seoul Institute of Technology and the Seoul Research Institute of Public Health and Environment. More specifically, the Seoul Institute of Technology could develop and verify GHG emissions reduction technologies, while the Seoul Institute could conduct policy research on carbon neutrality and assess policy implementation through its Green New Deal Research Center.

Reporting and monitoring

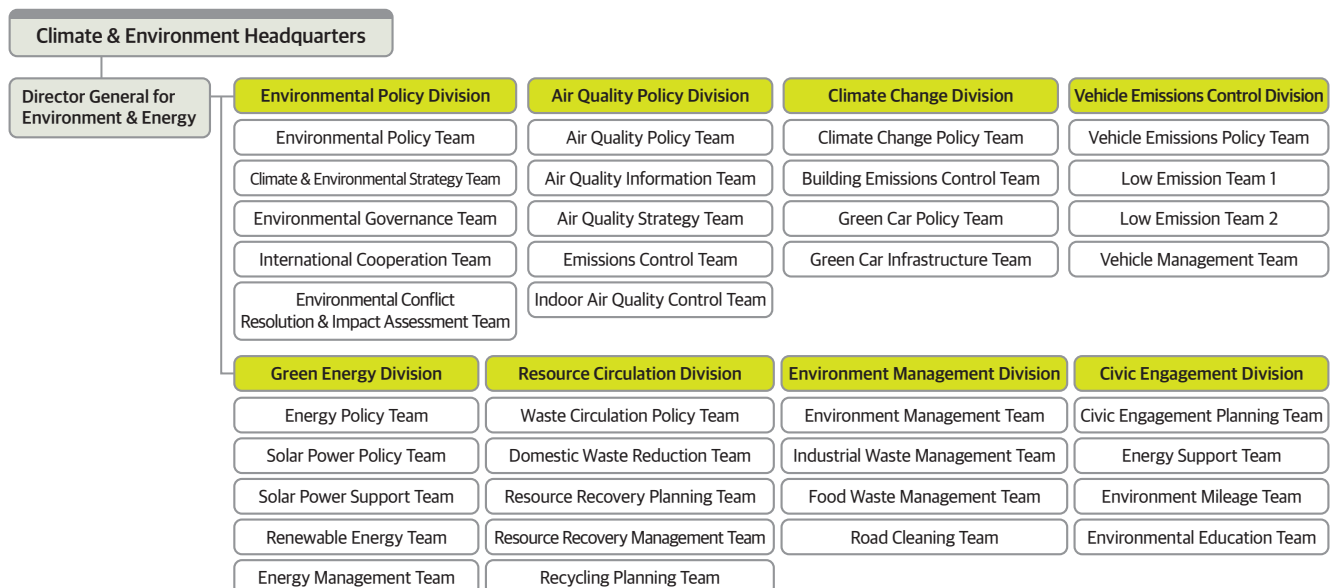
Seoul is going to include key actions of this climate action plan into the Climate Change Masterplan (2022-2026), and annually monitor and evaluate their progress.

More specifically, internal assessment of the progress of specific actions taken by each city division will be conducted. A monitoring group is going to review the internal assessment, and the Environmental Policy Division of the SMG is going to conduct comprehensive policy progress assessment. Finally, the Climate Change Committee will approve and report it to

Seoul Metropolitan Government's organization



Seoul Climate & Environment Headquarters organization



the Seoul Metropolitan City Council.

With such steps, Seoul is going to monitor its policy progress, and develop and implement its policies by each year.

Budget

● Funding for climate action

Dedicated budgets as well as staff are required to successfully implement the climate action plan.

Seoul generally secures dedicated budgets for its climate policies and get funds from existing projects. For example, the city reinvests the revenues (saved energy cost) from its energy efficiency projects into other energy and climate programs and secure private capital through contracts with energy

generators.

The city has the Climate Change Fund in accordance with the Seoul Metropolitan Government Ordinance on Establishment and Operation of Climate Change Fund. The fund is raised through contributions from general accounts of the Seoul Metropolitan Government, proceeds from the operation of the fund, dividends on investment in the Korea District Heating Corporation, stock dividends of the Korea Gas Corporation and proceeds from the sales of GHG emissions permits, among others. The fund is used to supply renewable energy and district energy, develop GHG emissions reduction technologies, and implement energy efficiency and energy welfare projects.

Still, the city recognizes the need to diversify funding sources from the central government and businesses.



