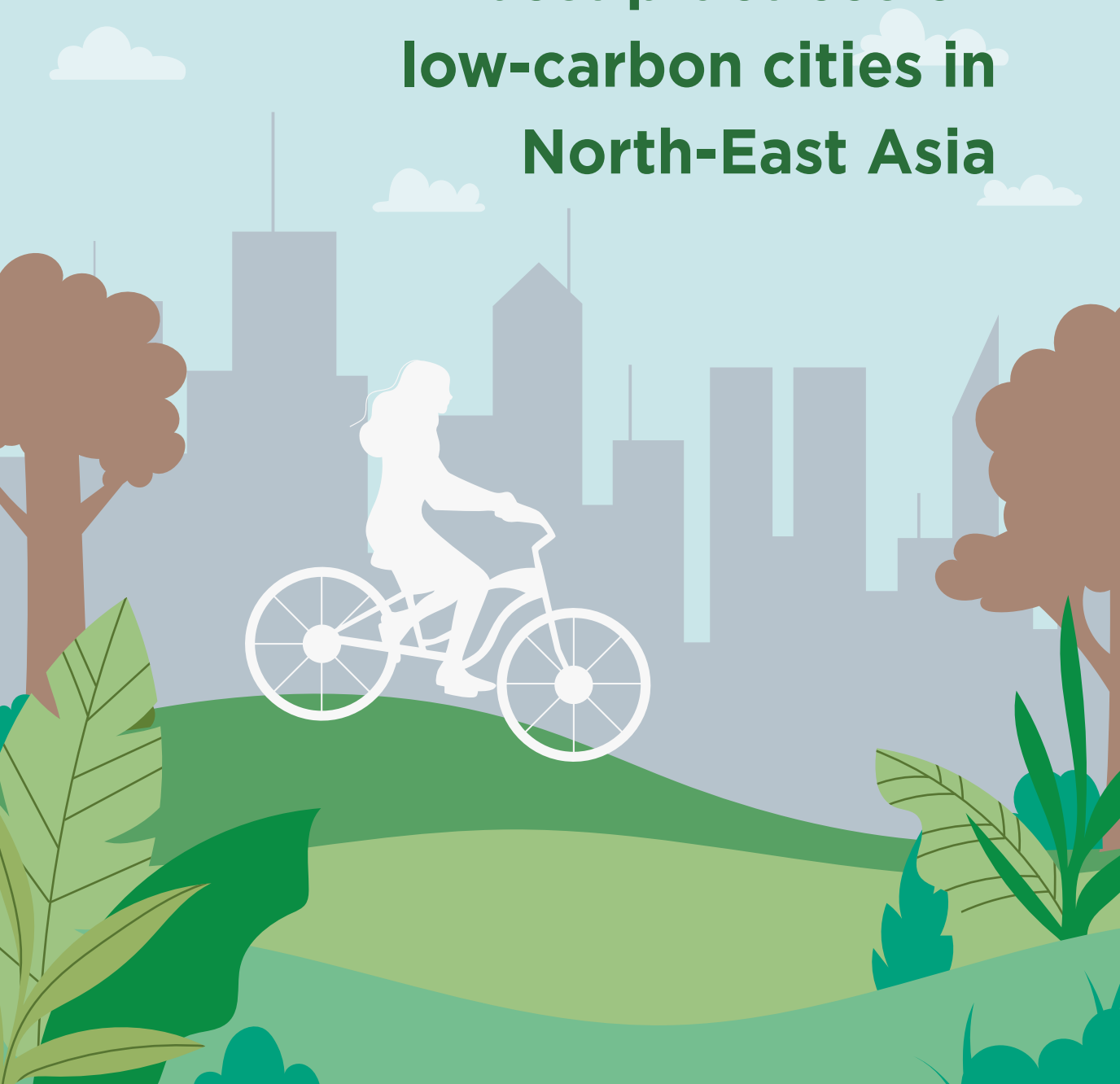




Compendium of best practices on low-carbon cities in North-East Asia





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INTRODUCTION

Developing low carbon and resilient cities serves as an important pathway for realizing national and local mitigation targets while assuring long-term economic growth and improving the quality of life. This compendium collates a total of 20 cases from North-East Asia on how cities and urban centres are making efforts to reduce their carbon emissions and build resilience through the following 4 categories:

- Governance and Policy
- Stakeholder Engagement
- Nature Based and Innovative Solutions
- Circular Economy

Since the adoption of the Paris Agreement in 2015, there has been growing commitments to the transition to a low carbon economy, with more than 130 countries committed to achieving net-zero carbon emissions as of early 2022. In North-East Asia, Japan and the Republic of Korea have pledged to become carbon neutral by 2050,¹ whereas China has committed to building an 'ecological civilization' with carbon emissions peaking before 2030 and achieving carbon neutrality before 2060.² The Democratic People's Republic of Korea has also pledged to reduce its emissions footprint by 15.63 percent by 2030 and 50.34 percent with international support.³ Mongolia has also enhanced the target of its Nationally Determined Contribution (NDC) to achieve a 22.7 percent reduction in greenhouse gas (GHG) emissions from its business-as-usual scenario by 2030 through domestic efforts and to increase its reduction target to 27.2 percent with international support.⁴ The Russian Federation also aims to achieve carbon neutrality by 2060 starting with transforming the fossil-fuel-rich Sakhalin Island into carbon neutral by 2025.⁵

With the increasing urbanization of countries within the subregion, cities play critical roles for implementing projects and policies towards achieving the Sustainable Development Goals (SDG) and meeting pledged reductions in GHG emissions. As in many of the cases presented in this compendium, reducing such emissions often has impacts on many interrelated SDG Goals, often helping to reduce poverty, improve food and energy security, as well as improving the ecosystem for both wildlife and humans. The compendium aims to facilitate learning between cities and accelerate the implementation of emissions reduction measures that are effective for their local conditions.

1 Japan and the ROK pledged carbon neutrality in October 2020.

2 In September 2020, China committed to peaking and carbon neutrality goals by 2030 and 2060 respectively.

3 Values are extracted from DPRK's VNR for 2021. In 2019 climate action summit, DPRK had raised its previous commitments from 2016 of approximately 8% as per its NDC and 32% with international cooperation to approximately 16.4% and over 52% respectively.

4 Mongolia's NDC was approved in November 2019 by government decree No. 407 and a total mitigation of 44.9% by 2030, through the use of forests.

5 As announced at COP 26, as stated through its implementation of Russia's new 2050 strategy of Social and Economic Development



A

GOVERNANCE AND POLICY CASES

Case A1

Reducing Emissions of New Buildings Using Certification Standards in Areas with Heavy Snowfalls (Sapporo, Japan)

Case A2

Greenhouse Gas and Energy Target Management System for the Public Sector (Incheon, Republic of Korea)

Case A3

Reducing Emissions through Renewable Energy and an Energy Management System on a Remote Island (Sado, Japan)

Case A4


Pilot on Constructing Cold Chain Facilities Close to the Farm Gate (Cixi City, Zhejiang Province, China)

Case A5

Deployment of 100 percent Renewable Energy and Certification Systems (Kitakyushu, Japan)

Case A6

Ecological Modernization of the Transport System (Moscow, Russian Federation)



A: GOVERNANCE AND POLICY CASES

Governance and Policy cases cover the innovations on frameworks, regulations, directives and subsidies as examples for city-led emissions management and climate adaptation. In these cases, strategic goals are achieved through careful planning and often require coordination between agencies, as well as private entities and civil society.

Case A1: Reducing Emissions of New Buildings Using Certification Standards in Areas with Heavy Snowfalls (Sapporo, Japan)



Figure 1: Photos of Heavy Snowfalls in Sapporo, Japan.

- **Country/City:** Japan / Sapporo
- **Implementing agency:** Housing Division, Urban Affairs Bureau
- **Funding:** -
- **Funding source:** Local Government
- **Website:** <https://www.city.sapporo.jp/toshi/jutaku/10shien/zisedai/zisedaihojo.html>

Background

Sapporo is the political, economic, and cultural centre of Hokkaido, a metropolis with a population of more than 1.9 million people and is blessed with abundant nature. It is also one of the world's coldest and snowiest cities, with an annual snowfall of approximately 5 meters in winter as shown in Figure 2 below.

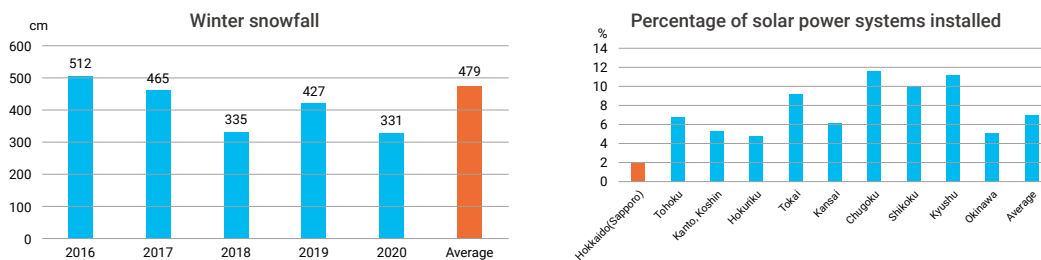


Figure 2: Sapporo Winter Snowfall Levels from 2016 to 2020 (Left) Percentage of Buildings with Solar Systems Installed in 2020 (Right). (Source: Ministry of the Environment, Statistical Survey on CO₂ Emissions in the Household Sector, 2020.)

Sapporo aims to reduce its emissions by 55 percent from 2016 levels by 2030 to become a

'Zero Carbon City' by 2050. Sapporo has developed advanced city promotions. In 2020, the city obtained the highest rank in the LEED for Cities and Communities, one of the categories of LEED, an internationally recognized environmental performance evaluation system. However, due to the extreme cold and heavy snowfall, energy consumption related to heating in Sapporo is three times higher than the national average in Japan. In addition, the use of photovoltaic (PV) systems was lower than other cities of Japan and needed to be promoted in line with adaptation to climate conditions to achieve the target as previously shown in Figure 2.

Therefore, to achieve decarbonization, Sapporo needed to increase the number of energy-efficient houses, and priority has been given to the improvement of insulation and airtightness in new houses and buildings, which will have a long-term impact on carbon dioxide emissions into the future.

Project Implementation

In 2012, Sapporo established the 'Next Generation Housing', a housing performance standard unique to Sapporo that exceeds national standards and has been working to promote highly insulated and airtight housing. New Next Generation Housing is defined as housing that meets both of the following criteria:

- Meeting standards for insulation, etc.; Houses that are highly insulated and airtight and use extremely little primary energy. As a standard, four grades were set based on indicators such as the average skin heat transfer coefficient (UA).
- Fulfilment of sustainability requirements; Houses that not only energy efficiency but also install solar panels and storage batteries as a flexible addition or deletion in response to technological innovations and other changes from the perspective of achieving the SDGs.

The standards were formulated based on the recommendations of the technical study committee, which included experts and others. At the start of the certification and subsidy system, in addition to publicising the system on the city's website and in PR magazines, briefing sessions were held for construction companies, house builders, sash and insulation material manufacturers, etc., and the industry was informed in advance. As small builders may be unfamiliar with calculating the heat loss coefficient of a house, technical manuals, and dedicated calculation sheets have been prepared to reduce the labour required by the builder to calculate the heat loss coefficient. The minimum level in Sapporo corresponds to the national energy efficiency standard, while the Sapporo standard is a measure that encourages more insulated housing as shown in Table 1 below.

Class	UA value W/m ² ·K (Heat Transfer)	Primary energy consumption Heating + Ventilation	Primary energy consumption BEI	C value cm ² /m ²
Top Runner / Platinum	0.18	35 percent	0.6	0.5 or less
High / Gold	0.22	45 percent	0.8	
Standard / Silver	0.28	60 percent		
Basic / Bronze	0.36	75 percent		
Minimal	0.46	90 percent		1.0 or less
Additional Sustainability Requirements				
Solar power generation facility	<ul style="list-style-type: none"> • Total output: 1.5 kW or more • Connecting to energy storage facility. If connected to an electric vehicle, V2H shall be installed. 			
power storage facility	<ul style="list-style-type: none"> • Capacity of energy storage facilities: 2.0 kWh or more • To charge and discharge electricity by connecting to a solar power generation facility. 			

Table 1: Sapporo's New Energy Efficiency Building Standards Emphasizing Insulation and Energy Self-Sufficiency with Power Generation and Storage.

The Sapporo Next Generation Housing was revised to further promote a decarbonised society, and the new system began operating in April 2023. The new standard restructured insulation and other standards and made it newly mandatory to install photovoltaic power generation and storage facilities based on the new national energy efficiency standards.

If the Next Generation Housing is satisfied, a housing interest rate reduction can be applied in conjunction with a 'fixed-rate mortgage for the full term', which is handled by more than 300 financial institutions nationwide in partnership with the Japan Housing Finance Agency.

Results and Impacts

Increase in Energy Efficiency Housing: As a result of Sapporo's efforts to promote and educate the public through certification, labelling, and subsidy schemes to promote Next Generation Housing, energy efficiency in detached houses is gradually increasing, shifting from 19 percent when this standard was established (in 2012) to a higher level of 73 percent in 2020. This is shown in Figure 3 below of the number of new certifications per year since 2015.

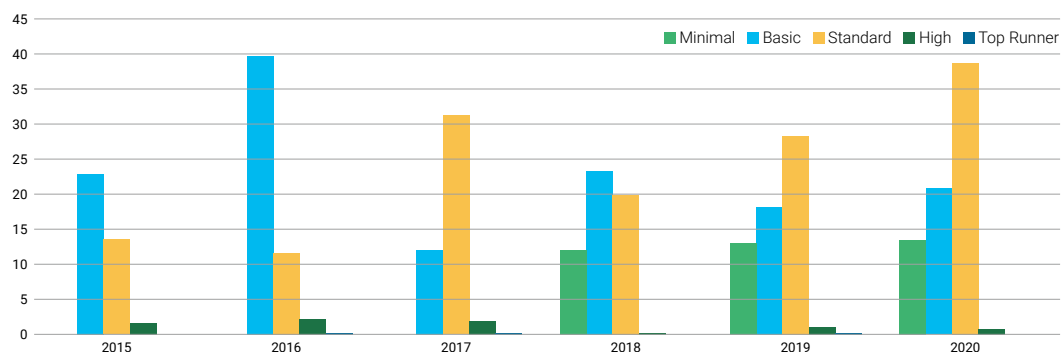


Figure 3: Number of New Buildings and their Certification Levels.

Technical Improvement of Homebuilders: By promoting the spread of energy efficiency standards that exceed those of the national government, this has contributed to the commercialisation of highly insulated houses by various housing manufacturers, as well as to the development of higher-performance products by sash manufacturers and insulation material manufacturers, thereby improving the technological capabilities of related industries.

Lessons learned

By 2030, the aim is to achieve 100 percent of new houses with energy efficiency equivalent to a zero energy home or better. Disseminate Sapporo's initiatives throughout the country. Promote cross-sectoral initiatives by bringing together various actors, including citizens, businesses, and government, with the aim of realising the 'SAPPORO, Environmental Capital', a sustainable city where the next generation of children can live happily.

Issues with rental housing: Rental housing is governed by commercial values of how to build and rent at minimum cost. At present there are no direct means to promote housing built intended for rental to achieve higher tiers and the subject is under further consideration on persuading owners to meet stricter standards.

Technical support for small and medium-sized enterprises: Generally, technical support is needed for small and medium-sized enterprises as they often lack in-house technical skills with regards the construction of houses which have significant thermal insulation and high airtightness, capacity building and tools are provided to help accelerate the transition towards the new standards.

