

New Renewable Energy (One Less Nuclear Power Plant)

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1. New Renewable Energy System and Policy

Based on the official effect of the Tokyo Protocol in 2005, it is predicted that the obligation of reducing greenhouse gases will need to be performed during 2008 to 2012, and Seoul, as a biggest energy consumer in Korea, is required to support the government's new renewable energy and renewable energy policies as well as make concerted efforts to promote the reduction of atmospheric contamination and the relief of global warming.

Through the Seoul Energy Declaration in Seoul in 2007, the goal of the nation's first low carbon society vision and the obligation to reduce greenhouse gases were established. Furthermore, the '5 year Green Growth Plan (2009-2013)' was proposed to apply low carbon technologies and develop green cities. Along with this plan, demonstrative cities with respect to the low carbon urban restoration project and low carbon energy saving new city developments were selected and supported. From this, the specialized new renewable energy supply project was initiated for residential housing, buildings, and regions.

Seoul reflected the regional properties and the flow of the international society in order to establish the 'Energy Master Plan' in 2008. This plan proposed the vision of 'the realization of sustainable energy' and, in the following year, Seoul city reinforced its relativity with the Energy Master Plan to announce the '2030 Seoul Energy Master Plan' including the vision of 'low carbon green growth'. To realize this plan, Seoul city proposed three initiation strategies of the low energy consumption city, energy recycling city, and energy welfare city. To initiate the three strategies, specific plans were established, such as guarantees of basic energy rights, in addition to long and short term energy saving, increases in efficiency, and low carbon energy supply plans in the home, commercial buildings, transportation, and public fields. In 2011, Seoul city set the goal to reduce the emission of greenhouse gases, reduced energy usage, and increased use of new renewable energy as part of the 'Seoul Energy Declaration'. In addition, the '2030 Seoul Green Design Masterplan' was established to conform to the vision of the basis

¹ Translation by ESL®

of the government’s policy of low carbon green growth, and to propose an initiation plan that emphasizes the properties of the metropolis of Seoul, and includes integrated and long term plans.

As an integrated means of the 「One Less Nuclear Power Plant Plan」 through reduced energy consumption and increased generation of new renewable energy, the goal of reducing 2 million TOE of energy by producing 410 thousand TOE of new renewable energy (including solar power and hydrogen cell), and reducing 1.59 million TOE through low energy consumption and the efficient use of building transportation energy, was established in 2012.

In 2014, the goal of Phase 1 of the One Less Nuclear Power Plant Plan was achieved, and Phase 1 initiation projects were effectively reinforced and expanded to new fields in order to initiate Phase 2 of the One Less Nuclear Power Plant Plan. It aims to reduce 40 million TOE of energy, gain 20% of energy by 2020, and to reduce 10 million tons of CO2 of greenhouse gases.

Table 1. Comparison of Phases 1 and 2 of Seoul City’s 「One Less Nuclear Power Plant Plan」

	Phase 1	Phase 2
Vision	<ul style="list-style-type: none"> ▪ Energy self-reliant construction 	<ul style="list-style-type: none"> ▪ Energy self-reliant city, Seoul - Three values of energy: independence, sharing, participation
Goal	<ul style="list-style-type: none"> ▪ Reduction of 20 million TOE of energy 	<ul style="list-style-type: none"> ▪ 20% power independence rate (2020) - Reduction of 40 million TOE of energy, reduction of 100 million ton of greenhouse gases
Strategy	<ul style="list-style-type: none"> ▪ Production, efficient use and saving of new renewable energy 	<ul style="list-style-type: none"> ▪ Change of the social structure through institutionalization - Dispersive energy generating city - Efficient low consumption social structure - Innovative energy employments - Warm energy sharing community
Task	<ul style="list-style-type: none"> ▪ 71 projects in three fields 	<ul style="list-style-type: none"> ▪ 88 projects of 23 tasks in 4 fields

Source: One Less Nuclear Power Plant 2 Seoul Sustainable Energy Action Plan, Seoul City

One Less Nuclear Power Plant Plan

Seoul city predicted that the reduction of 2 million TOE in Phase 1 of the One Less Nuclear Power Plant Plan would be completed in the first half of 2014, six months earlier than planned,

and so discussed the methods of establishing the succeeding plan from January 2014.

Phase 2 of the One Less Nuclear Power Plant Plan comprised various means of professional meetings, citizen discussions, and the analysis of overseas cases to realize the values of energy self-reliant programs, sharing and participation as pursued by Seoul. These were based on improved policies and the innovation of the energy consumption structure achieved by Phase 1.

Discussions of Phase 2 of the One Less Nuclear Power Plant Plan were conducted around private and governmental governance organizations, ‘One Less Nuclear Power Plant Plan executive committee’ and the executive committee discussed the values and visions of Phase 2 of the One Less Nuclear Power Plant Plan. In order to establish an efficient executive plan, the existing four divisional committees were reformed into five divisions of general affairs division, energy generation division, energy efficiency and saving division, energy industry and employment division, and energy welfare and the community division. Through many meetings, the tasks required to achieve the visions and values were devised. Furthermore, an initiation plan was discussed, and a forum was held to discuss policy he energy industry to collect broad opinions of professionals and citizens.²

Table 2. Phase 2 Executive Plan of One Less Nuclear Power Plant

General Affairs Division	Production Division	Efficiency and Saving Division	Industry and Employment Division	Community and Welfare Division
<ul style="list-style-type: none"> * Organization of plans * Reformation of policies and regulations 	<ul style="list-style-type: none"> * Renewable energy * Dispersive energy, etc. 	<ul style="list-style-type: none"> * Building and transportation sectors * Eco mileage, etc. 	<ul style="list-style-type: none"> * Industry and employment support * Social corporation support 	<ul style="list-style-type: none"> * Low income class support * Donations and sharing projects

Source: One Less Nuclear Power Plant 2 Seoul Sustainable Energy Action Plan, Seoul City

To devise projects in Phase 2 of the One Less Nuclear Power Plant Plan, the opinions of citizens were actively collected through discussions and internet forums. The name was selected as ‘Phase 2 of the One Less Nuclear Power Plant Plan’ through a public naming competition in February 2014. In March, a survey was conducted on 2,000 citizens on the awareness and willingness to participate in the One Less Nuclear Power Plant Plan. Furthermore, the ‘Social Fiction Festival for One Less Nuclear Power Plant Plan Phase 2 was held at Seoul City Hall under the theme of ‘10 million citizen’s Sunlight Imagination Fair for Energy Self-reliant City of Seoul’ attended by 400 citizens to voice their opinions.