The Citizens Committee for Green Seoul



● Adopt climate budgeting

Seoul is planning to introduce a climate budgeting from 2022 as part of its efforts to embed climate change across the city government, and the commissioned research to Seoul Institute on how the city could best adopt a climate budget is done.

The climate budgeting that Seoul is considering will make city departments to include analysis of climate impacts in their budget planning. Every budget activity will be divided into GHG emissions reduction activity, currently emitting, and potentially emitting activity. Activities that currently and potentially release GHGs will be required to come up with reduction measures.

Communication

Seoul is strengthening public communication to accelerate Green New Deal and implement the climate action plan. As described earlier, the city made sure that it had widely communicated its plan for carbon neutrality and listen to and incorporate citizens' voices into the final climate action plan. Toward the end, the city conducted two public surveys and ran the Climate Action Forum comprised of experts and members of civic groups and reflected their proposal into policies through the Climate Crisis Taskforce discussions.

By having a press conference on Green New Deal, the city announced the beginning of public opinion gatherings for its

2050 climate action plan. Since then, the city government spared no efforts to communicate with the public through other efforts, including discussions with district offices and public consultations.

In addition, the civic committees participating in the Metagovernance are communicating the 2050 Seoul Climate Action Plan. For example, the Citizens Committee for Green Seoul, the Energy Policy Committee, the Construction Committee and Transportation Committee included in the Metagovernance each communicate actions belonging to their own sectors to the public.






Seoul also recognizes the importance of education to build a public consensus on climate action. The city is going to strengthen climate education based on the third Seoul Master Plan for Environment Education. According to the plan, the Seoul Environment Education Center will be set up to support and connect environmental education providers, assist educational program development and train experts. Also, the Seoul Environment Education Portal provides information on climate education and serves as a networking platform for green education organizations. In addition, the city is going to designate elementary, middle, and high schools as the Green Future Schools to provide incentives for climate education.

Such communication and education efforts are expected to contribute a lot to the implementation of this climate action plan.





SUMMARY

2050 Seoul Climate Action Plan

Climate Change Mitigation Actions

Sector	Key Actions	Timeline	Leading Divisions
 Building	Green remodeling of old buildings	[Table 4-1]	Climate Change Division etc.
	Mandatory ZEB for new buildings	[Table 4-2]	Architecture Planning Division etc.
	GHG caps for buildings	[Table 4-3]	Climate Change Division
 Transport	Accelerating shift to clean vehicles	Municipal fleet (from 2020~) City buses (from 2021~) Taxi (from 2030~)	Climate Change Division, Bus Policy Division, Taxi & Logistics Division
	Road space reallocation	22 roads to be reallocated by 2025 for green mobility	Transportation Policy Division etc.
	Ban on new registration of ICEVs	from 2035	Vehicle Emissions Control Division
	Ban on use of ICEVs	from 2050	Vehicle Emissions Control Division
 Waste	Foster disposable packaging-free stores	by 2025	Resource Circulation Division
	Zero municipal waste sent direct to landfill	by 2026	Resource Circulation Division
	Resource circulation industry	-	Resource Circulation Division
 Energy	Solar PV	5GW installed solar capacity by 2050	Green Energy Division
	Fuel cell and other renewable energy	1GW installed fuel cell capacity by 2050	Green Energy Division
	Smart energy city	Energy Information Center to be set up by 2025	Green Energy Division
 Forest	Urban forest	30 million tree planting by 2022	Parks & Landscape Planning Division
	Anti-desertification in Northeast Asia	100ha, 100,000 tree planting from 2016 to 2020 Tree maintenance from 2021 to 2023	Climate Change Division