References

1. Sapporo City Government. (2023). The city has begun operating the new "Sapporo Next Generation Housing Standard".
<https://www.city.sapporo.jp/toshi/jutaku/10shien/zisedai/zisedai.html>
2. Sapporo City Government. (2023). Explanation of the System "The new Sapporo version of next-generation housing and the subsidy system."
https://www.city.sapporo.jp/toshi/jutaku/10shien/zisedai/documents/r5_0323_zisedai-seidokaisei.pdf
3. Sapporo City Government. (2022). Technical Review Meeting on Revision of "Sapporo Next Generation Housing Standards"
https://www.city.sapporo.jp/toshi/jutaku/10shien/zisedai/r4_zisedai-kijun-minaoshi.htmlhttps://www.city.sapporo.jp/toshi/jutaku/10shien/zisedai/r4_zisedai-kijun-minaoshi.html
4. Ministry of Internal Affairs and Communications.(2012) Local Government Revitalization Policies (Regional Policy Trends)
https://www.soumu.go.jp/main_content/000215399.pdf
https://www.soumu.go.jp/main_content/000215399.pdf
https://www.city.sapporo.jp/toshi/jutaku/10shien/zisedai/documents/r5_0323_zisedai-seidokaisei.pdf
https://www.city.sapporo.jp/toshi/jutaku/10shien/zisedai/documents/r5_0323_zisedai-seidokaisei.pdf
5. Sapporo City Government. (2023). Explanation of the System "The new Sapporo version of next-generation housing and the subsidy system."
https://www.city.sapporo.jp/toshi/jutaku/10shien/zisedai/documents/r5_0323_zisedai-seidokaisei.pdf
6. Sapporo City Government. (2022). Technical Review Meeting on Revision of "Sapporo Next Generation Housing Standards"
https://www.city.sapporo.jp/toshi/jutaku/10shien/zisedai/r4_zisedai-kijun-minaoshi.html
https://www.city.sapporo.jp/toshi/jutaku/10shien/zisedai/r4_zisedai-kijun-minaoshi.html
https://www.city.sapporo.jp/toshi/jutaku/10shien/zisedai/r4_zisedai-kijun-minaoshi.html
7. Ministry of Internal Affairs and Communications.(2012) Local Government Revitalization Policies (Regional Policy Trends)
https://www.soumu.go.jp/main_content/000215399.pdf
https://www.city.sapporo.jp/toshi/jutaku/10shien/zisedai/documents/r5_0323_zisedai-seidokaisei.pdf
https://www.city.sapporo.jp/toshi/jutaku/10shien/zisedai/documents/r5_0323_zisedai-seidokaisei.pdf

Case A2: Greenhouse Gas and Energy Target Management System for the Public Sector (Incheon, Republic of Korea)



Figure 4: Installation of Solar Power Generation Facilities in Incheon Public Institutions and Lights off at Incheon City Hall during lunchtime.

- **Country/City:** Republic of Korea / Incheon
- **Implementing agency:** Incheon City Hall
- **Funding:** -
- **Funding source:** Local Government
- **Website:**

Background

The central government sets an annual target rate for Greenhouse Gas (GHG) reduction in areas for local governments and the public sector and operates a system to manage its implementation performance. This project aims to induce voluntary and active participation of citizens and the private sector by leading public efforts to reduce GHG emissions.



Figure 5: Carbon-neutral win-win cooperation MOU signed (business, academia, and the public sector)

Project implementation

The Greenhouse Gas Target Management System targets buildings and vehicles used in the public sector, and the central government checks them by setting GHG reduction targets every year. The guidelines for the GHG target management system are prescribed by law, and the Ministry of Environment oversees the overall operation. Each mayor and public organization head, has a role in promoting GHG reduction activities to achieve reduction targets, and this performance is disclosed. It supports facility improvement, and installation of new facilities in the public sector is provided with the budget of the national and local governments.

Incheon Metropolitan City plans various projects to achieve its goals and is also encouraging members of the public to participate. It improves energy efficiency through the upgrading of facilities such as the installation of renewable power generation facilities in public buildings and replacing older light fixtures

with high-efficiency LED lighting devices. The city also carries out behavioural change projects, such as compliance with air conditioning and heating temperatures, prohibition of bringing disposable items into the building, and enforcement of the alternative-day-no-driving system.

To encourage private participation in GHG emissions reduction, various campaigns conducted both online and offline through awareness raising and education on GHG reduction and carbon neutrality, amongst members of the public sector. In addition, a carbon point system is being implemented for the purpose of incentivising citizens to practice carbon neutrality. This programme, as depicted in Figure 6 below, which is a nationwide GHG reduction practice system that reduces the use of electricity, water supply, and urban gas in homes, commerce, and apartment complexes and gives carbon points according to the reduction rate.

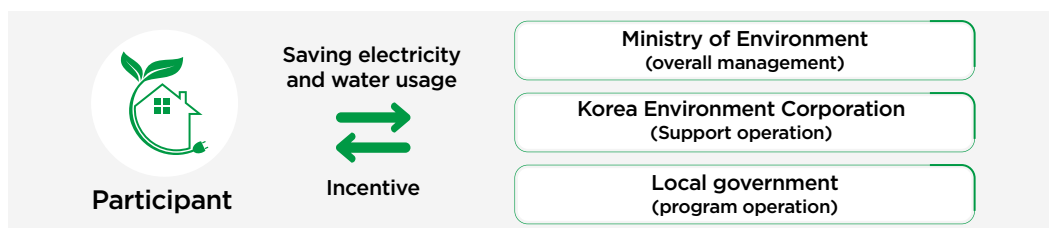


Figure 6: Carbon Point Programme Operating Structure

This programme provides an annual incentive of up to about \$300 if a participant reduces energy (electricity, waterworks, city gas) usage this year by 5 percent or more compared to the same period last year or two. Private businesses, schools, apartments and individuals can participate.

Results and impacts

Greenhouse Gas Reductions Through Efficiency and Awareness Campaigns: Incheon Metropolitan City had the highest reduction rate of GHG emissions in the public sector, including public buildings and vehicles, at 61.4 percent in 2022, among 17 metropolitan governments in the Republic of Korea. Incheon City emitted 25,987 tons equivalent of CO₂ in 2021, reducing 11,870 tons equivalent of CO₂ (61.4 percent) from 37,857 tons equivalent of CO₂ (average GHG emissions from 2007 to 2009).

Incheon Metropolitan City is recognized as one of leading metropolitan cities in the Republic of Korea in efforts to reduce GHG emissions and as a local government. It has been ranked No. 1 for more than five years. The GHG target management system directly improves energy efficiency and contributes to GHG reduction and continues to raise awareness among the public.

Lessons learned

Budget Sustainability Important for Continued Incentives: To maintain incentives and upgrading, the results and effects are proportional to the budget. Stable budget input is therefore essential for continuous project promotion and expansion. This system for the public sector has a limit to the reduction of large amounts of GHGs emitted by the government. Inducing active voluntary private participation is crucial in realizing practical and sustainable GHG reduction effects towards carbon neutrality. As it is difficult to establish a legally binding system for the private sector at the local government level, efforts are needed to expand the public sector efforts to the private sector through private cooperation networks.

Private Partnerships can Enable Project Longevity: Various incentives and specific projects that can incentivise private participation should be devised, with efforts made to share the results and achievements actively. Recently, Incheon Metropolitan City has created a cooperative body and coalition of 35 organizations, including the private and public sectors in the Incheon area, and plans to promote continuous performance management towards carbon neutrality.

Case A3: Reducing Emissions through Renewable Energy and an Energy Management System on a Remote Island (Sado, Japan)

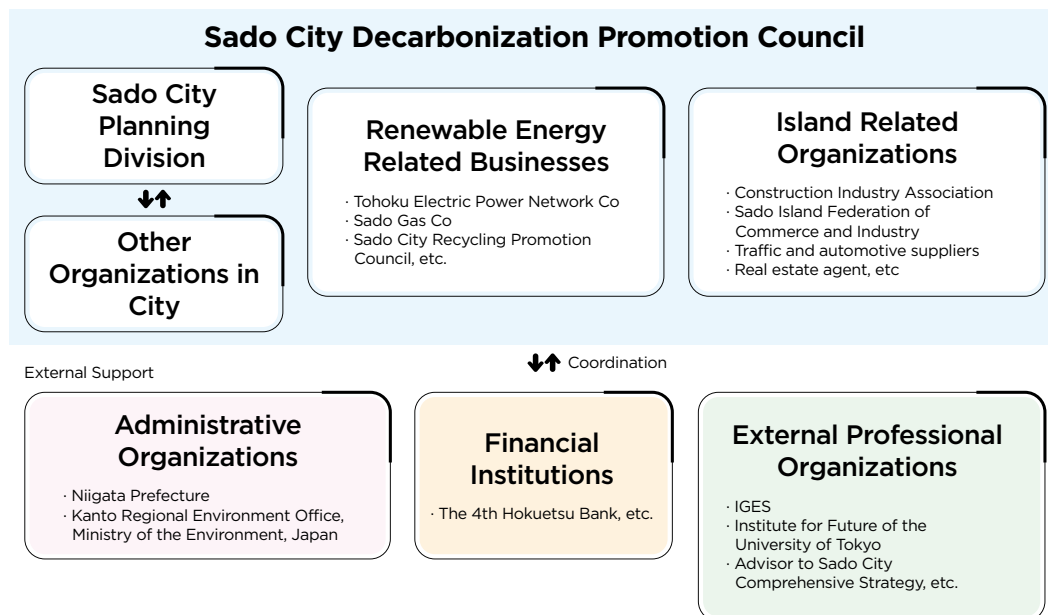


Figure 7: Carbon Point Programme Operating Structure

- **Country/City:** Japan / Sado
- **Implementing agency:** General Policy Division, Planning Department
- **Funding:** JPY 7,597,145,000
- **Funding source:** Ministry of Environment of Japan Grant
- **Website:** <https://www.city.sado.niigata.jp/life/1/19/104/>

Background

Sado City is the largest remote island in Japan and has a diverse and beautiful natural environment, including the Toki (Japanese Crested Ibis). Local industries such as tourism and agriculture, forestry, and fisheries have developed by utilising its natural and cultural resources. The population has declined year by year and now stands at 51,910. The declining population faces several challenges, including falling birth-rates, an aging population, depopulation, economic stagnation, and declining disaster preparedness. As Sado is not connected to the mainland by a power grid, electricity demand is also limited to the island, which results in challenges in balancing between the supply and demand for electricity. To ensure energy security, the island has been diversifying its power sources beyond the three diesel thermal power units, which currently produce 94 percent of the island's share of electricity generation, and the energy supply will primarily come from renewable energy sources such as solar power.

Project implementation

Sado was selected as a Decarbonisation Leading Area by the Ministry of the Environment to ensure stable energy sharing and received a grant for its regional development. The grant was used to implement a self-sustaining, decentralized, and renewable energy system using energy management systems (EMS) in remote island areas. The total project cost: JPY 7,597,145,000. Sado has established the Sado City Decarbonisation Promotion Council with demand facilities, renewable energy power generators, island-related organisations, advisors, and financial institutions with the

aim of realising the Decarbonisation Leading Areas.

As part of the energy creation project, 125 public and private facilities will be equipped with solar panels to generate renewable energy with an output of 7,313 kW and an annual generation capacity of 8,195 MWh. In addition, biomass power generation will also generate 2,964 MWh of renewable electricity, bringing the total to 13,363 MWh of renewable energy in Decarbonisation Leading Areas as can be seen in Table 2 below. For EMS, large storage batteries are deployed mainly in public facilities that serve as major disaster-prevention centres, and each facility is networked to create an energy management system incorporating demand response, thereby securing independent and decentralised power sources, and making electricity supply and demand visible.

On-site (facility installation)	
Number of facilities	125 facilities
Total facility electricity demand	14,628 MWh/year
Total self-consumption of renewable energy	8,195MWh/year
Total storage battery capacity	13,720kWh
Number of mega-storage batteries	10 locations (one in each district)
Off-site (renewable energy)	
Solar radiation	2,204MWh/year
Woody biomass	2,964MWh/year

Table 2: On-site and Off-site Renewable Energy Transition Installation.

Results and impacts

Positive impacts of energy efficiency upgrades: As part of the energy efficiency project, initiatives to reduce electricity consumption through energy efficiency were promoted in 22 public facilities such as primary and secondary schools, including the use of light emitting diodes (LEDs) and air-conditioning upgrades, resulting in an overall reduction of 1,472,619 kWh of electricity annually.

Accelerating renewable energy generation: Through various initiatives such as renewable energy and energy efficiency, CO₂ emissions from electricity consumption in the civilian sector in decarbonised regions will be net zero. A survey on power purchase agreement (PPA) projects for 18 facilities have been initiated in 2022 to develop requirements for solar power and storage batteries while utilising PPA projects, as well as to carry out facility renovations to save efficiency and reduce CO₂ emissions. In 2023, PPA equipment will be installed in public facilities.

Upscaling other initiatives: In addition to the commercialisation of Decarbonisation Leading Areas, the project will also consider appropriate waste and sewage disposal and promotion of resource recycling such as plastics (*civilian sector CO₂ measures, reduction of waste disposal costs, etc.) and agriculture, forestry and fisheries sector measures (reduction of chemical fertilisers, appropriate residue disposal, and livestock management, etc.).

Total emissions can still rise despite efforts at decarbonisation: Regarding changes in GHG emissions in Sado City over time, in 2021, GHG emissions are still increasing despite reduction and renewable energy measures due to increasing building and facility occupancy rates as seen in Table 3 below. 40 percent of Sado City's GHG emissions are derived from electricity, and there is a high potential to significantly reduce GHG emissions by replacing it with renewable energy with funding already secured and well-established renewable energy technologies available.

Year	Amount of emissions (tons of CO ₂)	Comparison with 2016
2016	26,573	-
2017	26,350	▲ 0.8%
2018	25,484	▲ 4.1%
2019	25,662	▲ 3.4%
2020	25,021	▲ 5.8%
2021	25,344	▲ 4.6%

Table 3: Greenhouse Gas Emissions of Carbon Dioxide from 2016 to 2021

Lessons learned

Importance of energy storage for lowering emissions: Sado aims to shorten the project period (early realisation of project effects) by maximising the implementation of renewable energy and large-scale storage batteries, mainly in public facilities, and by networking these facilities to achieve centralised energy management. Sado City also hopes to realise the "Remote Island Sado Model" of Decarbonisation Leading Areas in Sado, the largest remote island in the country, and to extend this successful example horizontally to other 256 remote island regions in Japan.

Regulations to support stable energy supplies: Off-site renewable energy, such as solar and woody biomass, is generated and supplied to consumers in the leading area. Legally, electricity must be supplied via a retail electricity supplier to ensure a stable supply of renewable electricity. Furthermore, a constant balance between the supply and demand of electricity at each facility through the use of centralised EMS and demand response (DR) management through the use of battery storage, demand cut-off or reduction smart systems as examples.

Other initiatives to accelerate green economy: In addition, Sado City was the first local government in Japan to declare itself 'Nature Positive', which aims to restore the ecosystem through reduced farming and to promote investment in nature and a recycling-oriented economy. The aim is to create a regional recycling symbiosis zone and to create islands where its citizens can continue to live in peace.

References

1. Sado City Government. (2022). The city was selected as a leading decarbonization area. <https://www.city.sado.niigata.jp/soshiki/2005/38500.html>
2. Ministry of the Environment (2022). The City Selection Proposal. <https://policies.env.go.jp/policy/roadmap/assets/preceding-region/1st-teiansyo-10.pdf>
3. Ministry of the Environment (2023). Progress Report of Sado City. <https://policies.env.go.jp/policy/roadmap/assets/preceding-region/1st-shinchoku-joukyo-houkokusyo-10.pdf>
4. Sado City Government. (2022). Sado City Decarbonization Promotion Council Meeting Results. <https://www.city.sado.niigata.jp/soshiki/2005/47516.html>
5. Zero Carbon Cities: Linking Decarbonization to Regional Development(n.d).

Case A4: Pilot on Constructing Cold Chain Facilities Close to the Farm Gate (Cixi City, Zhejiang Province, China)



Figure 8: Photo of a Cold-chain Warehouse. (Source: Ningbo Daily)

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- **Country/City:** China / Cixi City, Zhejiang Province
 - **Implementing agency:** The People's Government of Cixi County
 - **Funding:** 20 million yuan
 - **Funding source:** China's Central Government Funding
 - **Website:** -

Background

Food loss is costly to the climate and environment. According a 2011 FAO assessment, global food loss and waste generates around 4.4 gigatons equivalent of CO₂ per year. Emissions from food loss and waste resulting specifically from the absence of refrigeration totalled around 1 gigaton equivalent of CO₂ in 2017. As climate change-induced extreme weather events such as heatwaves, droughts, and floods become more frequent and reduce food production capabilities, more emphasis is being put on the need to reduce food loss and waste through increased refrigeration and a robust cold chain. Food loss is particularly high in developing countries. While developing countries produce nearly 80 percent of the world's food, they refrigerate only around 20 percent of perishable food products (compared with 60 percent in developed countries).

As an essential first step in the fresh food cold chain is precooling and cold storage for new produce. Precooling and cold storage allow farmers to maximize the sellable life of fresh produce while maintaining nutritional quality and reduces energy consumption in the rest of the food cold chain. In China, less than 20 percent of the precooling and cold storage demands close to the farm gate are met, making investments in other components of the food cold chain inefficient. Post-harvest losses for fruits and vegetables can exceed 45 percent, accounting for the largest amount of food loss in the food supply chain. Only around 35 percent of the country's fruits and vegetables move through the food cold chain, compared with 95 percent in the United States. To address this issue, the 2021 No.1 Document released by China's central government pointed out the importance of building cold chain facilities near farms.

Project implementation

The county of Cixi in Zhejiang Province produces 1.2 million tons perishable items every year, mainly fruit and vegetables. The local need for cold storage capacity in Cixi county is 1.5 million cubic meters. However, with no more than a quarter of this demand being satisfied, there is an urgent need for both building new cold chain facilities and mobilizing existing cold storage resources.