Phase 2 of the One Less Nuclear Power Plant Plan was planned to effectively reinforce the projects of Phase 1 and to manifest the energy value through a progressive change of the production and consumption structure of energy and eco-friendly policy. Furthermore, efforts

² Combined Plan of the 「Seoul Sustainable Energy Action Plan」, Seoul City (2014)

were made to supplement the problems including lack of governance and integrated executive, which were found in phase 1. Moreover, the committee focused on application of newly developed technologies, introduction of previously implemented policies and exploration of new tasks.

2. Policy Goal

The management of quantitative goals in Phase 1 of the One Less Nuclear Power Plant Plan evolved to energy value goals in Phase 2, deducing the three values of energy self-reliance, energy sharing, and energy participation.

Energy Self-Reliance	<ul style="list-style-type: none"> * Decreased dependency on external energy to facilitate conversion into a responsible energy consumption city * Generation of safe and sustainable energy in preparation for an energy supply crisis * Expansion of energy industry and employments through the process of energy self-reliance
Energy Sharing	<ul style="list-style-type: none"> * Citizens who enjoy energy services share their resources to energy minority classes and sharing with the future generation <ul style="list-style-type: none"> - Coexistence through energy welfare in minority classes and fair distribution of energy generation and consumption
Energy Participation	<ul style="list-style-type: none"> * Construction of energy governance for the establishment and execution of energy policies * Publication of energy information and policies, and provision of education and training opportunities

Figure 1. Three Values of Phase 2 of the One Less Nuclear Power Plant Plan

Source: One Less Nuclear Power Plant 2 Seoul Sustainable Energy Action Plan, Seoul City

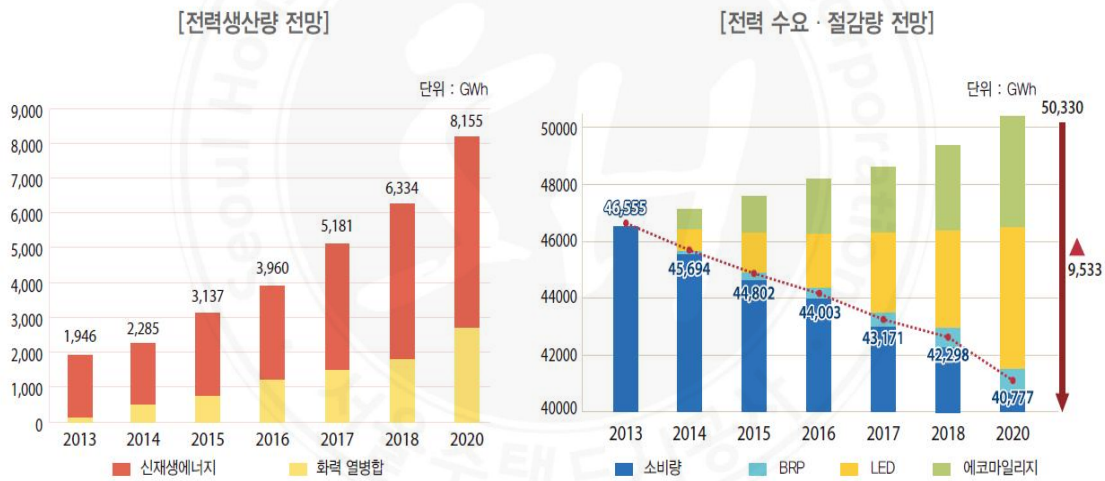
Seoul city has set the goal of expanding energy self-reliance from 4.2% in 2013 to 20% by 2020. 46% of this rate is to be achieved through new renewable energy and thermal convergence development, and 54% is to be achieved through improved energy efficiency and energy saving.

As a core index, energy self-reliance pursues the energy justice from an energy consumption city to a generation city, and reflects regional energy policies that supplement the government's policies on mass production and mass transmission. Furthermore, it is also an index for ascertaining the initiation achievements of the increased efficiency policy and the generation of dispersive energy. The goal energy self-reliance rate is an index that represents the generation of new renewable energy and dispersive energy, efficient usage and saving, and can be considered as the goal achieved by increasing generation and reducing consumption. There are difficulties,

however, in reflecting the effort and achievement of reducing other energy sources, such as fossil fuels, and thus, the reduction of greenhouse gases and the amount of generation and reduction of the total amount of energy (TOE) are concurrently managed.

The amount of energy consumption in Seoul in 2020 is prospected to be 50,330GWh, which applies the 1.2% increase rate of the average energy usage in Seoul over five years from 2009 to 2013. Energy consumption is planned to be reduced to 40,777GWh by 2020, by reducing 9,553GWh through Phase 2 of the One Less Nuclear Power Plant Plan. 5,639 GWh will be reduced through increased efficiency of energy by introducing BRP and LED, and 3,914 GWh will be reduced through energy saving using methods such as eco mileage.

In addition, 8,155 GWh of energy is to be generated through the expansion of new renewable energy and thermal power generation, as well as heat convergence generation, in order to achieve an energy self-reliance of 20%. Through the generation of new renewable energy, including 256GWh of solar power and 2,365GWh of fossil fuel, a total of 2,711GWh of energy will be generated, and 1,195GWh of group energy, 803GWh of self-heat convergence energy and 3,446GWh thermal energy will be generated to equate to 5,444GWh of energy.



Prospects of Energy Generation	Prospects of Energy Consumption & Reduction Rate
<ul style="list-style-type: none"> ■ New Renewable Energy ■ Thermal Heat Convergence 	<ul style="list-style-type: none"> ■ Consumption ■ Eco mileage

Figure 2. Core Index: Prospects of Achieving an Energy Self-Reliance of 20%

Source: One Less Nuclear Power Plant 2 Seoul Sustainable Energy Action Plan, Seoul City

Seoul city has proposed the goal of reducing 10 million tons of greenhouse gases by 2020, a 20.5% reduction compared to 49,008,000 ton CO₂eq of emission in 2011. To achieve this, there are plans to improve energy efficiency by 2,861,000 tons CO₂eq, generate 2,148,000 tons

CO₂eq of new renewable energy, save 2,119,000 tons CO₂eq, supply 2,094,000 tons CO₂eq of LED, transport 576,000 tons CO₂eq, and generate 245,000 tons CO₂eq of thermal energy.