Climate Change Adaptation Actions

Sector	Sub-sector	Key Actions	Leading Divisions
 Health	Heat waves	Cooling shelters and safety systems	Safety Support Division etc.
		Protection of vulnerable groups to heat waves	Public Health Division, Low-income and Homeless Assistance Division etc.
	Infectious diseases	Infectious disease response systems	Infectious Disease Control Division
		Food poisoning response	Food Policy Division
	Air pollution	Protection of the health of vulnerable populations from air pollution	Air Quality Policy Division, Infectious Disease Control Division
		Air pollution monitoring and prevention	Air Quality Policy Division
 Disaster	Storms and floods	Strengthen emergency response to storm and flood damages	Stream Management Division , Safety Support Division
		Enhance restoration capability of vulnerable populations	Stream Management Division
		Improve safety of flood-prone communities	Stream Management Division
		Improve infrastructure to better respond to heavy rain	Stream Management Division, Sewerage Treatment Planning Division
	Heavy snow and cold waves	Reduce damages from heavy snow and establish safety system	Road Management Division
		Strengthen snow removal system by areas	Road Management Division
 Water	Stable water management	Increase safe water reuse	Water Circulation Division
		Supply municipal water in case of a drought	Seoul Waterworks Authority
	Clean and healthy water	Reduce pollutants from streams and rivers	Water Circulation Division, Sewerage Treatment Facilities Division
 Forest-Ecosystem	Forest disaster and prevention	Establish a system to prevent forest disasters	Landslide Prevention Division, Nature & Ecology Division
		Improve forest resilience	Nature & Ecology Division
	Biodiversity preservation	Strengthen monitoring of species vulnerable to climate change	Nature & Ecology Division
		Preserve and restore ecosystem	Nature & Ecology Division
	Green spaces	Prevent damage to park facilities from water storms and floods	Landscape Division
		Expand urban green spaces	Landscape Division
		Promote urban farming	Urban Agriculture Division, Agricultural Technology Center

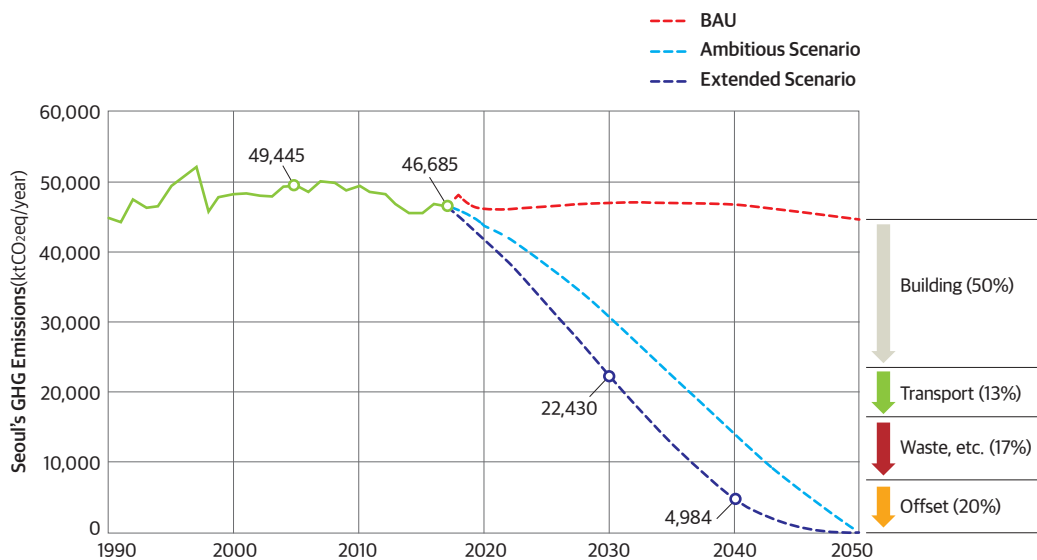
APPENDIX

Extended Scenario

According to C40 Cities, the extended scenario serves to identify strategies that if implemented could close the gap between the city's ambitious action scenario and Deadline 2020 emissions reduction objectives.

Seoul's 2050 target is to reach net emissions by 2050 and its interim targets are to cut GHG emissions by 40% by 2030 and 70% by 2040 from 2005 levels. As C40 commented that Seoul's 2030 scenario is not compatible with the Paris Agreement's 1.5°C ambition, Seoul modeled an extended scenario as below:

The extended scenario includes a target to cut GHG emissions by 54.6% by 2030 and by 89.9% by 2040 from 2005 levels.



Below are additional reduction strategies under the extended scenario and key barriers that make them infeasible under current and foreseeable future conditions.

Additional reduction strategies

1	Tighten the cap on GHG emissions for buildings	Building
2	Introduce a vehicle tax based on GHG emissions	Transport
3	Improve energy efficiency of aviation	Transport
4	Improve energy efficiency of industry	Industry
5	Deploy additional renewable energy	Energy
6	Secure additional carbon credits	Offset