To understand the challenge, the Cixi Department of Agriculture and Rural Affairs conducted an investigation. It discovered that most of Cixi's refrigerated warehouses are owned by local farmers and are mainly for self-use. It found that farmers generally use these cold stores for about six months a year, leaving them empty the rest of the time, and that 60 percent of farmer-owned cold storage facilities are seasonally vacant. Therefore, the government sought to build precooling facilities and cold stores to meet the increasing demand, while at the same time pursuing the equally important task of finding ways to more efficiently utilize the existing refrigeration capacities.

In 2021, Cixi was selected as a site for a pilot project to build cold chain facilities closer to farms, receiving project funding of 20 million yuan from the central government. To address the unmet need for "first mile" cold chain facilities, Cixi has taken the pilot project as an opportunity to test innovative solutions, including by digitizing the management of cold chain facilities. Project funds have not only been used to build more "first-mile" facilities but have also been invested in the development and running of an online tool called "Shared Cold Storage" that optimizes the use of existing cold stores.

The tool can be utilized by regulators, cold storage owners, and farmers and has several applications. The first application is a cold storage map, which promotes the integration of the cold chain network. Cold stores of more than 50 cubic meters in size, along with refrigerated trucks, portable cold storage, and other facilities, are all included in a map of Cixi cold chain facilities. The map fully integrates geographical data from the Department of Natural Resources, cold chain facility regulatory data from the Department of Commerce, electricity consumption data from the local power department, as well as other relevant data, allowing it to precisely monitor cold storage status and implement cross-sectoral supervision in a comprehensive manner. A mobile phone app has also been developed. The "Shared Cold Storage" app collects smart meter data on the power consumption of the refrigeration facilities, enabling analysis of their vacancy status. The app simplifies cold chain facility management via its "one-key sharing" function, which allows facilities managers to set sharing mechanism of cold storage. For users, the app provides the functions of "smart searching" and "map searching" of cold chain facilities, allows visibility into warehouses in VR preview mode, and contains navigation functions and owner contact information. These functions enable farmers to quickly find suitable facilities for precooling and cold storage.

The second application enables "early warning." By installing smart meters, temperature, and humidity sensors, monitors and other equipment, cold storage facility owners can monitor the cold store operations in real-time. This enables accurate de-risking and improves convenience in the maintenance of cold chain facilities. The government also collaborated with local cold chain associations and other social organizations to provide door-to-door maintenance services. If there are abnormal data readings, facility owners are notified and can call for assistance from technicians by simply placing an order on the app. These timely maintenance services can effectively reduce food loss caused by malfunctions.

The app also integrates public services including policy inquiry and information exchange, making information on agricultural policies from various government departments available on a central platform. It also includes a module for handling agricultural project declarations, approvals, and verifications, streamlining formerly cumbersome administrative procedures.

Results and impacts

Climate change mitigation: Since implementation of the pilot, the number of cold storage facilities in Cixi has gradually increased. The capacity of refrigeration warehouses has increased by more than 30 percent, and the precooling rate of perishables has increased by 10 percent. Since the "Shared Cold Storage" tool has been online, from mid-2021, more than 22,000 cold storage owners and farmers have registered. The "Map of Cixi Cold Chain Facilities" has so far covered 457 shared cold stores, with a shared storage capacity of 1.14 million cubic meters, increasing the utilization rate of cold storage by 15 percent. According to electricity monitoring data provided by the local power supply department, the increased cold storage utilization rate has effectively optimized the allocation of resources and contributed to carbon emission reductions.

Resilience enhancement: The project also increased farmers' resilience to climate change by improving their ability to cope with, resist, and recover from climate disasters. Before the arrival of the typhoon "Yanhua" in 2021, Cixi farmers utilized the "Shared Cold Storage" online tool to identify suitable cold stores to preserve the harvested grapes, honey pears and other fruits. These fruits were later sold to the market when the prices rose by 10 to 20 percent, saving farmers from financial losses.

Social and economic benefits: Owing to the increasing capacity of cold chain facilities, local farmers can sell their harvests off season when produce prices are usually higher. The effective use of spare cold storage facilities has enhanced farming productivity. The proper use of the cold chain has not only extended the shelf life of perishable produce, but also helped expand its selling radius. Farmers have reported an average 5,000 yuan increase in earnings annually thanks to the revenues from renting the refrigeration facilities and increase in selling prices.

Lessons learned

Policy, funding and stakeholder support are important: The policy and financial support from the central government was essential for the pilot's success. With strong political momentum and adequate funding, the local government was able to engage with stakeholders and expand the beneficiary households to more than 20,000.

Data transparency and trust important to success: The transparency of information and cross-sector and cross-department collaboration also contributed to the project's success. Local authorities and farmers alike were able to monitor the project implementation process using the map of Cixi cold chain facilities in the online tool, which displays the status of cold storage in real-time. Public oversight also strengthened implementation of the pilot project.

References

1. FAO. (2014). Food Wastage Footprint & Climate Change. Rome.
<http://www.fao.org/3/bb144e/bb144e.pdf>.
2. IIR. (2021). Annex – The Carbon Footprint of the Cold Chain, 7th Informatory Note on Refrigeration and Food. April.
<https://iifir.org/en/fridoc/the-carbon-footprint-of-the-cold-chain-7-lt-sup-gt-th-lt-sup-gt-informatory-143457>.
3. International Renewable Energy Agency (2018). Renewable Power
4. UNEP and FAO. 2022. Sustainable Food Cold Chains: Opportunities, Challenges and the Way Forward. Nairobi, UNEP and Rome, FAO.
<https://doi.org/10.4060/cc0923en>
5. Crnews. (2021). Open up the "first kilometer" for fresh and live agricultural products to go out of the village and enter the city - the person in charge of the Department of Market and Informatization of the Ministry of Agriculture and Rural Affairs replied to a reporter's question.

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6. Huang, J. (2021). Food Loss and Waste in China: Status Quo, Policies and Actions.
https://www.dcz-china.org/wp-content/uploads/2022/09/Policy_Brief-Food_Loss_and_Waste_in_China-12-2021.pdf
 7. LeadLeo. (2022). 2022 Report on Development Trends of Cold Chain Logistics Innovation in China.
https://pdf.dfcfw.com/pdf/H3_AP202208311577904614_1.pdf?1661981011000.pdf
 8. Central Document No. 1 (2021)
http://wjfp.mfa.gov.cn/chn/xgzz/202102/t20210222_10029414.htm
 9. Zhejiang Provincial Department of Agriculture and Rural Affairs. (2022). Cixi Shared Cold Storage Practice Are Being Promoted at the National Meeting.
http://nynct.zj.gov.cn/art/2022/8/31/art_1630298_58943912.html
 10. The People's Government of Ningbo Municipality. (2022). Cixi shared cold storage: through the circulation of agricultural products "the first kilometer".
http://www.ningbo.gov.cn/art/2022/4/6/art_1229099769_59424140.html
 11. The People's Government of Cixi County. (2021). Cixi was selected as one of the pilot areas for the National Pilot on County-wide Promotion of Constructing Cold Chain Facilities Close to the Farm Gate.
http://www.cixi.gov.cn/art/2021/7/8/art_1229036208_59050230.html
 12. Ministry of Agriculture and Rural Affairs of the People's Republic of China. (2023). Cixi uses the "shared cold storage" application to fully promote the county-wide cold storage and preservation pilot.
http://www.scs.moa.gov.cn/ccll/dfsj/202303/t20230329_6424182.htm

Case A5: Deployment of 100 percent Renewable Energy and Certification Systems (Kitakyushu, Japan)



Figure 9: Kitakyushu's 100 percent Renewable Energy Certification Sticker (Source: Kitakyushu Government)

- **Country/City:** Japan / Kitakyushu
- **Implementing agency:** Renewable Energy Promotion Division, Green Growth Promotion Department, Environmental Bureau, Kitakyushu City
- **Funding:** -
- **Funding source:** Local Government
- **Website:** https://www.city.kitakyushu.lg.jp/shisei/menu01_00345.html

Background

Kitakyushu has pledged its commitment to contributing to global climate change mitigation efforts, setting a target to achieve net-zero GHG emissions by 2050. As outlined in its net-zero roadmap, the city aims for a substantial reduction of at least 47 percent in GHG emissions by 2030. A prominent facet of Kitakyushu's decarbonization strategy centres on the expansion of renewable energy sources. To expedite the adoption of renewable energy and stimulate innovation in related technologies, Kitakyushu introduced the Kitakyushu Model for 100 percent Renewable Energy in February 2021 and 100 percent Renewable Energy Certification System in December 2021.

The two initiatives are tailored to drive the transition to renewable energy in distinct sectors: public facilities and private companies. Concerning public facilities, Kitakyushu plans to shift the power sources of all municipal establishments—comprising around 2,000 facilities—to a 100 percent renewable energy framework by 2025. The effort encompasses facilities for which the City Government is responsible for electricity bills. For the private sector, the city is dedicated to accelerating the integration of power generated from renewable sources. Beyond the core decarbonization objective, the initiatives encompass broader aspirations, including the realisation of an “Advanced Battery System City” and active contribution towards achieving Sustainable Development Goals (SDGs).

Project implementation

From 2021 onward, the Kitakyushu Model for 100 percent Renewable Energy is designed with a three-step framework to facilitate the transition towards renewable energy utilisation at public facilities:

Step 1: Integration with existing renewable power sources. Public facilities are connected to readily available renewable energy sources, including wind farms and biomass energy. The city is strategically expanding its utilisation of biomass power (waste-to-energy) at public facilities, with projections for connections to reach 200, 600, and 1,200 facilities in 2021, 2022-2023, and 2024-2025, respectively.

Step 2: Implementation of solar panels and battery systems at public facilities. Third-party entities are entrusted with the installation of solar panels and battery systems at public facilities. The electricity generated from solar panels is managed by Kitakyushu Power Company. Moreover, surplus energy generated by solar panels and local renewable sources is stored within batteries. The stored energy is optimally utilised during peak hours characterised by high electricity cost, thereby contributing to reducing electricity costs. Smart systems enable a energy management system (EMS)

Step 3: Installation of energy efficient equipment. In scenarios involving construction or facility renovation, energy efficient equipment is installed. This approach enhances overall energy efficiency and curtails the total power consumption.

In the execution of this project, Kitakyushu has embraced the “Usage Rather Than Ownership” business model. This approach eliminates the initial costs of renewable energy equipment. Under this business model, solar panels, batteries, and other energy efficient equipment are owned by third parties. The government needs to pay a fixed usage fee for equipment and electricity bills, bypassing the need for upfront costs. For a comprehensive overview of the pivotal stakeholders and their respective roles shown in Figure 10.

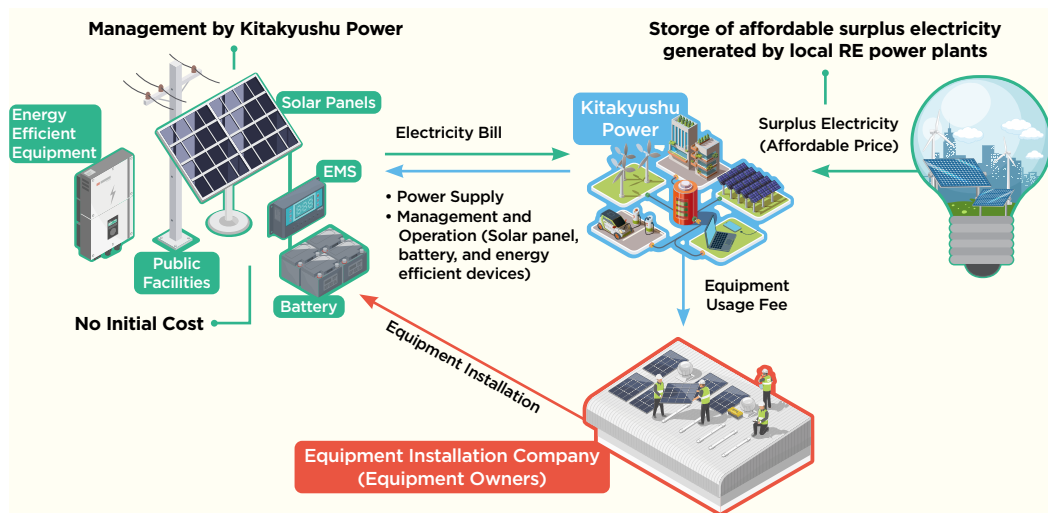


Figure 10: System Structure of Kitakyushu Model for 100percent Renewable Energy at public facilities (Source: Translated from Kitakyushu Government)

Following the initiation of efforts to transition public facilities to renewable energy, Kitakyushu introduced 100 percent Renewable Energy Certification System to accelerate the integration of renewable power within private enterprises. Under this system, companies utilising power sourced exclusively from renewable energy or other decarbonized sources are eligible to seek certification from the government. The process for application and certification is outlined in Figure 11.

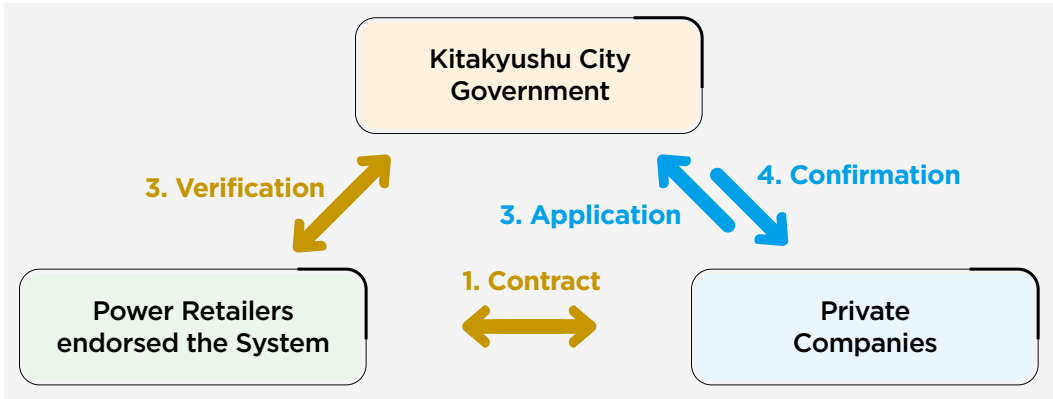


Figure 11: Overview Diagram of Kitakyushu City Decarbonized Electricity Certification System (Source: Translated and adopted from Kitakyushu Government)

To encourage companies to participate in the certification system, the government provides the several benefits for certified entities, including:

- Authorization to utilise the certification sticker and logo on promotional materials and business cards.
- Consideration of additional evaluation points during government subsidy assessments
- Eligibility for low-interest loans while participating in municipal projects.
- Publicity on the city's website and social media platforms

Furthermore, the initial 100 certified companies will be recognized as "Decarbonization Pioneering Companies", meriting a special certificate to acknowledge their pioneering role.

To meet the increasing demand from the above renewable energy adoption initiatives, Kitakyushu is focusing on three pillars of renewable energy generation: wind power, energy storage, and hydrogen. Firstly, wind power stands as a foundational energy source for Kitakyushu, fortified by the city's designation as a hub port and the advantageous wind conditions prevalent in the Hibikinada Sea Area. The city has incorporated wind power, especially offshore wind. Secondly, with the increasing integration of renewable energy, energy storage assumes paramount importance. Kitakyushu's blueprint entails the widespread deployment of storage batteries. Thirdly, Kitakyushu has undertaken demonstration projects within the Kitakyushu Hydrogen Town to foster the advancement of hydrogen technology.

Results and impacts

Through the promotion of renewable energy adoption across public facilities and corporate entities, Kitakyushu has been instrumental in advancing the city's renewable energy deployment. The city's initiatives have fostered advancements in renewable energy-related technologies, particularly in the domains of energy storage and the reduction of battery costs.

Renewable energy for public facilities: 260 public facilities have converted to 100 percent renewable energy by the end of 2021. Nine power retailers have endorsed the 100 percent renewable energy certification system by February 2023, and 36 companies have joined the certification system by June 2023. Kitakyushu's effort on promoting the utilisation of renewable energy in both public facilities and private companies have yielded the following outcomes:

Demonstration of power purchase agreements business model: The concerted effort has provided

invaluable insights into the societal and economic intricacies entwined with the expansion of renewable energy. This encompasses valuable lessons derived from the innovative "usage other than ownership" business model, which has facilitated the transition to renewable energy sources.

Enhanced power grid resilience: The incorporation of locally generated renewable energy coupled with the integration of energy storage systems has fortified energy security and resilience.

Lessons learned

The city's experiences provide a roadmap for other regions aspiring to advance their renewable energy ambitions in a holistic and sustainable manner. Key lessons from Kitakyushu's effort on 100 percent renewable energy include:

Financial challenges for implementation and upgrades: Technical and financial hurdles pose significant considerations for sustained progress. Firstly, the proliferation of renewable energy necessitates substantial upgrades to transmission grids. Secondly, while hydrogen holds pivotal status as a renewable energy source in Kitakyushu, cost factors continue to impede its wider-scale integration.