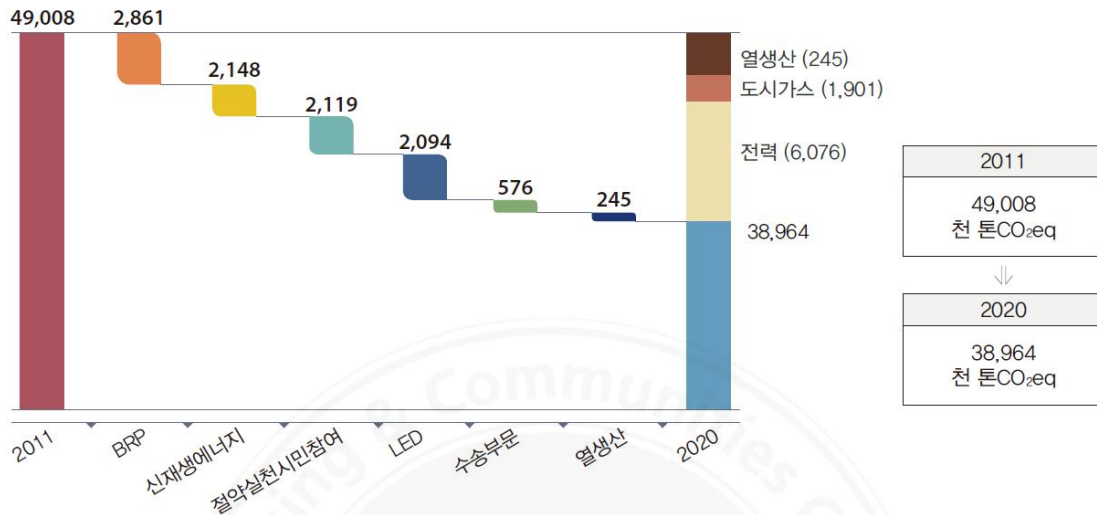


Figure 3. Reduction of 1 million tons of Greenhouse Gases

Source: One Less Nuclear Power Plant 2 Seoul Sustainable Energy Action Plan, Seoul City

Figure 3 translation.	열생산: Heat generation 도시가스: City gas 전력: Power
신재생에너지: New Renewable Energy	49,008,000 ton CO ₂ eq
절약실천시민참여: Participation of citizens in energy saving	38,964,000 ton CO ₂ eq
수송부문: Transported	
열생산: Heat generation	

3. Necessity of Plan

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Seoul's energy self-reliance rate is remarkably low compared to energy consumption, and the generation of new renewable energy is a mere 1.5% of the energy consumption. Thus, there is a need for a new paradigm regarding energy policy.

Although nuclear power is a cheap and efficient source of energy, significant sacrifices and costs arise if a problem occurs, demonstrated by the Fukushima nuclear accident in Japan. Seoul city is reducing the need for the nuclear power plants through the generation of environmentally friendly energy sources. As much as 90% of greenhouse gases, which increase the earth's temperature, are caused by the generation and consumption of energy; thus, Seoul has made efforts to decrease the rising temperature of the earth and to make Seoul healthy and safe for future generations.

Due to possible depletion of fossil fuel and climate change, new renewable energy is noted as

the future’s sustainable energy source. However, the new renewable energy sources that have been developed so far encounter problems of low energy sufficiency or costs. There is a need, therefore, to introduce better research and development and policies for new renewable energy. Seoul is making an effort to further expand new energy and renewable energy sources that can be introduced.

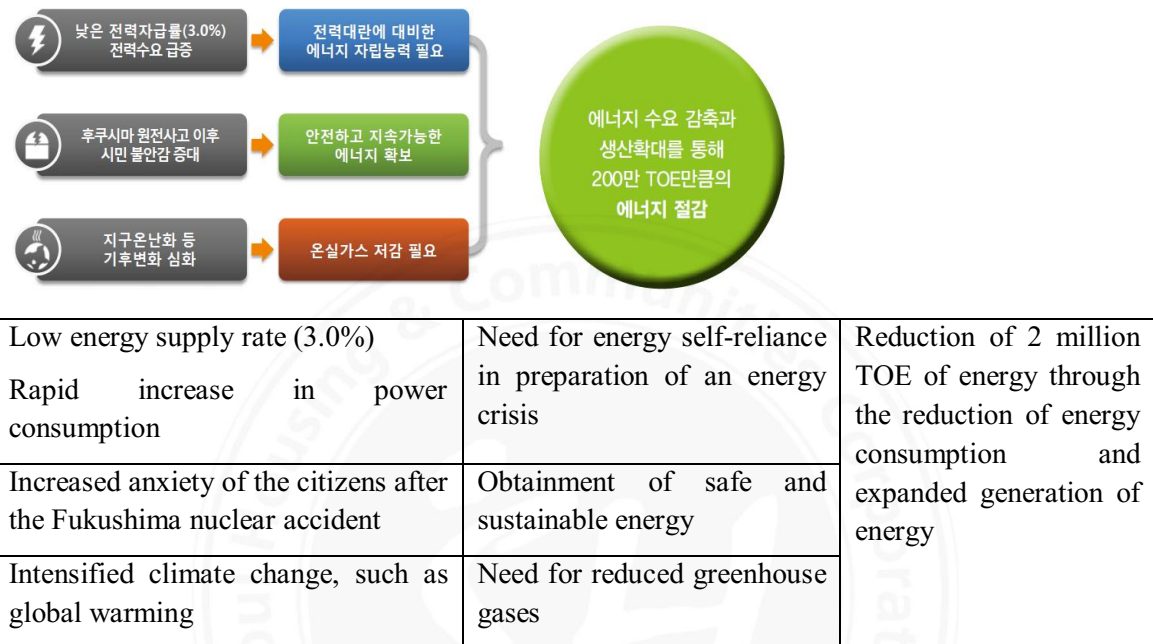


Figure 4. The Need for the 「One Less Nuclear Power Plant」 Plan

Source: One Less Nuclear Power Plant Plan Guidelines, Seoul City

4. Main Policy Contents

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One Less Nuclear Power Plant Plan Phase 2 primarily initiates 10 core projects divided into 88 unit projects and 23 tasks. It has four basic guidelines of the dispersive energy generation city, social structure with energy efficiency, good energy work sites through innovation, and the warm energy sharing community.