Strategy 1

Tighten the cap on GHG emissions for buildings

Description/ Assumptions	<ul style="list-style-type: none"> Seoul's scenario : Introduce a cap on GHG emissions first for municipally-owned buildings and buildings with high energy consumption and phase in other types of buildings later on. Extended scenario : Expand the cap to include small and medium-sized buildings
Barrier	<p>Legal & Institutional : Revisions to the Green Building Construction Support Act is needed to enforce the cap on GHG emissions for buildings.</p> <p>Financial : N/A</p> <p>Political & Social : Imposing the GHG emissions CAP on small and medium-sized buildings is expected to be not well received by the owners of the buildings.</p> <p>Practical implications & technological : N/A</p> <p>Other : N/A</p>

APPENDIX Extended Scenario

Strategy 2 Introduce a vehicle tax based on GHG emissions

Description/ Assumptions

- **Seoul's scenario** : Vehicle taxes are currently imposed based on the ownership (displacement, vehicle types etc.) and driving (fuel types etc.) of vehicles.
- **Extended scenario** : Introduce a vehicle tax (carbon tax) based on vehicles' GHG emissions

Barrier

Legal & Institutional : An amendment to local acts is required to introduce this new tax, over which the state government has control and the city cannot do on its own.

Financial : N/A

Political & Social : N/A

Practical implications & technological : N/A

Other : N/A

Strategy 3 Improve energy efficiency of aviation

Description/ Assumptions

- **Seoul's scenario** : There are no policies put in place by the city in relation to this.
- **Extended scenario** : Improve energy efficiency of aviation to further cut GHG emissions from transport

Barrier

Legal & Institutional : The national government has powers over aviation policies

Financial : N/A

Political & Social : N/A

Practical implications & technological : N/A

Other : N/A

Strategy 4 Improve energy efficiency of industry

Description/ Assumptions

- **Seoul's scenario** : There are no policies taken by the city in relation to energy efficiency improvements of industry.
- **Extended scenario** : Further GHG emissions reduction could be achieved through improvements in the industrial sector

Barrier

Legal & Institutional : The national government has powers over industrial policies

Financial : N/A

Political & Social : N/A

Practical implications & technological : N/A

Other : N/A

Strategy 5

Deploy additional renewable energy

Description/
Assumptions

- Seoul's scenario : 5GW installed solar PV power and 1GW fuel cell power by 2050
- Extended scenario : Increase renewable power generation

Barrier

Legal & Institutional : An overhaul to electricity pricing is needed to further accelerate renewable energy, but control over this is owned by the national government.

Financial : Additional finance is need to be secured and the economic feasibility of renewable electricity should be improved in order to set higher renewable deployment targets.

Political & Social : Low responsiveness by the public to changes needed on the way to further deploying renewable energy should be resolved.

Practical implications & technological : N/A

Other : N/A

Strategy 6

Secure additional carbon credits

Description/
Assumptions

- Seoul's scenario : Offset about 20% of GHG emissions by 2050 from 2005 levels
- Extended scenario : Further offset GHG emissions by securing carbon credits

Barrier

Legal & Institutional : There is a lack of global consensus on the methodologies of carbon offsets.

Financial : N/A

Political & Social : N/A

Practical implications & technological : N/A

Other : N/A

EPILOGUE

Fully recognizing the crucial roles of cities in limiting global warming to 1.5°C, Seoul is committed to the global efforts toward carbon neutrality by 2050. As indicated in the public surveys and policy proposals by the Climate Action Forum, a majority of Seoul citizens support the 1.5°C goal and expect their city to take action toward carbon neutrality by 2050. How Seoul is going to achieve the target is presented across this plan. Most of all, Seoul is going to aggressively tackle building, transport and waste emissions that account for 94% of the city-wide emissions, while offsetting any remaining emissions to reach net zero emissions by 2050.

Seoul is going to implement GHG emissions cap for buildings and promote zero energy buildings as key actions for its carbon neutrality target. In addition, the city is going to expand driving ban in the city center and fully shift to zero emission vehicles by 2050. With this change, electricity demand is expected to grow, and the city is going to make sure that the electricity is generated from clean energy sources by expanding solar PV and fuel cell power generation. Seoul is also going to reduce waste emissions by working toward zero waste to landfill, among others.

Seoul expects such efforts to not only cut GHG emissions and contribute to the global target of limiting temperature rises to 1.5°C, but also reduce air pollution and create new economic opportunities, thereby improving the quality of life for its citizens.

As Seoul presented its adaptation goal as a healthy and safe city, the city is going to do everything it can to improve resilience of four key areas of health, disasters, water, and ecosystem.

Seoul is committed to successfully implementing and revising this climate action plan every five year to keep us on the path toward carbon neutrality by 2050.

2050 Seoul Climate Action Plan

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