Role of local governments in markets: Local governments must embrace a leading role, leveraging their substantial purchasing power, governments wield the potential to significantly influence the marketplace. Kitakyushu's proactive approach in adopting renewable energy in public facilities effectively amplifies the proportion and competitive edge of renewable energy.

Private Sector engagement: Within Kitakyushu's initiatives to expedite the transition to renewable energy, private enterprises play pivotal roles. These roles encompass ownership of renewable energy assets, provision and operation of efficient equipment, and active participation in certification systems.

References

1. Kitakyushu City Government. (2021a). Regarding the Achievement of 100percent Renewable Energy Powering for Municipal Public Facilities in the Fiscal Year 2025.
<https://www.city.kitakyushu.lg.jp/files/000916827.pdf>
2. Kitakyushu City Government. (2021b). Regarding the Commencement of the Kitakyushu City Decarbonized Electricity Certification System.
<https://www.city.kitakyushu.lg.jp/files/000958708.pdf>

Case A6: Ecological Modernization of the Transport System (Moscow, Russian Federation)



Figure 12: Moscow's Mayakovskaya station, a part of its extensive metro system.

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- **Country/City:** Russian Federation / Moscow
 - **Implementing agency:** The Government of Moscow
 - **Funding:** -
 - **Funding source:** Local Government Budget
 - **Website:** <https://www.mos.ru/en/>

Background

Moscow is located in the northern part of Eurasia and is susceptible to temperature increases in the course of ongoing climatic changes. In 2010, the city experienced an extreme heat wave with a total duration of 42 days and temperatures up to 37.5°C. Since transport is one of the sources of anthropogenic heat and emissions of greenhouse gases and pollutants, optimizing it and cutting the emissions is necessary to reduce the negative impact of the climate and adapt to climate change.

In the 20th century, Moscow's development was focused on the public transport, considering the low levels of personal vehicles. However, after the opening of international markets, citizens began to rapidly purchase personal vehicles: between 1990 and 2010 the number of cars registered in Moscow increased by 4.2 times (from 917 thousand to 3,854 thousand). This resulted in persistent traffic congestion, increased emissions of pollutants and greenhouse gases. There were significant economic losses from excessive fuel consumption.

Since 2011, comprehensive and balanced development has been the priority of Moscow's transport system management, while improving the quality of the city's environment. It is reflected in Moscow's State program, which implies diversification of transport types, prioritization of public transport over private transport, electrification of public transport, development of a charging network for electric vehicles, optimization of freight transport and measures to reduce the average length of private transport trips.

In September 2011 the Government of Moscow approved the State Program of Moscow "Development of the Transport System".⁶ Together with the city's environmental policy, the program's aims include:

- Increasing passenger transportation by public transport.
- Shortening traffic intervals for public transport.
- Increasing the environmental sustainability of public transport.
- Making traveling by public transport more comfortable.
- Developing travel tickets valid for various types of public transport.
- Optimizing the paid parking system in the city center and high traffic areas.
- Decreasing the number of trips by car to the city center.
- Reducing the number of transit freight traffic through the city.
- Creating new services for planning, purchasing and traveling by various types of public transport.
- Implementing advanced technologies into the transport system of Moscow.

Project Implementation

Rail transport has been a key for Moscow's public transport. Since 2011, more than 200 km of metro lines and 100 stations have been built with Moscow's "Big Circle Line" fully launched in 2023 and is now the largest metro circle line in the world. In addition to the "Big Circle Line", 4 Moscow Central Diameters have been launched, which are new "overground metros" of Moscow, integrating railway lines into the city network and connecting remote districts to the city center. At present, approximately 90% of citizens live within walking distance from a rail transport station.

To further augment public transport utilizing the waterways through the city, the first regular route of electric vessels was launched early in 2023, and the launch of the second route is planned for the end of the year. The new river transport will operate on schedule all year round, regardless of weather. River transport is an alternative type of public transport helping to reduce road congestion, in addition to enabling urban planning goals. The vessels are electrically powered, and thus their use will reduce emissions of pollutants and greenhouse gases.

The transport means diversified through the expansion of public transport options and regulating emissions and individual car arrangements. Every day there are up to 2-2.5 million cars on the roads. The road network constraints remain due to the historical features of city planning. In 2011-2022 1,232 km of roads were built in Moscow, which increased the length of the road network by 20%. Road development is aimed at improving connectivity and reducing congestion.

In 2011, with the city streets congested with illegally parked vehicles, the first step of the program was the introduction of high fines and an evacuation system for illegal parking. This relieved roadsides from improper parking and thereby increased their capacity. In addition to dissuading illegal parking, paid parking zones have been gradually introduced across the city. By the beginning of 2023, more than 90,000 parking spaces have been created in the paid parking area of Moscow. With greater road discipline among drivers, a reconstruction program of over 400 central streets in 2014-2018 could be implemented. Traffic lanes were narrowed to a standard width of 3.5m, which allowed wider sidewalks and the planting of trees without reducing the traffic lanes. Bicycle lanes and paths were created on some of the reconstructed streets to facilitate low carbon mobility.

Moscow's short-term bicycle rental service has been developing since 2013. Currently the bike-sharing system has 776 rental stations and more than 10 thousand bicycles. The city bike rental system is supported through subsidies from the Moscow city budget, acquiring bicycle rent services under a government contract, and integrating bike rental with the Moscow Transport app.

⁶ Decree of the Government of Moscow dated September 2, 2011 No. 408-PP "On Approval of the State Program of the city of Moscow 'Development of the Transport System'"

The length of bike lanes in Moscow is estimated at approximately 500 km, their layout is depicted in Figure 13 below.

In 2015 short-term scooter rental services (kick-sharing) appeared in the city. Now there are approximately 60 thousand electric scooters available for rent. To support the development of the service, subsidies were allocated to scooter rental operators in 2021 and 2022 to partially reimburse the costs of purchasing new electric scooters.

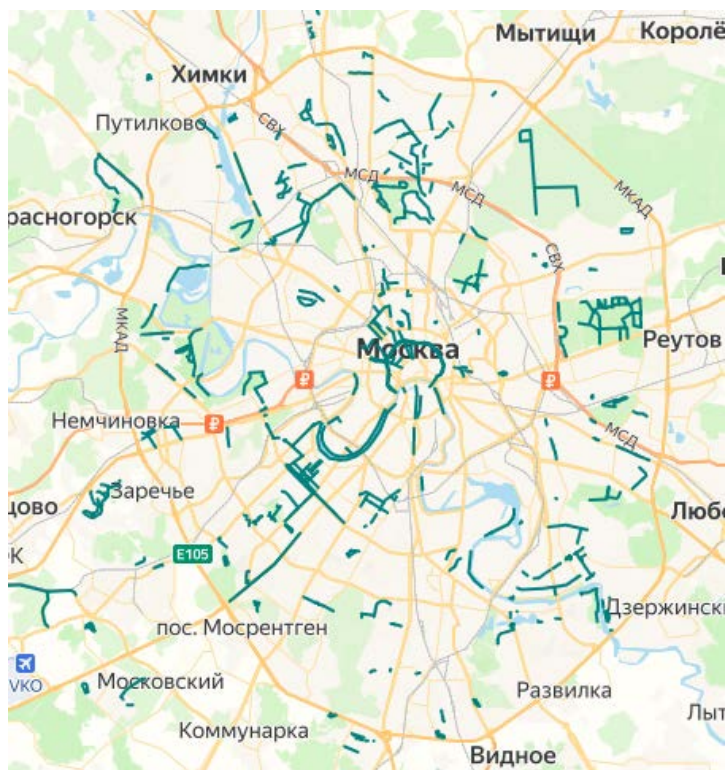


Figure 13: The layout of bike lanes in Moscow (excluding dedicated lanes for public transport) by the end of 2022 (Source: Moscow Transport portal, <https://transport.mos.ru/bicycle>)

Other than the measures intended to improve passenger and traffic flow within the city and to reduce the wastage of fuel spent in congestion, significant emphasis has also been placed on “Greening” the vehicle fleet. The environmental performance of the vehicle fleet is improved through federal environmental requirements for new vehicles’ engines (from 2016 - at the level of Euro 5) and regional environmental requirements for freight transport and buses entering certain areas of Moscow (low emission zones). For example, trucks that can’t meet the requirements of at least Euro 3 emission standard are forbidden from entering the central part of the city to improve the air quality. The restriction is regulated round-the-clock. There are also special subsidies allocated to car-sharing operators and taxi service companies to purchase vehicles of at least Euro 4 emission standard and electric vehicles.

Starting from 2011, old Euro 2 emission standard buses were replaced by Euro 4 and Euro 5 buses, since 2012 – by at least Euro 5 buses and starting from 2021 - by electric buses only. Currently, the bus fleet operating on city routes includes Euro 5 buses and more than 1,200 electric buses. The replacement of diesel buses with electric buses is expected to be completed by 2030. Land public transport also includes a modern tram network.

Measures taken to improve the efficiency and attractiveness of public transport include;

- Upgrading vehicles to ensure accessibility for people with limited mobility, the best sanitary and hygienic (air temperature, air exchange, etc.) and leisure conditions (access to Wi-Fi, chargers).
- Creating dedicated lanes for public transport.
- Improving connections between different types of public and private transport, thus increasing the transfers' convenience. Introducing transport interchange hubs and intercept parking lots.
- Creating alternatives to private cars for door-to-door trips: developing taxi transportation and short-term car rental services (carsharing):
 - o Moscow's taxi passenger traffic has increased by 36.5 times since 2010 (from 16 million to almost 585 million people per year).
 - o 22,000 Euro 5 vehicles and 50 electric vehicles in Moscow's car-sharing fleet. 48 million trips were made in 2022.
- Mobility as a service (MaaS) approach: online portal and mobile applications for simplicity of public transport use and navigation.

To promote the purchase of electric vehicles in Moscow, charging stations are being installed across the city and the fee for placing electric vehicles in paid city parking lots has been canceled,⁷ so parking for electric cars is free. About 400 charging stations for electric vehicles are publicly available in Moscow. From 2020 till the end of 2024, Moscow has cancelled the transport tax for owners of all-electric cars, to promote the electrification of vehicles.

Results and impacts

Reduced Pollution Through Vehicular Upgrades: The total environmental efficiency of the entire set of measures to green the transport system can be assessed by Moscow's environmental monitoring data. The concentration of pollutants near highways in 2022 decreased by 3.8 times compared to 2011 (carbon monoxide, nitrogen oxide, sulfur dioxide). Nitrogen dioxide remained at the same level and particulate matter concentration decreased by 1.5 times for PM2.5 and 1.4 times for PM10 compared to 2014 levels. Over the past ten years, the renewal of the city transport fleet and the transition to electric buses have reduced CO₂ emissions by 130,000 tons. Between 2010 and 2022, the proportion of cars meeting Euro 4, Euro 5 and Euro 6 environmental requirements in Moscow increased from 30% to 75%, as shown in Figure 14 below.

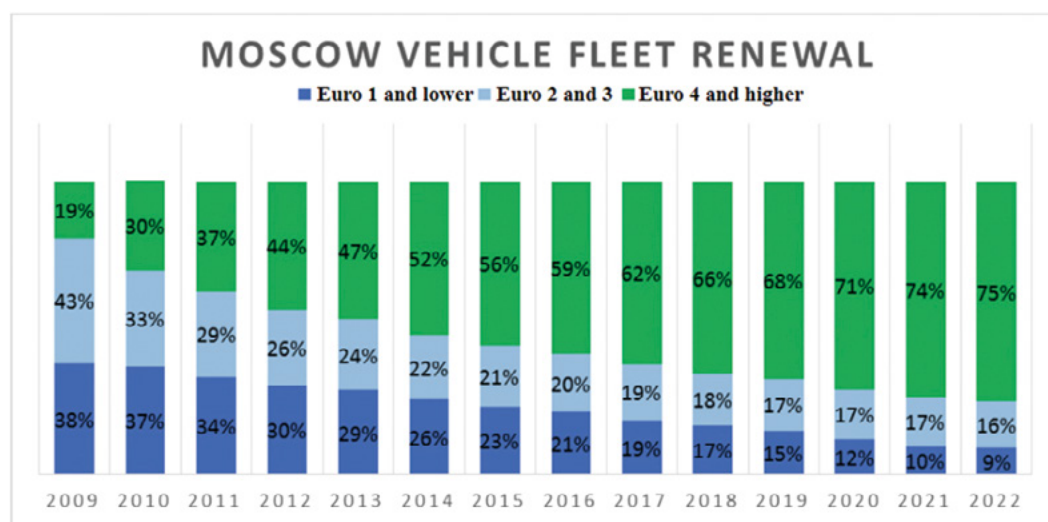


Figure 14: Changes of the Moscow vehicle fleet based on Euro emissions standard.

⁷ Decree of the Government of Moscow dated May 17, 2013 No. 289-PP "On the organization of paid city parking lots in the city of Moscow"

Increasing Electrification of Transport: The development of electric transport has a significant potential for reducing emissions of major pollutants from road transport in Moscow. Currently, more than 50% of passenger trips in the city are made using electric transport, while personal electric cars use is still low. The tram fleet has been renewed by 95%, and the underground carriage fleet by 70%. In 2019 (the pre-pandemic year), the share of public transport in passenger traffic increased to 70% from 63% in 2014.

Increased Share of Pedestrian and Personal Mobility Devices: As a result of street improvement works in 2015-2016, the number of pedestrians increased by 2-4 times, the speed of traffic flows grew by 5-7%, and the accident rate decreased by 37%. The city's short-term bicycle and electric scooter (kick-sharing) rental services are being actively developed. In 2022 3.3 million city bike trips and 26.3 million kick-sharing trips were made by users. Over the five years of the service's existence, the number of kick-sharing trips rose by 226 times.

Lessons learned

The main success factor of Moscow's transport development is the coherence and comprehensiveness of the implemented measures, and their distribution in time, whereby the first block of measures paves the way for the subsequent ones. During the implementation of the comprehensive program, a significant number of challenges have been overcome: technical, communicational and financial ones.

Managing the Expansion of Transport Options: Massive construction and reconstruction of the road network, tram tracks and metros lead to changes in the habitual routes of residents, create noise and cause inconvenience and delays in transport. Such issues have a negative impact on residents' perception of transport projects and require long-term work with residents on future transport benefits. The transport complex temporarily replaces closed metro stations with free buses and informs people on construction works through the city media, social networks and announcements in transport. On the contrary, the creation of new green spaces improves the perception of projects.

Financing the Renewal of Public Transport: The "Green bonds", intended for the renewal and electrification of public transport, allow not only to effectively attract funding for projects that have a calculated environmental effect, but also to popularize the projects and environmental activities among the population.



B

STAKEHOLDER ENGAGEMENT CASES

Case B1

Accelerating Coal-to-Solar Transition in Ger Districts Through Climate Financing (Ulaanbaatar, Mongolia)

Case B2

Innovative Financing Pilot Project for Deployment of Distributed Photovoltaic Solar for Rural Revitalisation in Hanyin County, Shaanxi Province, China

Case B3

Public Engagement in Mindful Energy Consumption: Eco-Smart Metering App “E-Keeper” (Suwon City, Republic of Korea)

Case B4

Empowering Community Partners in Developing Plastic Reduction Education Initiatives and Activities (Beijing, China)

Case B5

Public Engagement in Eco-Friendly Lifestyle Activities (Kyoto, Japan)

Case B6

Carbon Neutral Point System (Daegu City, Republic of Korea)

B: STAKEHOLDER ENGAGEMENT CASES

Stakeholder engagement cases involve collaboration with many stakeholders. Often, key recipients are directly involved in the planning and consultation process to achieve desired goals for residents and beyond.

Case B1: Accelerating Coal-to-Solar Transition in Ger Districts Through Climate Financing (Ulaanbaatar, Mongolia)



Figure 15: Installation of Solar Panels in Ger District (Source: The Asia Foundation)

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- **Country/City:** Mongolia / Ulaanbaatar
 - **Implementing agency:** Project Developer - The Asia Foundation, Project Executor – URECA, GerHub
 - **Funding:** -
 - **Funding source:** Carbon finance
 - **Website:** -

Background

The idea for this project stemmed from The Asia Foundation's desire to offset the carbon emissions of their Mongolia Office. However, this was not easy to accomplish, not only because there is no specialized market for carbon credits verification, valuation, and exchange in Mongolia, but also because of the difficulty of finding matching projects with social and environmental benefits. The Foundation discovered an opportunity in the Ger Districts of Ulaanbaatar, Mongolia, which has become one of the world's most polluted cities.