4 Guidelines of Energy Policy			
Expansion of Dispersed Generation 5 Tasks, 19 Projects	Energy Efficient City 9 Tasks, 34 Projects	Good Energy Work Site 4 Tasks, 17 Projects	Realization of Welfare through Sharing 5 Tasks, 18 Projects
<ol style="list-style-type: none"> 1. Seoul City of Sunlight! Project 2. Opening of the dispersion energy generation era in buildings 3. Expansion of group energy to 60,000 units by saving 20% of heating cost 4. Finding unused energy within the city 5. Active support for energy self-reliance with innovative policies 	<ol style="list-style-type: none"> 1. Proclamation of zero energy in new buildings 2. Healthy and comfortable architectural city through energy diagnosis and increased efficiency 3. Reinforced responsibility of increasing efficiency in energy in the public sector 4. LED light city Seoul! 5. Reformation to low energy consumption urban space structure 6. Expansion of green car supply 7. Energy saving traffic environment city 111741492670662 8. Settlement of an energy saving citizen life culture 9. Creation of the world's best recycling city 	<ol style="list-style-type: none"> 1. Creating green energy work places with the citizens 2. Customized support for each phase of the life cycle of green energy corporations 3. Construction of the green energy industry and green technology infrastructure 4. Fostering green IT-based green energy innovative technologies 	<ol style="list-style-type: none"> 1. Construction of citizen participating energy welfare fund (platform) 2. Guarantee of basic energy rights 3. Conversion and increased efficiency of reducing energy costs 4. Special means for the energy minority class 5. Energy community project

Figure 5. 4 Energy Orientation Points in of the One Less Nuclear Power Plant Plan Phase 2

Source: One Less Nuclear Power Plant 2 Seoul Sustainable Energy Action Plan, Seoul City

Dispersive energy generation city

Next is a focus on the initiation of the 4 projects of citizen participation, dispersed power, new renewable generation, and regional specialize energy. The initiation goal is to expand small scale dispersive power through new renewable energy and thermal convergence generation.

Citizen Participation	Dispersive Power	New Renewable Generation	Regional Specialized Energy
40,000 mini solar power	61 MW self-thermal convergence	300MW solar power and fuel cell	1.65 million Gcal cooling heat and burning heat

Figure 6. Initiation Goal of Dispersive Energy Generation City

Source: One Less Nuclear Power Plant 2 Seoul Sustainable Energy Action Plan, Seoul City

More support is offered to expand the supply of new renewable energy led by the public sector to include the small scale generation of private buildings as well as the initiation of policies joined by citizens, including mini solar power, sunlight generation citizen funds, and mini power plants.

Along with the obligatory implementation of dispersive power, policies to increase power generation are implemented. To achieve this, Seoul will introduce stricter criteria for the environmental impact assessment, and lower the city gas cost for fuel cells and thermal convergence generation.

1) Production of ‘Healthy and Clean Electricity’ with Citizen Sunlight Generation

- For the conversion of citizens, from energy consumers to energy generators, interest in environmentally friendly energy is induced by supplying 40,000 250W ‘mini solar power generation facilities’, which then allow easy installation in apartments and housing verandas.
- 10MW solar power generation facilities will be installed on urban roads and streets by 2018 to compose a ‘sunlight generation citizen fund’, which is directly invested and profited by citizens.
- The installation of solar light is continually expanded using unused spaces (such as school roofs and corporate buildings), and the locations for the installation of solar power generation facilities using public sites are then diversified.
- The improvement of policies for the expansion of installing solar power generation facilities is continually carried out while the reintroduction of the FIT policy is proposed to the central government to preserve profits of small scale generation businesses.



Figure 7. Solar Power Generation Facility Building

(Source: Seoul Remarkable Environment Policy (Energy City Seoul) One Less Nuclear Power Plant Plan, Seoul City)

구분	합계(MW)	공공시설	민간시설	학교시설
2012~2014	63.9	33.3	26	4.6
2003~2011	20.4	6.3	12.2	1.9
계	84.3(100%)	39.6(47%)	38.2(45.3%)	6.5(7.7%)

*2014년 말 기준

연도별 보급 실적

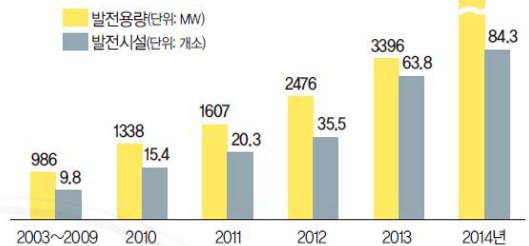


Figure 8. Current Status of Solar Power Generation Facilities

(Source: Seoul Remarkable Environment Policy (Energy City Seoul) One Less Nuclear Power Plant Plan, Seoul City)

2) Safe City with Dispersed Electricity Generation

- As of 2013, there were 46 units of 89MW self-thermal convergence generation facilities, such as apartments and buildings, in Seoul. Thermal convergence generation facilities, which generate electricity and heat in large buildings, are to be expanded from 90MW in 2014 to 150MW in 2018.



Figure 9. Rooftop Solar Panel in Gangseo Agricultural Market

Source: One Less Nuclear Power Plant 2 Seoul Sustainable Energy Action Plan, Seoul City

- In order to increase the power independence rate of housing, old boilers are replaced with extra small heat convergence boilers. These generate electricity and 10,000 sterling engine boilers are scheduled to be supplied to individual homes, such as apartments and villas, by 2020.
- The stability of the operation of city based facilities is maintained through an emergency power supply by installing 174MW fuel cell plants. These have the effect of a high attraction of private investment and power independence by 2018, and installing 20MW fuel cell in city based facilities, such as rail bases (Shinnae, Suseo, Jichuk) and the Seonam water regeneration center.
- Group energy supply facilities are to be constructed for the stable supply of heat sources in the Magok region. The expected heat demand will be responded in connection to the Mokdong thermal convergence plant and GS Power's Bucheon power plant, A 280MW combined gas power plant facility is to be constructed in 2017 for use as a stable heat source after 2020.
- Efforts are extended to improve policies on expansion of dispersive power. In order to increase the installation of new renewable energy facilities over the newly constructed large buildings with surface areas of above 100 thousand m², Seoul will have higher score on the obligatory installation of new renewable energy facilities as one of the deliberation criteria of EIA.



Figure 10. Case Study of Solar Light installed on a Roof

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(Source: One Less Nuclear Power Plant 2 Seoul Sustainable Energy Action Plan, Seoul City)

3) The maximum use of energy in adjacent cities and wasted energy

- Wasted thermal energy is collected for regional floor heating. Hydro energy sources are actively extracted from Jamsil reservoir, water regeneration centers, and purification centers, based on substantive projects to install a 3,160kW scale hydro power plant by 2018.
- Wasted heat sources from adjacent local governments and private corporations are collected to supply the heat source for 10 thousand units, and 35 thousand Gcal is to be supplied per year in connection with the metropolitan heat pipe networks in 2018.

- Through the participation of citizens, the creation of resources is promoted by enhancing recycled waste of vinyl and fabric. Waste vinyl bins will be used in all regions of Seoul to recycle 243,000 tons by 2018, and separated disposal of fabric will be enforced to recycle 168,000 tons of waste fabric by 2018.

Energy efficient social structure

Buildings consume 56% of energy, 87% of electricity, and vehicles release 20% of greenhouse gas emissions, which cause atmospheric contamination. There shows an urgent need for special means to combat this - including the efficient use of buildings, LED supplies, environmentally friendly traffic, and urban planning.

Efficient Use of Buildings	Supply of LED	Environmentally friendly Traffic	Urban Plan
Energy diagnosis systematization (2015) Publication of energy efficiency (2015)	Public 100% (2018), Private 25% > 65% (2018)	Increased charge for greenhouse gas emission	Production of energy map, reinforced inspection of environmental efficiency

Figure 11. Initiation Goal of an Energy Efficient Low Consumption Social Structure

(Source: One Less Nuclear Power Plant 2 Seoul Sustainable Energy Action Plan, Seoul City)

Support, such as facility improvement cost loans are continually expanded for the efficient use of energy, while the introduction of the obligatory efficient use policy is supplemented in consideration of the fact that the policy is still in a nascent stage. To achieve this, policies related to the environmental effect evaluation deliberation standards, green architecture planning standards, and public architecture planning standards are reinforced. Moreover, the concurrent application of institutional regulations and the efficient use of energy are reflected to the market value of buildings to compose a basis for the efficient buildings project to be initiated by market principles. Furthermore, the obligation of diagnosis, substantive application of architecture energy consumption verification policy, and the publication of energy grades will be initiated.

1) Introduction of improved energy efficiency and market principles for buildings through policies

- Seoul will have have stricter deliberation criteria for environmental impact assessment(EIA), obligate the installation of the building energy management system (BEMS), and replace all lighting in buildings to LED lights by 2018 in order to improve the efficient use of energy in large buildings and large scale development projects. This will reinforce the construction of buildings with the level 1 energy efficient.

- Policies are to be improved to have stricter energy audit program on large buildings that consume 2,000 TOE of energy, and an energy reduction model for each application (including hospitals, schools, professional facilities, and hotels), is to be developed and supplied through research.
- A financial basis is to be composed, such as loans for the efficient use of energy in buildings and housing; the scale of these loans and the beneficiaries of this support for efficient buildings are to be expanded, and energy audit is required upon applying for any BRP projects, in order to encourage the reinforcement of the BRP project.
- The beneficiaries of the loans are to be expanded to include energy audit, eco-friendly boilers, and air conditioning devices, in addition to windows and insulation, as well as installation and replacement, operation systems, and monitoring costs. Furthermore, up to 15% of asset tax is exempt upon obtaining the new green architecture certificate or architecture energy efficiency level, and the same benefits are applied to existing building efficiency projects.
- The verification system of the energy efficiency level evaluation report is to be enforced for the value of efficiency projects applied to buildings to be reflected in the trading price of buildings.

2) LED light in all public facilities

- 100% of lighting in public buildings, subway stations, and security lights are to be replaced with LED lighting by 2018, and 65% of lighting in private sectors, which accounts for 30 million units, is to be replaced with LED lighting.

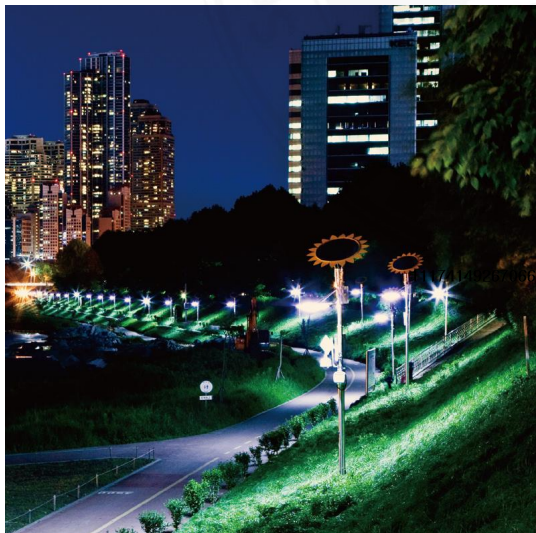


Figure 12. Solar panels installed at Yangcheon River

(Source: One Less Nuclear Power Plant 2 Seoul Sustainable Energy Action Plan, Seoul City)



Figure 13. LED installation at Dongdaemun History and Culture Park

(Source: One Less Nuclear Power Plant 2 Seoul Sustainable Energy Action Plan, Seoul City)

3) Human-oriented, energy saving traffic environment city

The car sharing project, which saves energy through the reduction of traffic consumption, achieves the effects equivalent to the reduction of 3.4 vehicles per one participating vehicle a year, and equivalent to the reduction of over 10,000 personal vehicles for 3,000 shared cars a year. Furthermore, the system is to be reformed to focus on consumers in apartments, public organizations, and corporations, to expand from 1,500 vehicles in 2014 with 1.68 million users, to 3,000 vehicles in 2018 with 2.5 million users.

- Electric vehicles are estimated to achieve the effect of reducing 25% of greenhouse gases including the generation phase compared to standard vehicles. Thus, the emission of fine dust and the consumption of energy are to be reduced through the supply of electric vehicles (green cars).