The city's elevated level of pollution is attributed to the approximately one million residents who reside in traditional "gers" or yurts, where coal, tires, and refuse are burnt to keep warm in the harsh winter conditions that can plummet to temperatures as low as minus 45 degrees Celsius. Burning coal, which is essential for survival in Ulaanbaatar's gers, is extremely costly for the around 200,000 underprivileged families in the Ger area communities. Less than 40 percent of these households

earn \$90 per month, whereas the expense of purchasing coal can cost as much as \$400 annually. Moreover, burning coal indoors and outdoors can cause serious health issues and has become a major contributor to Mongolia's carbon emissions.

Project implementation

Working with URECA, a young climate-tech company, and local NGO GerHub, the Asia Foundation initiated a pilot project in March 2022 that leverages climate finance to accelerate coal-to-solar transition in the Ger Districts. The project's objective is to extend access to carbon credit mechanisms to individual renewable energy producers in Mongolia who currently face limited opportunities to engage in such incentive programmes. This initiative also targets those outside the centralized heating system and possessing only partial access to the electrical grid.

The pilot has recruited five low-income households to fund their shifts from coal-burning stoves to solar energy systems, and to use that transition to generate and sell carbon credits through the URECA marketplace. The verification, valuation, and exchange of carbon credits involve the use of a complex system developed by URECA. The system integrates AI-based technology and verifies the emissions savings from replacing coal with renewable energy sources such as solar and wind, by using data collected from tamper-proof smart meters. The data is then connected to a blockchain system that links carbon credits to individual producers and keeps track of the exchange or retirement of these credits. This smart, cost-effective system generates high-quality carbon credits, even for household-level producers, that are connected to a URECA marketplace where they can be sold and bought.

The Asia Foundation also worked with GerHub to engage with residents in the "ger" area communities. The project has supported five beneficiary households, containing eleven children, replacing their coal-burning stoves with 1.8-5kW solar energy systems with electric heaters and "ger" insulations. Apart from paying for the solar systems and improved insulation, the project team will continue to provide continuous technical support, monitor household satisfaction, and evaluate the overall impact of the initiative.

An initial baseline assessment estimates that each family will cut their carbon emissions by 10 to 20 tons per year and save their fuel costs by as much as 70 percent. The project partners are seeking to answer significant questions on how highly the market will value pilot households' carbon credits. If the valuation can reach the low-end target of \$80 per ton, the pilot households will be able to earn between \$800 and \$1,600 per year by generating and selling carbon credits, adding to the hundreds of dollars saved on energy costs. This is a major achievement in terms of improving the quality of life of residents and reducing air pollution in Ulaanbaatar every winter.

Results and impacts

The five families produced their first carbon credits at the end of November 2022. The carbon credits are now available for purchase on the URECA marketplace. 3 of the 20 tons equivalent of CO₂ put up for sale have already been purchased.

Climate Change Mitigation: The project is playing an important role in mitigating GHG emissions and improving public health by reducing coal consumption. The pilot has reduced the households' reliance on fossil fuels, mainly coal. Without the implementation of the initiative, the households would be left with little option but to continue to rely on fossil fuels such as coal for heating. This would lead to emissions of carbon as well as air pollutants in Ger area communities, particularly during winter.

Social Benefits: The combustion of coal indoors and outdoors has dire health implications and serves as a significant contributor to Mongolia's carbon emissions. This initiative has forged a path for households and children to live in a much healthier environment through the reduction of indoor and outdoor air pollutants. The project empowers families to lead improved lives by ensuring cleaner indoor air quality. Moreover, it aids women and children in diminishing and ultimately eradicating the need to burn coal for heating. Households stand to save up to 70 percent of their energy expenditure, while project participants can also generate income from the sale of carbon credits.

Lessons learned

Small scale pilot projects such as this can better test the strength of cutting-edge technologies on how to engage communities with families, helping to meet their needs. It is of great importance to build inclusive participation into climate action by engaging grassroots communities to act and to be part of the solution.

References

1. The Asia Foundation. (2022). In Mongolia, a Quest to Democratize Carbon Credits.
<https://asiafoundation.org/2022/11/09/in-mongolia-a-quest-to-democratize-carbon-credits/>
2. URECA. (2023). Coal-to-Solar Initiative: Empowering Ger District Communities through Climate Financing.
<https://ureca.com/marketplace/listing/12>

Case B2: Innovative Financing Pilot Project for Deployment of Distributed Photovoltaic Solar for Rural Revitalisation in Hanyin County, Shaanxi Province, China



Figure 16: Installation of Solar Panel in Hanyin County.

- **Country/City:** China / Hanyin County, Ankang City, Shaanxi Province
- **Implementing agency:** Tencent Sustainable Social Value, China Construction Bank Shaanxi Branch, Huanghe Photovoltaic, National Energy Administration, the Research Institute of Finance and Banking of the People's Bank of China, Ankang Municipal government, Hanyin County government, Shaanxi Local Financial Supervision and Administration, Shaanxi Rural Revitalization Bureau, Shaanxi Electric Power Corporation of State Grid, Shaanxi Power Exchange Center and others.
- **Funding:** -
- **Funding source:** Philanthropic Funds, Bank Loans
- **Website:** -

Background

To maximize the use of solar resources and contribute to the carbon peaking and neutrality goals, in 2021, China's National Energy Administration initiated a pilot programme entitled "County-wide Development of Distributed Solar Photovoltaics," with 26 counties in Shaanxi Province selected as pilot areas. Although Shaanxi has set an ambitious target of achieving 4.2 million kilowatts of installed solar capacity, implementation progress has been slow. In 2022, merely six percent of the set target was completed. In addition to constraints imposed by poor electricity infrastructure in rural areas, there are two other main reasons for the current underachievement. First, the return on investment (ROI) of rural PV projects are not profitable enough to attract private investors. Second, the state-owned enterprises that are usually responsible for implementation of these projects lack capacity in engaging with individual farmers.

In mid-2022, Tencent Sustainable Social Value (SSV), in partnership with China Construction Bank (CCB) Shaanxi Branch, initiated the project "Innovation Pilot on Distributed Solar Photovoltaic for Rural Revitalization." The objective of the pilot is to drive distributed solar PV uptake in Shaanxi Province and explore an innovative financing mechanism for charitable projects.

Project implementation

Tencent SSV, serving as the principal, contributed 8 million yuan to the project, entrusting CCB Trust

to set up a charitable trust. A project company was founded under this trust as the main vehicle to operate the pilot project. The 26 pilot areas in Shaanxi were selected against three main criteria:

- Counties with low solar resources with 900 to 1,200 annual equivalent utilization hours where the profitability of PV projects is not substantial enough to attract commercial investments.⁸
- Counties that have also been selected as National Rural Revitalization Pilot areas, which means that the average annual income per household is ten to thirty thousand yuan.
- Counties where CCB has extensive solar PV project experience, meaning a foundation has been laid in both political and practical terms.

In the first phase, the project has recruited close to 40 households in Hanyin County of Ankang City to each install 10kW solar panel systems, with CCB's Shaanxi Branch offering half of the installation costs in loans. The generated electricity has been integrated into the national grid, with revenues from sales of electricity received by the project company going toward paying a stable annual rent to the farmers and repaying the bank loans. Remaining revenues will be used to reimburse the charitable fund and reinvest in other philanthropic projects.

In the upscaling phase, the pilot plans to cover 3,000 to 4,000 households. A new industrial investor, Huanghe Photovoltaic, will be brought in to work with the capital fund to set up a new project company. Tencent will own 20 percent of the company while Huanghe Photovoltaic will own the remaining 80 percent. In addition, it is expected that CCB Shaanxi Branch will offer a loan of up to 80 percent of the construction costs. The pilot's innovative financing structure is illustrated in Figure 17.

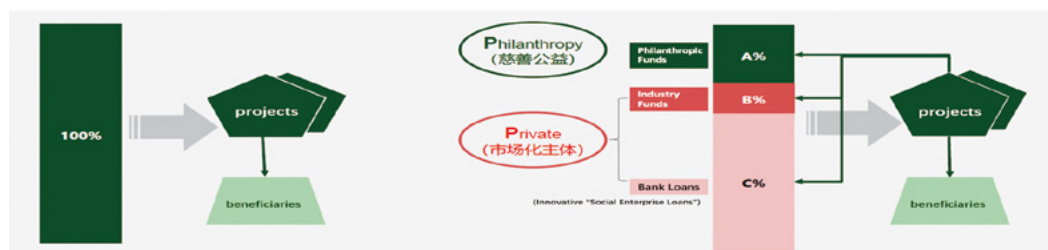


Figure 17: Traditional Financing Model and Innovative Financing Model

Compared with traditional philanthropic projects where funding comes solely from donations, this new financing model leverages industry funds and bank loans with charitable funds. It is expected that this innovative financing model will make similar charitable projects more sustainable. First, the inclusion of charitable funds ensures that the projects selected have cascading social benefits. Second, CCB's management of the charitable fund ensures a transparent and secure use of the donations that fulfil its philanthropic purposes. Moreover, the addition of leverage enables the expansion of beneficiaries. For example, by using the new financing model, the second phase of the pilot can recruit approximately 4,000 to 5,000 households, compared with 200 households using the traditional financing model. The more than 20-fold increase in beneficiaries demonstrates the multiplier effect of the new financing model. Third, by working with industrial partners, the pilot can guarantee long-term maintenance of equipment and contribute to the rejuvenation of the local market.

The pilot also engaged key stakeholders at both national, provincial, and local levels, including the National Energy Administration, the Research Institute of Finance and Banking of the People's Bank of China, Ankang Municipal government, Hanyin County government, Shaanxi Local Financial

⁸ China has divided solar resource regions into three categories based on annual equivalent utilization hours. Regions with annual equivalent utilization hours exceeding 1600 hours are classified as Category One, regions with annual equivalent utilization hours between 1400 and 1600 hours are classified as Category Two, and regions with annual equivalent utilization hours between 1200 and 1400 hours are classified as Category Three.

Supervision and Administration, Shaanxi Rural Revitalization Bureau, Shaanxi Electric Power Corporation of State Grid, Shaanxi Power Exchange Center, and others.

Results and impacts

Financing models can improve outreach and impacts: In the first phase of the project, around 40 households in Hanyin County received funding to set up solar PVs with total capacity of around 400 kW, and each household received annual rent of around 500 yuan. In August 2023, China's National Development and Reform Commission, Ministry of Finance, and National Energy Administration jointly issued "Promoting the Full Coverage of Green Power Certificates for Renewable Energy to Facilitate Renewable Energy Power Consumption." This policy expands China's Green Power Certificate coverage to distributed solar photovoltaic power generation. In the next step, the pilot project plans to apply for Green Power Certificates to boost the ROI of the project, thereby making it more bankable.

Lessons learned

The engagement of key stakeholders is crucial for successful pilot implementation. The combination of market-oriented ideas, innovative methods, and financing models has a multiplier effect on alleviating poverty and promoting social welfare.

References

1. China Energy News. (2023). What Factors Hinder the Implementation of County-Wide Distributed Solar PV Promotion in Shaanxi?
<https://new.qq.com/rain/a/20230325A02HHP00>
2. Shaanxi Charity. China Internet Public Welfare Summit - Sustainable Finance for Rural Revitalization and Dual Carbon Side Event Held in Xi'an
<http://www.xxbc.com/info/1015/83041.htm>
3. BJNews. (2023). New Sample of Rural Revitalization: A "Finance + Public Welfare" Experiment on a Rooftop in Southern Shaanxi Province.
<https://finance.sina.com.cn/wm/2023-03-14/doc-imykveiz8386103.shtml>
4. People's Daily. (2023). Expansion of the issuance scope of renewable energy green power certificates.
http://paper.people.com.cn/rmrb/html/2023-08/07/nw.D110000renmrb_20230807_3-02.htm

Case B3: Public Engagement in Mindful Energy Consumption: Eco-Smart Metering App “E-Keeper” (Suwon City, Republic of Korea)



Figure 18: Representation Photo of Smart Metering App (Source: Gyeonggi News)

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- **Country/City:** Republic of Korea / Suwon
 - **Implementing agency:** Suwon City Government
 - **Funding:** 2 million KRW per year
 - **Funding source:** Local Government
 - **Website:** www.suwon.go.kr

Background

The building sector accounts for more than two-thirds of the total GHG emissions in Suwon City. On its pathway towards becoming an Environmental Capital of the country, the city launched the ‘Carbon Monitoring in Our Home’ initiative to accelerate energy efficiency in residential buildings and promote the decarbonization of the building sector. A mobile application called ‘E-Keeper’ developed by Aju University Carbon Zero Energy Center helps apartment residents monitor their energy usage in real time, including gas, electricity, and hot water consumption. It also allows them to compare their usage with other households and provides a carbon emission forecast. The initial phase of the project aims to involve 1,999 households in three apartment complexes: 836 households from Shinmyung Dongbo Apartment, 363 households from Namgwang Housestory Apartment, and 800 households from Hillstate Homeshil Apartment. The project is expected to scale up based on the outcomes of its initial phase. The city aims to engage 20 percent of its total apartment buildings, which amounts to approximately 60,000 households out of a total of 279,614, in the project by 2025.

Project implementation

The third 5-year Master Plan on Climate Change Response of the city, published in 2022, outlines three key strategic approaches to reduce GHG emissions from the building sector, which is the largest source of GHG emissions as shown in Figure 19 below by 40 percent through enhancement of building efficiency, advancement of Zero-Energy urban development, and increased engagement of civil society. Within this framework, E-keeper, the mobile application for monitoring energy consumption in residential buildings as part of the project, contributes to the establishment of an integrated energy system, leading to the decarbonization of the building sector.

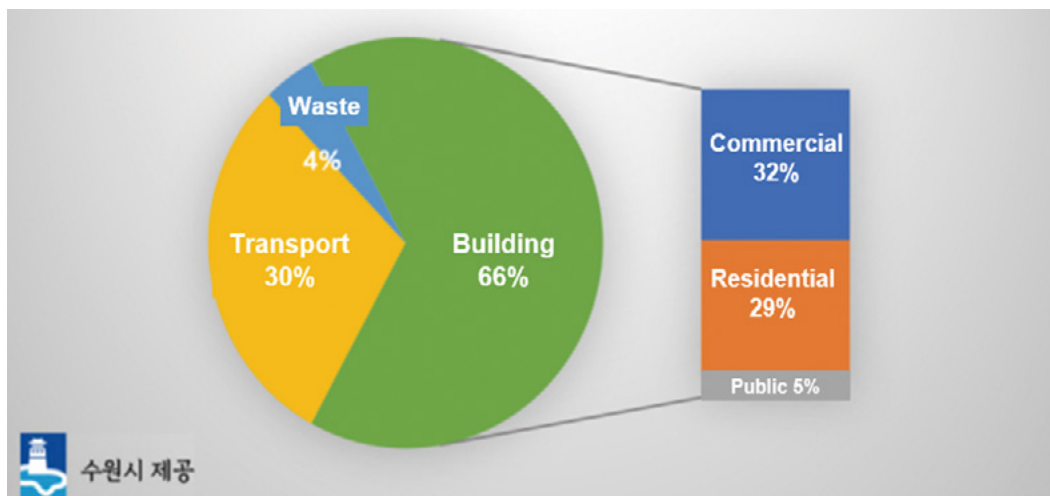


Figure 19: Suwon city 2021 GHG Emissions per sector (Source: Suwon City Government)

- Phase 1.** To develop an implementation roadmap for the monitoring energy usage initiative and its pilot project plan, Suwon city formed a steering advisory committee and a dedicated council in December 2022. With the aim of promoting public engagement in energy efficiency and the decarbonization of residential buildings, Suwon city, Ajou University, three participating apartment complexes, Suwon City Apartment Residents' Association, Korea Housing Management Association, and Suwon City Neighbourhood Association Council signed an MOU. The city will operate monitoring server; the university will develop and manage the monitoring application and conducted performance analysis; Suwon City Apartment Residents' Association will lead the participation of apartment complexes, and the council will lead the participation of residents. The first phase implemented for three months, with participation of a total of 1,999 households from three apartment buildings participating. Data monitoring and collection, and performance analysis were conducted.
- Phase 2.** The second phase began in August 2023 and will continue until December 2023. The phase features expanded public engagement compared to the previous one, involving a total of 17,053 households from 15 apartment buildings and 1 detached house. Additionally, the city will host two award events to recognize outstanding participants for their performance, while fostering private sector engagement in providing financial benefits for participants.

The project provides a compelling example of public engagement. The local government raises public awareness and interest in energy efficiency and the decarbonization of residential buildings through a series of discussions, seminars, and campaigns. They also designate Citizen Climate Ambassadors to promote the project. These ambassadors play a crucial role in encouraging more apartment buildings to participate and in facilitating project implementation by supporting the installation of the mobile application, opinion collection, and organizing public campaigns, and fostering collaborative and community-driven activities.

Results and impacts

Data Availability has an Impact on CO₂ Reductions: The three apartment complexes participating in the first phase reduced their electricity usage by an average of 10.01 percent, 12.17 percent, and 9.6 percent, respectively as seen in Figure 20. This is equivalent to a GHG emissions reduction of 26.94 tons of CO₂ per month on average. It also provides a financial benefit to households.