4) Settlement of public culture of saving resources and energy

- The citizens' representative energy saving program of the eco mileage system is to be continued. 1.68 million eco mileage members in 2014 is to be expanded to 2.8 members by 2018, and 850 thousand TOE of energy, such as electricity and city gas, is to be reduced. To achieve this, members will be obtained through connection with various new renewable energy sources, BRP, LED, and consulting projects, while optimizing energy reduction through monitoring, effect analysis and feedback of the participants.

- Discarded garbage is recycled and changed to energy, while various projects are initiated in order to connect such processes to employments and industries. First, recycling stations will be installed in housing units to increase the recycling rate and to provide employment. About 1,128 stations in 73 quarters in 2014 will be expanded to 3,500 stations by 2016, and the effect of employment creation will be increased through the efficient management of recycling stations by appointing a total of 10,000 station managers with 15 to 30 managers per quarter.

5) Reflecting energy concerns in city policies including climate energy map and urban plans

- An energy map is to be produced to be used as basic data upon establishing main urban plans and climate environmental plans - including city plans, and site usage plans. The energy map is to reflect the researched properties of each region and building with respect to the distribution of use, climate, and the current usage of energy source.

- In order to compose living zones for minimizing the loss of energy consumed during commute and rush hours, the '2030 Basic Urban Plan' will be established. The specific plan includes the composition of pedestrian friendly living zones adjacent to work and housing, the reformation of spatial structures within metropolitan areas in connection with public transportation in order to suppress the use of personal vehicles, and the prevention of the energy-inefficient expansion of urban regions.

6) Reduction of greenhouse gases through the ‘One Less Nuclear Power Plant Plan Phase 2’

- The ‘emission tradingscheme’ delegates a permissible amount of annual emissions to businesses that release a lot of greenhouse gases. It also allows the trading of leftover amounts or insufficient amounts among businesses. The scheme is for corporations that have released more than an average of 125,000 tons CO₂eq and businesses that have released more than 25,000 tons CO₂eq on average over the past three years. 25 facilities in Seoul are included within these scopes, such as waste processing facilities, including the Nowon Resource Recovery Facility, and water regeneration centers that process water.

- Seoul city prepares greenhouse gas inventories by apprehending the greenhouse gas emissions and the current status in each sector. It then uses the inventories as basic data for the greenhouse gas reduction plan and the institutional direction. A greenhouse gas inventory organization is selected to initiate composition and verification, and an efficient reduction plan is to be carried out in connection to the greenhouse gas emission right trading system.

Good energy work sites through innovation

Seoul’s basis for the green energy industry is very weak. Among the approximately 10,000 businesses, 99% are small-and-medium businesses and 59.1% small scale corporations with 5 or less employees. Although investment in new renewable energy, such as solar power, increased with Phase 1 projects of the One Less Nuclear Power Plant Plan, the main products, such as solar power modules, are mostly produced in district areas. Thus the effect of direct contribution to employment creation was relatively small.

Structuralization of green industry	Citizens’ energy project	Regional energy service	Support of green corporations
6 green clusters	70 social corporations and cooperatives	25 energy hub centers	234 enterprise supporting corporations

Figure 14. Initiation goals of good energy work sites through innovation

(Source: One Less Nuclear Power Plant 2 Seoul Sustainable Energy Action Plan, Seoul City)

With continual investment in new renewable energy and LED industry fields, new facilities are to be installed, and service industries for post-management will be nurtured. Furthermore, the pioneering introduction of new technologies suitable for Seoul, such as BEMS and the smart grid will be supported. The customized support for each life cycle is reinforced by considering many small-and-medium corporations with poor management skills and that the formation of industrial market in its initial stage.

Employment in the service industry is based on region, and thus, this project is to be initiated to allow the participation of regional residents and in connection with the energy welfare of the community.

1) Green Metropolitan Seoul, Nurture of Seoul’s green energy industry

- G-Valley, located in Guro-gu of Seoul, is the largest cluster of new renewable energy corporations (including 60 new renewable energy corporations, 117 green IT corporations, and 44 LED corporations), and there is a high possibility of connection with the ICT corporations in G-Valley. Furthermore, green industries, such as IT integration, urban resource circulation, and green architectural service, are to be expanded to six regions within Seoul, and the focal industries will be appointed based on the experience of G-Valley, with various services supported for nurturing of the industries.

Pilot Operation	Expansion	Creation of Achievement
Creation of Pilot Cluster	Creation of Regional Cluster	Combination of Regional Clusters
* Demonstrative new renewable energy cluster project in G-Valley	* Initiation as a contest targeting the concentrated areas of green industries * Consortium of local governments, universities, research institutes and regional groups	* Joint research and production of fused products that include solar power and LED * Nurturing of independent and global cluster

Figure 15. Initiation Direction of the Seoul Green Industry Cluster Nurturing Project

(Source: One Less Nuclear Power Plant 2 Seoul Sustainable Energy Action Plan, Seoul City)

- Seoul city is initiating the pilot smart grid (intellectual power network) project for the establishment of a demand management market and to improve energy efficiency by fusing IT to the existing power network. Various types of projects are to be initiated according to the regional situation and properties of Seoul. Specifically, the project will be initiated in Sadang-dong region in connection with the community energy supply system (CES). The urban industrial complex efficient energy project is to be initiated in Guro Digital Industrial Complex, increased efficiency of energy will be initiated in city railway by Seoul Metro, and the intellectual wiring power network is to be initiated in unit-divided apartments. Together with these projects, the electric gauge, which allows automatic power consumption and demand management, will be supplied to a rate of 50% in 2016 and 100% by 2020. Furthermore, the electricity usage information alarm system, which alerts electricity usage and gradual increase in real time, is to be developed and demonstratively applied to apartments in Seodaemun-gu.

2) One-stop customized support for green corporation for each lifecycle

- To support the foundation of green corporations in Seoul, the ‘Green Corporation Enterprise Fund’ is operated. A total of 8 types of funds are composed equating to 126 billion won - including 46 billion won in 3 funds during Phase 1 and 80 billion won in 5 funds during Phase 2. The fund will be used to support corporations that have green technologies, but lack financial

strength, for 4 to 5 years. Prospective venture corporations are prioritized to annually provide financial support from the 25 to 30 billion won small-and-medium business nurturing fund.

- To create jobs in the green industry, the development of green technologies has been actively supported. First of all, financial support will be granted on the 7 major R&D for green technologies including green cars, green IT, new renewable energy, green architecture, and LED lighting by 2018. GT research and development tasks that suit corporate demand are to be selected to support new technologies in connection with corporation affiliated research institutes and university research institutes.

3) Creation of jobs in the green energy industry

- Seoul will select 70 social enterprises and cooperatives in the energy field by 2018. Intensive support will be made during the initial stage to develop them into grade corporations with remarkable self-sufficiency. First, up to KRW 300 million is to be supported as pilot operation costs, and a consulting education program will be operated to nurture socioeconomic bodies in the green energy field through the ‘socioeconomic support center’ and ‘cooperative consultation center’.

- Seoul will establish as many as 25 ‘regional energy hub centers’ by 2017, which provide energy-related services to the citizens. This center provides combined services, such as the installation of energy equipment, monitoring, and post-management, as well as other services, including installation of LED lighting, installation of solar lighting, provision of price information, group purchasing, and product exhibition. The hub center uses the offices of citizen groups, and leases public organizations when needed. It also plans to expand to a service sales network and energy cooperative service business.

Realization of welfare through sharing

Having an energy expense of 10% of the income, it is estimated that 10.3% of the households in Seoul are energy poor homes. Low income classes consume relatively high priced energy (LPG, kerosene), and low efficient home appliances to spend 4.7 times the average cost of all homes. The government has thus far failed to construct sufficient legal policies in this regard.

Responsibility of energy welfare	Citizen participation	Conversion, increased efficiency	Community
Energy welfare ordinance The country's only enactment	100,000 participants in the welfare fund	1,100 units in the low income insulation project	200 energy self-reliant villages

Figure 16. Goal of initiating warm energy sharing communities

(Source: One Less Nuclear Power Plant 2 Seoul Sustainable Energy Action Plan, Seoul City)

A regional energy welfare policy suitable for local government is to be realized. To this end, institutional consideration is supplemented in regions that are not benefited from the central government's welfare policies by reflecting the regional properties of Seoul. These include rented homes and lower class accommodation in the cities through such institutionalizations as the enactment of the energy welfare ordinance and basic energy rights.

Fundamentally, energy conversion projects are to be initiated, including increased energy efficiency in homes and the reinforcement of solar light. Furthermore, direct support of vouchers and energy costs are concurrently enforced in preparation of energy crises. Moreover, the capacity for carrying out specialized policies regarding energy welfare is reinforced by nurturing and conducting research on energy welfare officers, and reinforcing energy functions in residential welfare support centers.

1) Guarantee of energy welfare rights through policy

- Seoul is coming up with an institutional basis that guarantees the use of energy as universal and basic rights. Various opinions were collected to prepare the energy welfare ordinance plan, and the preparation of the ordinance plan is to be announced in order to declare energy welfare. The main content of the ordinance includes the preparation of specific standards, such as the selection of the eligible applicants, as well as specifying Seoul city's responsibility toward the energy poor class. This will be part of the preparation of the basis for the presentation of an energy welfare platform (fund).

- Seoul will raise energy welfare fund for citizens that is created, operated, and distributed by the people themselves. The fund is to be composed through profitable donations generated by the production and saving of energy (including solar power, LED, increased efficiency of housing, and eco mileage systems), and is to be used for the objective of supporting the energy poor class.

Citizen participation	Citizen management	Sustainable fund
> Participants in solar power, LED, and eco mileage projects	> 111,740 citizen committee members (fund, management, delegation)	> Preparation of a basis with the energy welfare ordinance > Connection with professional fund groups

Figure 17. Participation of citizens through the policy

(Source: One Less Nuclear Power Plant 2 Seoul Sustainable Energy Action Plan, Seoul City)

2) Building basis for the regional energy community

- An energy self-reliant village plan is to convert a village from a consumer to a village that creates profit through efficient use and generation of energy, and shares energy in connection with energy welfare. 15 villages in 2014 will be increased to 200 villages by 2018, and specialized projects suitable for each village will be branded.

- A virtuous cycle of an energy ecology system is to be created in the village community by expanding the citizen's energy saving project. After analyzing the effect of two demonstrative power saving stations in 2014, 10 stations will be installed in 2015, and consecutively expanded from 2016. A citizen power saving station is initiated with the direction of promoting value by reinvesting and sharing the incentive given to eco mileage members. The main fundamental group of the region will be selected, and a power saving station director performing the role of a coordinator is to be nurtured. An 『Energy Station』 for energy recharging services is operated in each village, and the investment basis of energy projects is composed by reforming the eco mileage system and reducing energy points.

Eco mileage reduction point system	Power saving stations in villages	Energy project investment and consumption	Village corporation
> Citizen power saving station	> Coordinator groups, power saving station director > Network, promotion, etc.	> Energy station > Energy supermarket, BRP, solar light, etc.	Citizen fund

Figure 18. Energy project through the citizen participation system

(Source: One Less Nuclear Power Plant 2 Seoul Sustainable Energy Action Plan, Seoul City)

5. Policy Effect

1) Proposal of vision and successful model of the regional energy policy

The One Less Nuclear Power Plant Plan is an energy policy that expands the former energy saving policy to the generation of new renewable energy and BRP, which has reduced the total consumption of energy - such as electricity, gas, and fuel. Furthermore, regardless of the restriction of a local government group, it is evaluated that a successful model of a regional energy policy is proposed through creative policy improvements and projects. Seoul's good policies, such as the Feed in Tariff (FIT) policy, improved rental of solar power generation facility sites, and the supply of mini solar power in particular, have been expanded to other district groups.

2) Improvement of public awareness of and revitalized public participation in energy policies

The One Less Nuclear Power Plant Plan can be considered a citizen-led energy policy. As many as 1.68 million Seoul citizens have participated in the eco mileage policy, and around 20,000 students in the energy guardian angel group to partake in energy saving in the home and at school.

Such citizen participation is estimated to be based on the active support from the citizens toward the One Less Nuclear Power Plant Plan. According to the survey conducted on the One Less Nuclear Power Plant Plan in March 2014, as many as 71% of the respondents said they knew about the One Less Nuclear Power Plant Plan. Furthermore, since 59% of the respondents stated that the Plan is ‘good’, it is believed that the One Less Nuclear Power Plant Plan is seen as a plan that is highly supported and necessary in Seoul at the current stage.