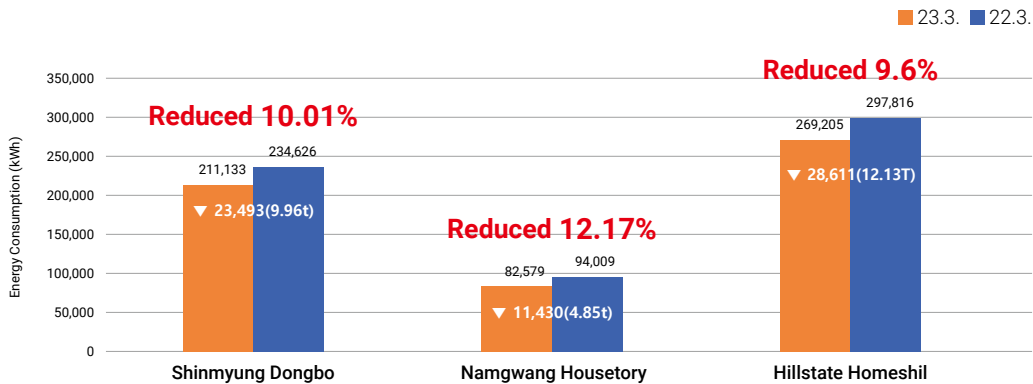


Figure 20: Electricity Consumption Comparison Chart (source: Suwon city)

Lessons learned

Due to the early stage of project implementation and limitations of the initial mobile application model, there is limited data available. More quantitative and qualitative data are required to assess practical impacts of the project, identify areas for improvement, and facilitate its broader scalability across the city.

Strong Interest from Public: The project highlights the active engagement and strong interest of the public in adopting a low carbon lifestyle as a step towards decarbonizing the building sector. The collection of scientific and accurate data about their real-time energy usage through the mobile application encourages them to take active and bold actions. This benefits each household and contributes to the decarbonization of the building sector, aligning with the city's goal of becoming a carbon neutral city.

Scaling up of Project: For example, the city plans to scale up the project, aiming to engage 60,000 households by 2025. This expansion is projected to result in a total annual reduction of 19,396,800 tons of CO₂ emission reduction every year based on average CO₂ reductions obtained from the project to date. The city is expected to achieve its goal of reducing GHG emissions from the building sector by 1.58 million tons of CO₂ earlier than the planned target of 2030. This achievement will accelerate low carbon initiatives in other sectors of the city and contribute significantly to achieving its carbon neutrality goals.

References

1. Suwon City Government. (2022). Suwon City Master Plan on Climate Change Response.
2. Kang, Y. (2023). Carbon Monitoring Business Agreement Ceremony.
https://www.ajou.ac.kr/en/intro/sdgs_goal13.do?mode=view&articleNo=219347&article.offset=0&articleLimit=10
3. Kim, Y. (2023) Suwon is on its pathway towards becoming an Environmental Capital with public engagement
<https://kgnews.co.kr/mobile/article.html?no=744756>
4. Kim, Y (2023). Carbon Neutrality Policy with Citizen Participation.
http://www.urbansdgplatform.org/profile/profile_caseView_detail.msc?no_case=640&from=list
5. "Carbon Monitoring in Our Home" (n.d). [Presentation slides].
6. Suwon City Government & Ajou University Carbon Zero Energy Center (n.d.). A Performance Report of the Pilot Project 'Carbon Monitoring in Our Home' (Phase 1). [Presentation slides]
7. Suwon City Government (n.d.). Introduction of the Public-engaged Pilot Project 'Carbon Monitoring in Our Home'. [Presentation slides]

Case B4: Empowering Community Partners in Developing Plastic Reduction Education Initiatives and Activities (Beijing, China)



Figure 21: Photo Collage of Community Outreach Activities and Education Initiatives.

- **Country/City:** China / Beijing and Qingdao
- **Implementing agency:** "Rethinking Plastic" Project, Beijing Huitian Community Foundation, Tiantongyuan Community Cultural Arts Center, Beijing Changping NGOs Incubation Center, Beijing Shunyi District, Science and Technology Association, Xingxingcao Teenager Public Welfare Benefit Organization, Beijing Changping District Changshengyuan Community Government, Beijing Changping District Primary School
- **Funding:** 410,000 yuan
- **Funding source:** Charitable Grants
- **Website:** -

Background

With the development of socio-economy and the acceleration of industrialization, human impact on the environment has become increasingly severe, and the issue of plastic pollution has garnered significant international attention. In recent years, China has introduced various plastic reduction and prohibition policies, promoting initiatives such as development of alternative materials and extended corporate responsibilities. These measures have contributed to a rise in public awareness towards plastic reduction. However, the full potential for public engagement remains untapped, primarily due to inadequate public understanding of plastic pollution and its implications, along with the lack of localized environmental education materials addressing plastic pollution at the community level. Communities, as the fundamental units of urban governance and development, provide an ideal setting for ongoing environmental education for the public. However, community managers, volunteers, and NGO partners lack a systematic understanding of plastic waste management, making it difficult to translate public awareness into environmentally friendly behaviours.

With the support of the "Rethinking Plastic", Institute for Global Decarbonization Progress (IGDP) is carrying out the "Clean Plastic Future" public education project. This project seeks to explore effective approaches to engage and empower various stakeholders at the community level in reducing plastic

pollution. The goal is to enhance public understanding of plastic pollution from a multi-dimensional perspective and encourage more proactive plastic reduction behaviours.

Project implementation

The initiative is being piloted in Tiantongyuan Community to establish an action network for public education among community stakeholders. Tiantongyuan Community in Beijing comprises 25 neighbourhood committees and has a resident population exceeding 400,000. The surrounding areas are densely populated as well, with over one million residents within a 10-kilometer radius. In December 2021, in collaboration with Tiantongyuan Community Cultural Arts Center, Community Foundation and a social organization incubation center, the project team facilitated the implementation of public education activities. iGDP supported the Community Foundation in planning and organizing a youth art competition focused on plastic reduction. Building upon this, a community plastic reduction science exhibition was held. The exhibition showcased the creative artworks of young individuals, reflecting their expectations and thoughts on a "Clean Plastic Future." Community residents were recruited as volunteer guides for the exhibition, where they educated the public about plastic reduction lifestyles and the hazards of plastic pollution. The exhibition yielded unexpected influence, and through community-driven promotion, it attracted over 200,000 visitors for learning and participation in both offline and online activities.

Leveraging the impact of the science exhibition, iGDP collaborated with university student organizations to organize a short video contest and partnered with a local NGO that provides youth with opportunities for public service to organize a seminar on reducing plastic waste. iGDP has equipped university student organizations and community NGOs with knowledge toolkits, enabling them to understand the development of plastic pollution issues and its impact on oceans, soil, and human health. A total of 118 college students and teams created and shared videos on social media platforms, reaching over 160,000 audiences. Moreover, 144 youth participants engaged in community plastic reduction presentations, prompting over 10,000 residents to pledge their commitment to plastic reduction.

Harnessing the influence of community workers and NGOs, we have been fostering the adoption of plastic reduction habits among the public. Through dialogue with the community workers and partners, the project team has recognized that the key to reducing plastic pollution lies in source reduction and the removal of plastic waste from our living environment. Thus, prompted by initiatives from the cultural center, 13 community workers participated in a workshop aimed at promoting low-carbon consumption at the community level. In the workshop, they identified challenges and designed strategies for implementing low-carbon consumption at the community level and explored pathways to inspire residents to reduce waste at its source.

iGDP provided the community workers with relevant action case studies and aided in formulating community action plans. In addition, in collaboration with community NGOs, iGDP orchestrated a short video dissemination campaign to document residents' best practices in plastic reductions. This included creative transformations of plastic waste, clean-up efforts targeting plastic leakage into the environment, waste sorting, and the reduction of plastic product usage. This initiative has reached over 1.5 million residents.

Expanding on the lessons learned from the Tiantongyuan community, iGDP refined the plastic reduction knowledge toolkit and collaborated with the Changshengyuan community to devise a public education initiative. A dedicated project manager was appointed from Changshengyuan to oversee the project planning, execution, resource coordination, and resident engagement processes. This manager successfully extended plastic reduction education to primary schools by conducting

lectures and facilitating plastic reduction-themed art creation projects. To engage the community's youngsters, the manager organized community council meetings, inviting them in discussions on how art could be employed for plastic reduction education within the community. The valuable insights from these young participants garnered enthusiastic responses from their families and community volunteers.

Through collective efforts, the community utilized art exhibitions to attract a larger audience. In collaboration with young volunteers, a swap event was organized where participants could exchange used items, including children's books and toys. University student volunteers provided informative explanations at the event. The funds raised during this event will be used to support future plastic reduction education initiatives within the community. This multi-faceted approach not only increased awareness but also engaged various segments of the community in a concerted effort to reduce plastic consumption.

Results and impacts

Currently, the "Clean Plastic Future" initiative has been successfully replicated in numerous communities across various cities in China. An increasing number of community workers have come to recognize the importance of promoting waste separation and reducing waste at its source, along with the necessity of public-oriented plastic reduction education.

Community Workers and Educational Toolkits Essential for Project: The project team has collaborated with the government to distil the lessons learned from previous projects. A comprehensive educational toolkit tailored for community workers has been developed, which includes plastic reduction courses, activity planning templates, and case studies. This toolkit empowers community workers to systematically conduct plastic reduction education activities.

Targeted Education Initiatives Bring Better Results: Notably, community workers are shifting their public education strategies. They are now delivering targeted explanations to the public about the significance of reducing plastic waste and proper waste separation. Moreover, they are customizing education initiatives to suit different demographic groups' habits and interests. For instance, specific activities have been designed for teenagers, such as promoting non-plastic book covers and milk carton recycling. Young adults are engaged in "Plogging" activities, combining jogging with litter clean-up. Elderly individuals are introduced to plastic repurposing and reuse methods. This multifaceted approach showcases the adaptability of plastic reduction education to different age groups, fostering a comprehensive shift in behaviour.

Lessons learned

Avoid Overloading Community Workers: Community workers play a pivotal role in mobilizing local resources and adjusting plastic management mechanisms. However, due to the intricate nature of policies that street level bureaucrats are required to implement, they often require assistance from volunteers or NGOs to carry out public education activities. This usually involves collecting public feedback, discussing effective plastic reduction action plans. Moreover, the government should utilize its purchasing power when procuring waste separation services to specify related requirements for service providers. This ensures that community workers avoid being overwhelmed by execution tasks, allowing them to capitalize on their strengths.

Women's Participation Can Increase Engagement: In terms of community engagement, women's participation can make a difference by translating discussed topics into public actions. It is because women tend to prioritize children's health, putting more emphasis on maintaining harmonious community relations and community development. It motivates them to invest time and resources

into participating in plastic reduction practices and discussions.

Local Cultural Integration Improves Knowledge Proliferation: Lastly, the effectiveness of plastic reduction education content is amplified when it is integrated with local culture and practical experiences. Such integration resonates better with the public, fostering increased willingness to engage in the dissemination of knowledge and experiences. Therefore, community partners should compile their practical experiences and transform them into case studies, thereby developing educational content that closely aligns with the daily lives of the residents.

Case B5: Public Engagement in Eco-Friendly Lifestyle Activities (Kyoto, Japan)

Overview of 2050 KYOSO Meeting

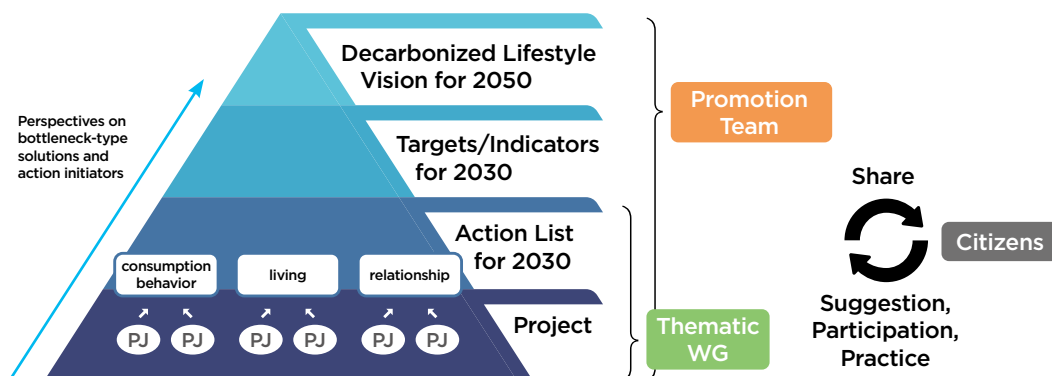


Figure 22: KYOSO Meeting Working Groups and Tasks.

- **Country/City:** Japan / Kyoto
- **Implementing agency:** Global Environment Policy Office, City of Kyoto
- **Funding:** -
- **Funding source:** -
- **Website:** <https://www.city.kyoto.lg.jp/kankyo/soshiki/5-7-0-0-0.html>

Background

Kyoto is an inland city located roughly in the center of Japan, with a population of approximately 1.45 million. Kyoto has been the ancient capital of Japan for more than 1,200 years and is now a tourist city with 43 million annual visitors. Kyoto City is also famous not only as a tourist destination but also as the birthplace of the 1997 Kyoto Protocol (COP3). In May 2019, at the Commemorative Symposium on the 49th Intergovernmental Panel on Climate Change (IPCC) Session convened in Kyoto City, the mayor of Kyoto City expressed his determination to achieve net zero GHG emissions by 2050, ahead of other local governments in Japan.

The COP3 has been an opportunity for all citizens to work together on acting against global warming and steadily reducing GHG emissions. In 2020, the energy consumption of the entire city of Kyoto has been reduced by 31.1 percent from its peak, while energy consumption from residential use has remained unchanged as can be seen in Figure 23 below. This indicated that it may be possible for Kyoto to further reduce its emissions through targeted measures at residents through public engagement.

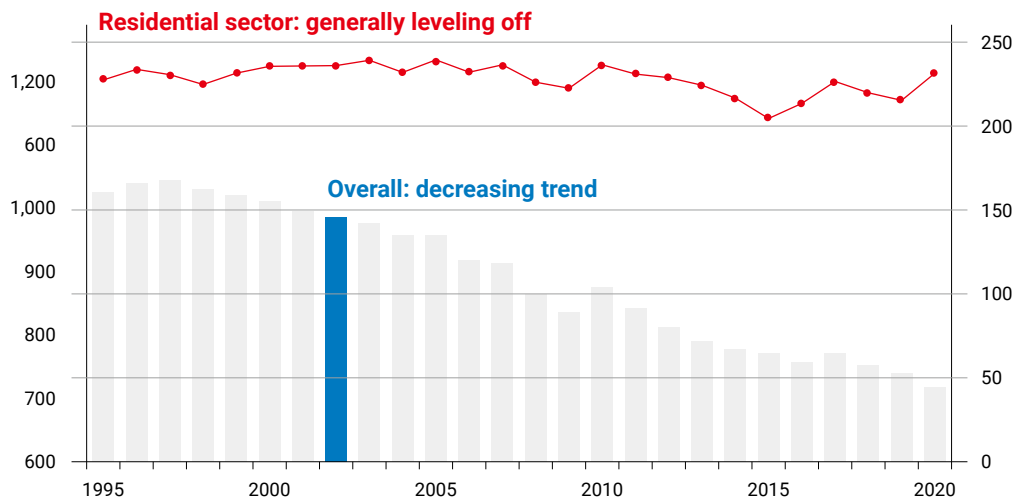


Figure 23: Energy consumption in Kyoto City

Kyoto City has been working with citizens and businesses under the slogan 'DO YOU KYOTO?' which has been ongoing since 2008, to change the lifestyles of its citizens, promoting the use of public transport with 'no-my car' and implementing energy-saving initiatives with 'Lights Down', to promote and raise awareness of environmental awareness and practice environmentally friendly measures. As a result, Kyoto City has achieved reductions in energy consumption and waste:

- Reduced waste by approximately 53 percent compared to the peak.
- The share of cars as a means of transport within the city has decreased by approximately 18 percent (from 28.3 percent in FY2000 to 23.3 percent in FY2021).
- The share of public transport (railways and buses) has increased by approximately 26 percent (from 21.8 percent in FY2000 to 27.5 percent in FY2021).
- The number of tourists traveling by car has also decreased by approximately 70 percent (from 30 percent in FY2009 to 8.6 percent in FY2018).

Project implementation

In order to realize a "prosperous Kyoto that will fulfil the dreams of future generations", the "Kyoto-based Decarbonised Lifestyle Promotion Team - 2050 Kyoto Creation Meeting" was established in September 2021, with citizens, businesses, and academics, mainly the young people who will lead Kyoto City in the future, to create a mechanism for each citizen to shift to their own unique decarbonized lifestyle, aiming to shift to a society and economic activities that do not emit CO₂. The 2050 Kyoto Creation Meeting will share decarbonised lifestyles appropriate for Kyoto in 2050 and create mechanisms (projects) in which citizens can propose and participate in making choices in their daily lives that lead to decarbonisation, rather than endurance and mentality.