3) Formation of initial basis for energy related industry and employment

The One Less Nuclear Power Plant Plan has revitalized the Korean LED market through the LED supply project in large scale public facilities, including the entire replacement of lighting in subway stations to LED lighting and required the installation of LED in newly constructed public offices, and has attracted 600 billion won of private capital to contribute to the preparation of employment in new renewable energy production and installation fields, such as solar power and fuel cells. Furthermore, energy planners have obtained new employment in the establishment of three cooperatives based on the experience of energy diagnosis in commercial buildings.

6. Policy outcome

Outcome of One Less Nuclear Power Plant Plan Phase 2

1) Initiation of the core index of Phase 2, such as increasing power independence rate

The bases of most projects were constructed by initiating Phase 1 of the One Less Nuclear Power Plant Plan, which accumulated experience to enable the achievement of exceeding the goal of the first year.

Index	Goal (Jul 2014 – Dec 2015)	Outcome (Jul 2014 – Sep 2015)
Energy self-reliance rate	7.0% (2014 Goal: 5.0%)	4.7% (based on the capacity of facilities at the end of 2014)
Increased efficiency in generating energy and energy saving	902,000 TOE	910,000 TOE

Figure 19. Energy self-reliance initiation achievement

(Source: One Less Nuclear Power Plant 2 Seoul Sustainable Energy Action Plan, Seoul City)*as of 2014

(Unit: 1,000 TOE)

Generation (64,000 TOE)	Increased efficiency (495,000 TOE)	Saved (351,000 TOE)
* Solar power 8.3 * Fuel cell, etc.: 55.6	* Green architecture planning: 225 * Efficiency of building energy: 86.4 * LED supply: 176.2 * Traffic: 7.3	* Eco mileage: 351

Figure 20. Reduction and generation of energy in main projects

(Source: One Less Nuclear Power Plant 2 Seoul Sustainable Energy Action Plan, Seoul City)*as of 2014

2) Main achievements

The initiation of the ‘Seoul City of Sunlight Project’ as a core project in the One Less Nuclear Power Plant Plan Phase 2 has led to the installation of 30MW solar power plants by September 2015. Thereby, Seoul city has a total of 101MW solar power generation facilities, to allow 34,000 homes in Seoul to only use power generated by sunlight.

In order to expand the supply of mini solar power plants, which was actively pursued from the One Less Nuclear Power Plant Plan Phase 2, the support that was provided only to housings installing the mini plants was then expanded to all areas (including public sectors) by increased contact with citizens and sales at large supermarket stores and other locations. Furthermore, a pilot project of installing solar panels on sale booths was initiated to install 2,528kW in 3,469 areas by September 2015.

Seoul has established Special Purpose Company (SPC) which is exclusively in charge of replacing lighting with low-energy high-efficiency LED lighting and has implemented the public lighting replacement project using private capital to replace 93,000 lighting fixtures in 48 business sites in Seoul and 13 other district areas. The project initiated to replace approximately 210,000 lighting fixtures in offices and control rooms of the subway station (Seoul Metro, Urban Railway Cooperation) was enforced by SPC and to be completed in October 2015. With the addition of 430 thousand lighting fixtures exchanged in Phase 1, a total of 640 thousand lightings, excluding the interior lighting of subway trains, were exchanged.

A fund of 1.6 million won in cash and gifts (LED, etc.) had been raised and in January 2015, the ‘Seoul Social Welfare Association’ was selected as the administrative fund operating group, and an agreement was then concluded. In July 2015, the ‘Seoul Citizens’ Energy Welfare Fund’ council was established, and a volunteer university group was created. Since it is important to bring about a warm social atmosphere for energy welfare, in addition to physical support, an energy welfare fund website was constructed to create a cordial living environment based on the participation of many citizens, and promotion has been conducted for the donations and participation of the citizens.

2015	2016	2017	2020
200 million won	600 million won	1.7 billion won	3 billion won

Figure 21. Goal of composing annual energy welfare funds

(Source: One Less Nuclear Power Plant 2 Seoul Sustainable Energy Action Plan, Seoul City)

8. Main challenges and solutions

After 2015, when the One Less Nuclear Power Plant Plan Phase 2 officially began, there were some obstacles caused by the changes in the external conditions and the deterioration of the social environment, including the outbreak of MERS case. Accordingly, there was a need to modify the strategies and goals of initiating the project. There was also a need to adjust the excessively high goals of certain projects that need to be initiated in cooperation with other organizations.

The ‘home energy clinic service’ project, under which energy planners visit homes or stores, thereby checking the energy usage pattern and providing information on how to save energy. However, it was difficult to continue the project in the first half of 2015 due to widespread outbreak of MERS and people’s tendency not to meet others for fear of possible contagion. It was difficult to secure space for the ‘wooden pallet usage boiler’ project causing reduction of demand, and thus it was necessary to modify the project target to public facilities.

Although these disadvantages were eventually overcome and the goal reached, it is predicted that there is a need to come up with strategies in order to achieve the goal of the One Less Nuclear Power Plant Plan Phase 2.

Accordingly, the cooperative system between the One Less Nuclear Power Plant Executive Committee and related organizations has been reinforced and the opinions of professionals of the Seoul International Energy Advisory Group will be collected to devise an efficient strategic system in order to achieve the core goals by 2020.

The solar power project among the core projects of Seoul’s One Less Nuclear Power Plant Plan focuses only on power generation. However, as a project that has been initiated to attract private investment, it is important to attract public attention. For instance, instead of installing solar panels only on school roofs, the installation of solar light in streetlamps near schools will allow citizens to personally experience and benefit from the results.

Although fuel cells, which occupy the largest proportion of new renewable energy sources, are used in large buildings or are supplied for power generation, the policy has not been properly pushed for. Fuel cells can be considered devices that create electricity using hydrogen or natural gas, and not a form of pure renewable energy. After all, fuel cell has limitations as it consumes more gas to generate energy. There is a need consider subsidiary support system for the fuel cell as is in the solar panel project. Overcoming these problems is predicted to contribute to the reduction of greenhouse gases and the generation of new renewable energy in Seoul. If Seoul overcomes such challenges, there will be a great leap forward in the reduction of green house

gas emissions and the development new renewable energy.



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