Results and impacts

Based on the discussions at the Kyoto Creation Meeting, a vision of a Kyoto-based decarbonised lifestyle is developed as a guideline to be shared by citizens. At the same time, targets and indicators for 2030, examples of actions (action list) to be taken by citizens, and mechanisms (projects) for citizens to put them into practice themselves based on the action list are compiled.

Marketing and spreading of information: As a catchphrase for environmentally friendly initiatives calling on the citizens to realise the vision, the new slogan 'DO YOU KYOTO? 2050, Let's change now. Let's change the future.' was developed from the slogan "DO YOU KYOTO?". In addition, the official Kyoto City decarbonised

lifestyle website '2050MAGAZINE' and social networking service (SNS) such as Facebook, Instagram, Twitter or Spotify, have been set up to disseminate information and raise awareness of the vision.

Pilot projects with businesses: Projects are created and demonstrated by the working groups (WGs) established under the Meeting (Consumption Behaviour WG, Housing WG, and Connections WG). In 2022, eight projects, including the 'RELEASE⇌CATCH' initiative to collect used clothes and circulate them in the region, are being demonstrated with the aim of achieving zero-waste fashion as shown in Figure 24 below. In addition, a number of initiatives are being implemented in which citizens are proactively involved, such as workshops for citizens of different age groups and training courses for citizen writers, which enable citizens to become writers themselves and disseminate initiatives that contribute to a decarbonised lifestyle.



Figure 24: Photo of the Kyoto Creation Meeting and an Example of the Projects Exchange Market.

Lessons learned

Encouraging voluntary grassroots shift in lifestyle: Achieving 'Net Zero by 2050' will require citizens to proactively engage in a lifestyle shift towards decarbonisation. To achieve this, a sense of crisis and a vision of what Kyoto City aims to become must be shared with citizens and businesses, and mechanisms must be created to make it easier for them to act. As it is difficult to collect information on the actions citizens would like to take and their own impact on the environment, a mechanism is needed to make citizens aware of global warming measures as their own affairs.

Private enterprise pilot demonstration projects: In the WG, the aim is to create projects that are not commissioned by the city but can be operated profitably and sustainably as a business and to support the creation and demonstration of projects that shift citizens' lifestyles to decarbonized lifestyles through collaboration between citizens, businesses, and communities.

Algorithm promotion of low carbon lifestyle choices: On the official decarbonised lifestyle website "2050MAGAZINE", a function will be implemented to display the CO₂ reduction benefits of its own carbon footprint measurement tool and actions that the viewer wants to take and to automatically suggest relevant projects and other activities in which they can participate.

References

1. Kyoto City Government (2022). Inauguration of the 2050 KyoSou Meeting.
<https://www.city.kyoto.lg.jp/kankyo/page/0000296476.html>
2. Kyoto City Government (2021). Kyoto City Global Warming Prevention Plan <2021-2030>
<https://www.city.kyoto.lg.jp/kankyo/page/0000000328.html>
3. Kyoto City Government (2023). Develop a vision for a decarbonized lifestyle.
<https://www.city.kyoto.lg.jp/kankyo/page/0000304996.html>
4. Kyoto City Government (n.d). "Kyoto City's Challenge to Net-Zero by 2050" [Presentation slides].

Case B6: Carbon Neutral Point System (Daegu City, Republic of Korea)

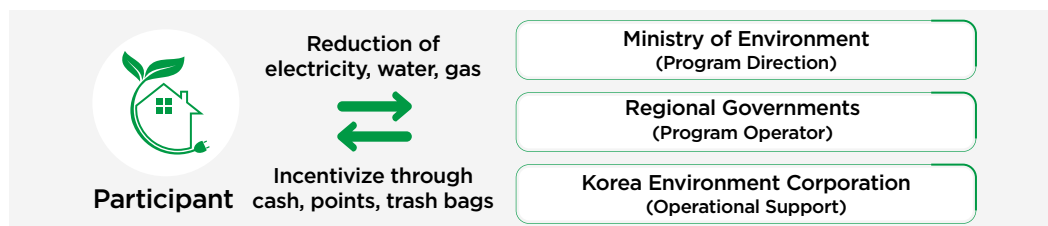


Figure 25: A diagram of Carbon Neutral Point System (Energy) (Source: Ministry of environment)

- **Country/City:** Republic of Korea/ Daegu
- **Implementing agency:** Ministry of Environment, Daegu Metropolitan City, Korea Environment Corporation
- **Funding:** Reducing Energy Use: 670 million won (2018), Reducing Travel Distance of Personal Vehicles: 240 million won (2023)
- **Funding source:** National government (50percent), Local government (50percent)
- **Website:** <https://cpoint.or.kr/>; <https://car.cpoint.or.kr/>

Background

Daegu City has been grappling with heatwaves due to climate change, earning it the moniker 'Daefrica', a combination of Daegu and Africa. In response to the adverse impacts of climate change, particularly revolving around heatwaves, the city has adopted a variety of bold climate actions founded on a legislative framework. Starting with the Climate Change Basic Plan formulated in 2010, the city has continually elevated climate actions on the municipal agenda with a stronger commitment. For example, the city envisions its transformation into a sustainable, low-carbon, and climate-resilient city, exemplified by the development of the 2050 Carbon Neutrality Plan in 2021.

The city has announced its target of GHG emissions reduction by 45 percent by 2023 compared to the 2018 level and has set 24 goals across eight areas, spanning from climate to energy transition. In line with its carbon neutrality goal, the city has adopted the Carbon Neutral Point System to enhance the effectiveness and efficiency of its climate actions through public engagement. The system effectively demonstrates coordination between multiple stakeholders, accelerating GHG emissions reduction at the local level.

Project implementation

Public and private partnership plays a critical role in the implementation of the Carbon Neutral Point System. Governments suggest the blueprint for the low-carbon transformation of the city and lead the implementation in the right direction. The Ministry of Environment of the Republic of Korea devised this system. Local governments, including the Daegu Metropolitan Government, adopt the system within the local context with support from Korea Environment Corporation, which is appointed to provide technical support to activities led by the Ministry of Environment. Private sectors contribute by encouraging citizen engagement through financial benefits.

The system consists of three pillars: reduction in energy usage, reduction in the usage of personal vehicles, and the promotion of eco-friendly activities in daily life. In particular, the system adopted in Daegu city places its primary focus on the first two pillars, with funding from both national and local governments.

In terms of reducing energy consumption, participating citizens benefit from incentives in the form of either cash or Green Card points resulting from energy savings in households. This includes savings on electricity, water, and gas bills monthly. Individuals who reduce their energy usage by 5 percent

or more compared to the level in the past two years are eligible for financial benefits of up to 50,000 KRW per year. Apartment complexes that successfully save energy can receive financial benefits of up to 600,000 KRW per year, based on a performance assessment that considers the ratio of GHG reduction rate to individual participation, with a ratio of 60:40.

When it comes to reducing the usage of personal vehicles, participating citizens who drive non-commercial, fossil-fuel combustion vehicles with a capacity of 12 passengers or fewer can receive financial benefits based on their reduced travel distance compared to their previous records.

Results and impacts

Reduction of CO₂ Emissions: In 2019, 78,865 households in participating in the energy-saving programme benefited from incentives totalling 572 million KRW. This initiative resulted in a significant reduction of GHG emissions by 20,732 tons. In 2021, the Daegu city successfully reduced GHG emissions by 1.52 million tons through a comprehensive set of low-carbon measures. The Carbon Neutral Point System played a crucial role in this achievement, contributing to a reduction of 310,000 tons of GHG emissions. This accomplishment exceeded their goal of reducing emissions by 12 percent.

As of July 2023, nearly 15percent of the total citizens has joined the system. Additionally, concerning the reduction of travel distances for personal vehicles, a total of 3,613 vehicle owners participated in the initiative in 2022. Among them, 2,118 vehicle owners ultimately benefited from incentives amounting to 154 million KRW, as a result of minimizing their travel distances. This initiative contributed to the reduction of 975 tons of GHG emissions reduction.

Lessons Learned

Improving citizen participation: The level of citizen participation in reducing their travel distance by using personal vehicle remains very low. While the government increased the allowance for personal vehicles from 6,000 to 60,000 between 2020 and 2023, this still represents only about 0.4percent of the total number of vehicles registered, which reached approximately 25.5 million as of 2022.

Generating citizen awareness: Less active advocacy for the entire programme in its early stage resulted in a lack of citizen awareness, which, in turn, led to their limited participation. Although 95,500 households joined the programme, a number three times larger than in 2010, this still accounts for only approximately 10 percent of the total households in the city, exceeding 940,000.

Diversification of promotional methods: The city is diversifying its methods to enhance citizen awareness of the programme and address the deficiency in early-stage promotion. These methods encompass the distribution of promotional materials to businesses and residential buildings, advertising on city billboards, and utilizing online platforms such as websites and SNS. Additionally, the city operates booths at various events to further promote the programme. Furthermore, the city is committed to broadening citizen engagement by organizing the Green Apartment Competition. Additionally, it plans to collaborate with educational institutions to encourage participation from households with elementary, middle, or high school students.

Operational challenges: The implementation of the programme in initial stage has several areas for improvement. First, the programme lacked incentive to encourage more active citizen participation beyond the initial target. Second, the programme lacked comprehensiveness that applies to every household, including those have moved into newly built or new housings in the past two years. It also doesn't fully consider the usage of gas for various purposes. Third, the programme provides relatively too many incentives for those who reduce their water usage.

Budget expansion: The city has made significant efforts to expand the budget and the number of eligible participants in the Carbon Neutral Points Automobiles System. Beginning with participation of only 400 vehicles in 2020, out of which 299 vehicles were rewarded with incentives totalling 19.84 million KRW, the budget has been progressively increased and reached 240 million KRW in 2023, with an expected benefit for 4,798 vehicles. This achievement is notable when compared to other metropolitan cities.

Improvement of the Programme Operation: The city has improved the criteria for applying reductions in energy usage and related incentive items. In terms of regulation amendments, the city adjusts the baseline used to calculate the amount of energy saving for households benefitting from incentives. This helps to prevent them from exploiting loopholes in the regulations and instead motivate them to make further energy usage cuts. Additionally, the city sets standards using estimated values for typical household usage for those who have moved into newly built or new housings in the past two years.

Furthermore, the city has implemented measures to provide incentives to citizens in a fair and efficient manner. For instance, it excludes households that use gas only for cooking from being eligible beneficiaries. It also expands incentives for reducing gas usage while reducing incentives for reducing water usage. In addition, it includes individual participants for whom estimated standard values are applied and extends incentives for participants operating businesses that are four times larger than before.

References

1. Bae, M. (2011, December). Invigorate Strategies of Carbon Point System in Local Governments. *Regional Policy Study*, 22(2), 14.
2. Chung, Y. (2023, February 22). Active participation in the 'Car Carbon Neutral Point System' to save the Earth. Senior Mael.
<http://www.seniormael.com/news/articleView.html?idxno=40983>
3. Daegu Metropolitan City. (n.d.). Daegu Metropolitan City Newsroom. Daegu Metropolitan City Newsroom. Retrieved August 28, 2023, from
<https://info.daegu.go.kr/newshome/mtnmain.php>
4. Daegu Metropolitan City. (2013, February 09). Daegu City Promotes Expansion of Carbon Point System Membership. Newswire.
<https://www.newswire.co.kr/newsRead.php?no=678852>
5. Daegu Metropolitan City. (2023, June 21). Carbon Neutral Point System(Energy). Daegu Metropolitan City. Retrieved August 28, 2023, from
https://www.daegu.go.kr/env/index.do?menu_id=00001309
6. Heo, S. (2020, April 22). Automobile Carbon Point System a "showoff". Jeju Citizen's News.
<http://www.jejudomin.co.kr/news/articleView.html?idxno=123614>
7. Hwang, S. (2012, June 27). What is carbon point?Only 10percent of households in Daegu participated. Mael News.
<https://news.imael.com/page/view/2012062710364042038>
8. Kim, E. (2020, May 13). Daegu City implements a carbon point system. ...Incentives up to 50,000 won per year will be paid. Sunday Seoul.
<http://www.ilyoseoul.co.kr/news/articleView.html?idxno=389891>
9. Kim, K. (2021, December 14). Daegu Announces Carbon Neutrality, First Regional Government..."Reducing Greenhouse gases by 45percent by 2030. Hangeore.
<https://www.hani.co.kr/arti/area/yeongnam/1023297.html>
10. Kim, K. (2022, October 24). Daegu City over-achieved its goal by reducing greenhouse gas emissions by 13.3percent last year. Hangeore.
<https://www.hani.co.kr/arti/area/yeongnam/1063960.html>

-
11. Korea Environment Corporation. (2014, February 21). The carbon point system will be improved. Carbon Neutral Point Energy. Retrieved August 28, 2023, from https://cpoint.or.kr/user/notice/read.do?notice_seq=10490&searchKey=&searchType=&pageIndex=2
 12. Ministry of Environment. (n.d.). Carbon Neutral Points (Automobiles). Carbon Neutral Point Automobiles. Retrieved August 28, 2023, from <https://car.cpoint.or.kr/guide/carCoPoint.do>
 13. Ministry of Environment. (n.d.). Participations. Carbon Neutral Points Energy. Retrieved August 28, 2023, from <https://cpoint.or.kr/user/currentStatus/currentStatus.do>
 14. Ministry of Environment. (2022, August 30). 2023 Ministry of Environment Budget. Ministry of Environment. Retrieved August 28, 2023, from <https://www.korea.kr/briefing/pressReleaseView.do?newsId=156523098#pressRelease>
 15. Ministry of Land, Infrastructure and Transport. (2023, January 17). Find out the status of car registration in 2022. Retrieved August 28, 2023, from https://www.molit.go.kr/USR/NEWS/m_35045/dtl.jsp?lcmspage=1&id=95087800#~:text=percent2722percentEBpercent85percent84percent20percentECpercent9Epercent90percentEBpercent8Fpercent99percentECpercentB0percentA8percent20percentEBpercent88percent84percentECpercentA0percent81percentEBpercent93percentB1percentEBpercentA1percent9D,percentECpercentB2percent9CpercentEBpercent8Cpercent80



C

NATURE-BASED AND INNOVATIVE SOLUTIONS CASES

Case C1

Deployment of a Digital Agricultural Brain (Shanghai, China)

Case C2

Climate-Smart Grassland Management Project (Xilin Gol, Inner Mongolia, China)

Case C3

Novartis Southwest Sichuan Carbon-Sink Forestry, Community and Biodiversity Project (Liangshan Prefecture, Sichuan Province, China)

Case C4

One Billion Tree Initiative (Mongolia)

Case C5

Urban Forest (Pyongtaek, Republic of Korea)



C: NATURE-BASED AND INNOVATIVE SOLUTIONS CASES

Nature-based solutions cases rely on nature to provide part of the answer to many of the climate challenges being faced, from air and water filtration to natural growth cycles.

Case C1: Deployment of a Digital Agricultural Brain (Shanghai, China)



Figure 26: Representation of Digital Agricultural Brain Application.

- **Country/City:** China / Shanghai
- **Implementing agency:** Shanghai Municipal Government
- **Funding:** -
- **Funding source:** Government's budget
- **Website:** -

Background

Agricultural intensification stands as a significant driver of climate change. Over the last five decades, the global area of irrigated cropland has approximately doubled, accompanied by a staggering 500 percent surge in fertilizer utilization (with an increase of over 800 percent for nitrogen alone). This intensification has led to water degradation, heightened energy consumption, and pervasive pollution. Nevertheless, the outcomes of agricultural intensification exhibit substantial diversity in terms of both advantages and drawbacks, frequently contingent upon geographical factors and agronomic methodologies.

Simultaneously, global food scarcity has emerged as a pervasive concern. The United Nations' World Population Prospects report of 2019 projects that the global population will reach 9.7 billion by 2050, necessitating a staggering 70 percent increase in food production. Unsustainable patterns of food production and consumption have become a prevalent theme intertwining numerous pressing challenges confronting humanity in the contemporary era.

Shanghai, boasting a population of 20.4 million permanent residents, stands as a mega-city; however, its suburban expanse remains the most compact among all Chinese municipalities. The level of integration and advancement of rural industries in Shanghai falls short of desired benchmarks. Urgent attention is required to enhance the quality and efficiency of agricultural supply chains. The

digitalization of agriculture holds the potential to effectively tackle the significant challenges facing the agricultural sector. This includes enhancing productivity, minimizing environmental impacts, and conserving precious natural resources.

Project implementation

Shanghai agriculture faces a series of problems, such as large environmental pressure, small space for industrial development, short industrial chain, low economic efficiency, weak product competitiveness, insufficient labour force, and serious labour force aging. The development of smart agriculture can effectively alleviate these problems and promote the green development of urban agriculture.

The Shanghai government took the lead in promoting digital agriculture. Outline of the 14th Five-Year Plan (2021-2025) for Shanghai's Economic and Social Development and Vision 2035 of the Shanghai government, and the Action Plan for Promoting High-quality Agricultural Development in Shanghai (2021-2025) both propose to promote the development of smart agriculture. Shanghai Urban Agriculture Development Project also takes "smart agriculture construction" as an important support direction.

Based on the characteristics of a mega-city and the needs of rural development, the Agriculture and Rural Affairs Committee of Shanghai actively formed a professional team to plan and formulate the top-level framework for the development of agricultural and rural informatization in Shanghai, which was called "1+N+X+ digital base" and built the Shanghai agriculture and rural digital platform. The platform was planned to incorporate the full-aperture production data of the large-scale rural industrial management subjects in whole industries into visual supervision. The platform provided a digital starting point for Shanghai agriculture to achieve the goal of "one map knows the countryside, one database collects all information, and one network management is the whole process".

In 2019, Shanghai started to draw a digital agricultural base map. A series of technical solutions were formulated by a special technical team such as "Classification System of Land Use for Current Agricultural Production in Shanghai", "Technical Regulations for Data Collection of Land Use for Current Agricultural Production in Shanghai", and "Code Restrictions of Land Use for Current Agricultural Production in Shanghai". Under the unified technical standard framework, the agricultural geospatial data scattered in different departments were integrated and collected. The digitization of 2.3 million mu agricultural land was completed. At the same time, three types of spatial basic data including remote sensing image data, basic vector data, and agricultural thematic data were gathered.

In 2020, according to the relevant requirements of constructing the city's big data system and platform, the integration of government information systems was carried out. With useless information systems cleaned up and data barriers broken, an agricultural data resource library was successfully constructed. N types of integrated business application scenarios were developed, including scenarios like planting, vegetables, animal husbandry, fishery, agricultural machinery, and safety supervision. X subsystems were integrated together supporting business modules of Shennong Pocket, animal husbandry management, and grid supervision of agricultural products. It took 5 months to build a digital agricultural management platform based on the agricultural digital map and other thematic databases. The platform mainly provides data support for the management of rural agriculture in Shanghai. Till now, the database has collected 385 million units of data, and the data storage capacity has reached 3.2TB.

Results and impacts

Market efficiency improvement: The real-time data provides solid information support for vegetable supply, market allocation, agricultural production planning, insurance subsidies, and agricultural guidance. Agricultural operators accumulate credit from their data assets to enjoy more services.

Online sellers, agricultural product buyers, and other social service institutions utilize the data platform to match production and marketing. The financial and credit departments can develop and sell more credit products based on data assets.

Agricultural production and management optimization: The reflectance spectrum information of crops was obtained by certain technical means. Thus, the growth state of crops was monitored, diagnosed and evaluated. Crop yield and protein content were also under prediction and evaluation using satellite remote sensing technology. Moreover, with the spectral data collected by remote sensing equipment analysed, a management decision support system for agricultural production was formed, to guide agricultural operation or design intelligent agricultural machine operation plans.

Waste and carbon emissions reduction: The intelligent management cloud platform could achieve precise cost control to reduce waste and carbon emissions in the farming process. The platform and the equipment system can be coordinated and interactive, continuing to work for 24 hours. Light, humidity, and nutrition were all automatically adjusted with intelligent greenhouse sensors real-time monitoring. In the fish reservoir, the data wireless transmission terminal, light intensity sensor, carbon dioxide sensor, probe device, and other equipment are installed, which can be more accurately according to the size, density, feeding conditions and other data strictly complete the feeding work. All these measures largely reduce the feed waste and fertilizer waste, which help reduce carbon emissions and pollution.

Lessons learned

Data shaping and quality are important for digital platforms: The reason why digital platforms based on digital pedestals can avoid information isolation is based on at least two things. First, effective allocation of resources was achieved through digital sharing, which effectively solve the problems of "who to share" and "how to share", to promote the effective allocation of high-quality agricultural resources. Second, justice and equality were ensured through big data. The value of digital agriculture comes from big data. Big data processing and management reduce the negative influence of power and make decision-making more neutral and scientific. With the visualization of agricultural producers' trust, the scientific decision-making of managers, and the precision of service, the goal of shaping the digital agricultural value chain will be obtained naturally. Therefore, digital agriculture successfully promotes the high-quality development of modern agriculture and rural areas.

Commitment to data integration and availability: Another significant factor in Shanghai's experience appears to be the driving role of the government. Through the services of governments at all levels, the Shanghai government broke various barriers such as regional and administrative barriers to obtain real and dynamic data. The value of data in all links of the value chain, thus, can be embodied. Meanwhile, the community was expanded through value sharing. The administrative forces identified digital technology suppliers. Then the government and digital technology suppliers jointly created value, to attract business entities and social service organizations. A regional digital agricultural ecology was then successfully constructed, which truly promoted the steady progress of digital agriculture construction.

References

1. Mueller, N. D., O'Connell, C., Ray, D. K., West, P. C. and Balzer, C. (2011). Solutions for a cultivated planet. *Nature* 478: 337–342.
2. Desa, U. N. (2019). *World Population Prospects 2019*. United Nations. Department of Economic and Social Affairs. World Population Prospects 2019.
3. FAO. (2018). *FAO's work on agricultural innovation: sowing the seeds of transformation to achieve the SDG's*. Rome, Italy: Food and Agriculture Organization (FAO).

-
4. Fang Zhiqian, Zhang Chen & Lou Jianli. (2020). Reflections on some problems of agricultural and rural modernization in Shanghai. *Science Development* (09),75-83.
 5. Robert Finger (2023). Digital innovations for sustainable and resilient agricultural systems. *European Review of Agricultural Economics*. jbad021.
<https://doi.org/10.1093/erae/jbad021>
 6. The People's Government of Shanghai Municipality. (2021). The 14th Five-Year Plan for Shanghai's National Economic and Social Development and the Outline of the long-term goals for the next five years
<https://www.shanghai.gov.cn/nw12344/20210129/ced9958c16294feab926754394d9db91.html>
 7. Shanghai Agriculture and Rural Affairs Committee. (2022). Consolidating the base of Digital Agriculture and Rural Cloud Platform "Shanghai Solution" for Planning smart Agriculture.
<https://nyncw.sh.gov.cn/mtbd/20220921/f460c870a8c5439892f815f6cbde14f7.html>
 8. Green Qingpu. (2022). "Will" farming but also "smart" farming, digital agriculture to help rural revitalization.
<https://baijiahao.baidu.com/s?id=1727327809146433192&wfr=spider&for=pc>
 9. Jia Jia, &Hu Ligang. (2023). Shaping Digital agriculture value chain - the digital agriculture construction logic behind the three digital agriculture cloud platforms.
<https://h5.drcnet.com.cn/docview.aspx?version=edu&docid=7056816&chnid=1005>

Case C2: Climate-Smart Grassland Management Project (Xilin Gol, Inner Mongolia, China)

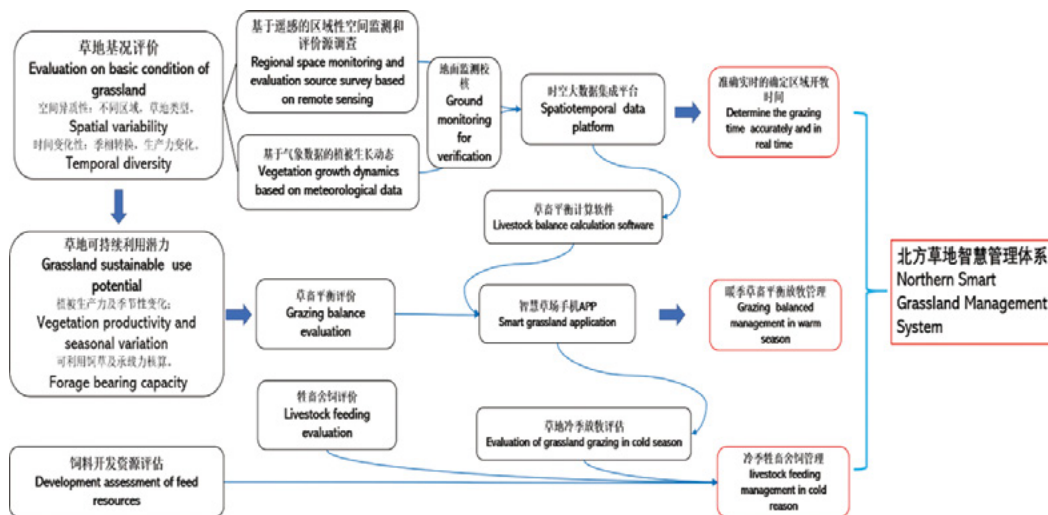


Figure 27: Flow Diagram of Northern Smart Grassland Management System (Source: The Nature Conservancy)

- **Country/City:** China / Xilin Gol, Inner Mongolia
- **Implementing agency:** The Nature Conservancy (TNC), the University of Inner Mongolia, and Lao Niu Foundation
- **Funding:** -
- **Funding source:** Philanthropic Funds
- **Website:** -

Background

With a grassland area of over 86.66 million hectares, Inner Mongolia is a significant livestock production base. However, due to unsustainable practices such as overgrazing and excessive cultivation, coupled with the impact of climate change, the grasslands have been undergoing degradation. This has led to a decline in productivity and a weakening of its ecological barrier function.

In a dynamic world characterized by demographic shifts, economic challenges, drought, heatwaves, desertification, and wildfires, safeguarding the provision of ecosystem services by grasslands is of significant importance to human well-being. Simply carrying out a long-term grazing ban can lead to grassland degradation, soil erosion, and deterioration of ecological and productive functions, reducing the adaptive capacity toward climate change.

Against this background, in 2018, TNC in collaboration with the University of Inner Mongolia, and Lao Niu Foundation, initiated the Climate-Smart Grassland Management Project in Xilin Gol, Inner Mongolia. Xilin Gol administrates major grassland areas in Inner Mongolia, which is one of the 35 priority areas for biodiversity conservation in China. The project seeks to establish a climate-smart grassland management system, which will help to achieve the visionary goals of increasing sustainable productivity, enhancing the adaptability of herders to climate change, reducing GHG emissions from animal husbandry, and increasing grassland carbon sinks, thereby providing a reference for the climate-smart management and sustainable development of grasslands around the world.

Project implementation

Climate-smart management of grassland is based on the natural restoration of nature-based solutions (NBS), combined with seasonal grazing moratoriums to promote the recuperation of grassland, and the application of "warm grazing and cold feeding" (balanced grazing management of grass and livestock in the warm season and reasonable forage supplementation in the cold season) to balance grassland productivity and livestock production efficiency. Remote sensing and meteorological data, combined with handheld terminals and Internet technology (Smart Grassland app, etc.) are also incorporated to make flexible contingency plans for grazing operations. With proper management and informed decision making, a deliberate transformation to more resilient grassland that provides critical ecosystem services and production functions, and mitigates climate change, is possible.

Through spatial and meteorological technologies, and ground corrective grassland monitoring, combined with analysis of the year's climate dynamics, the project is able to accurately determine the time of grazing, allowing the grassland to obtain sufficient time for growth. After the start of the pasture, the farmers used the hand-held terminals to conduct a rapid assessment of the status of the grassland, allowing them to forecast the grassland's productivity and develop a flexible grazing management plan. This allows them to dynamically determine the time of grazing and the intensity of grazing, and to achieve a balance between grass productivity and animal performance in the warm season. In the autumn and winter seasons, combined with local resources, farmers can assess the amount of forage available for grazing animals and supplement the forage to ensure livestock production efficiency.

Based on an analysis of the status of grassland owned by typical herding households in Xilin Gol, from 2019 to 2020 the project recruited 8 typical herding households living in 5 different cities. The theoretical stocking rate, the regeneration rate, and suitable starting period of each grassland was calculated using data such as estimated acre and type of livestock, etc. With this, a preliminary estimation of the reasonable length of grazing moratorium was made.

It was discovered that a longer grazing moratorium will allow the grass to retain a larger vegetation base and carrying potential. However, regarding grassland regeneration, appropriate grazing will lead to higher regeneration levels. Understanding the impact of different beginning periods on the productivity of grazing free grasslands will enable herders to estimate the grass rejuvenation period, grazing moratorium and starting period more accurately to make the most of the grassland resources.

By implementing a grazing moratorium, the forage must come from other sources other than grassland. As a result, this approach can significantly enhance herders' proactive involvement in vegetation restoration. The demand for forage during the resting periods serves as both a driving force for vegetation restoration efforts and a measure of their success. Using the forage reserve during resting periods as a guideline encourages farmers and herders to conscientiously adjust livestock numbers, addressing the issue of overgrazing and achieving a balanced grazing management of grass and livestock.

Results and impacts

Smarter grazing methodology improves efficiency: The climate-smart grassland management model used has gained recognition from herders and local governments. It has been scaled up to an area that exceeds 100,000 acres, providing valuable insights for its replication in other regions. Moreover, the project's achievements provide empirical data for current ecological construction and management initiatives such as "Ecological Red Lines" and "National Grassland Parks," contributing to the formulation and implementation of related policies. The production model of "warm grazing,

cold feeding, integrated farming and herding, and grass-livestock balance" has been further validated, holding the potential to drive a profound transformation in grassland livestock production methods in northern China's grassland regions.

In comparison to methods such as rotational grazing, implementing a grazing moratorium demands fewer agricultural facilities, reduced investment, lower management input, and less technical expertise. This approach offers a cost-efficient solution to China's challenge of harmonizing livestock production with the long-term sustainability of grasslands.

Nature-based solutions improves overall results: The project demonstrates that climate-smart grassland management aligns with natural patterns and local production methods, aiding in the restoration of its regenerative capacity and ecosystem services. This approach enables grasslands to be utilized in a more sustainable manner, addressing climate change and alleviating ecological concerns. Furthermore, it promotes community development and strikes a balance between conservation and development, ultimately achieving the sustainable development goal of shared prosperity between humans and nature.

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Lessons learned

Technology can augment grasslands sustainably: By employing effective management strategies and data-informed choices, it is feasible to transition towards more robust grasslands capable of offering sustainable productive services, both maximising livestock production on a given area of land while ensuring longer-term land productivity, regenerating with minimal costs to the farmers by using natural cycles.

References

1. Lao Niu Foundation. (2020). Smart Management of Grasslands: One of the Key Measures for Global Grassland Conservation.
http://www.infund.org/index.php?s=/Index/news_show/id/2131/cid/172.html
2. Lao Niu Foundation.(2021). World Environment Day | Smart Grassland Management Facilitating Harmonious Coexistence of Humans and Nature.
http://www.infund.org/index.php?s=/Index/news_show/id/2211/cid/172.html
3. TNC. Smart Grassland Management Project in Xilingol League.
https://tnc.org.cn/content/details33_728.html
4. TNC. (2021). Xilin Gol League Grassland Wisdom Management Project: Fine Management Sustainable Development.
https://www.tnc.org.cn/content/details27_1009.html

Case C3: Novartis Southwest Sichuan Carbon-Sink Forestry, Community and Biodiversity Project (Liangshan Prefecture, Sichuan Province, China)



Figure 28: Reforestation and Carbon Sinking Efforts in Liangshan (Source: Novartis)

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- **Country/City:** China / Liangshan Prefecture, Sichuan Province
 - **Implementing agency:** Novartis Group, The Nature Conservancy (TNC), Shanshui, Sichuan Forestry Department, the Sichuan Daduhe Forestation Bureau, and local communities
 - **Funding:** 100 million yuan
 - **Funding source:** Carbon finance
 - **Website:** -

Background

Starting from the desire to offset carbon emissions, in 2010, Novartis initiated Southwest Sichuan Carbon-sink Forestry, Community and Biodiversity Project in Sichuan Province. The project covers 61 land plots situated at altitudes ranging from 2,500 to 3,200 meters in five counties of Liangshan Prefecture, Sichuan Province. The project area was once a biodiversity and nature reserve hotspot, characterized by dense forests of spruce and fir trees, where arrow bamboo served as a food source for pandas. However, due to excessive logging from the 1950s to 80s, these regions had experienced deforestation and have not been restored since. Consequently, rampant deforestation has led to scarcity of essential resources for both local communities and wildlife animals. In addition, livestock grazing has also exacerbated land degradation, jeopardizing ecosystems and deteriorating wildlife habitats.

This initiative is a collaborative effort involving The Nature Conservancy's China Program, a prominent global conservation organization, and Shanshui, an affiliated Chinese non-governmental organization. Furthermore, Novartis and its partners are in close cooperation with forestry departments at the national, provincial, and local levels, including the Sichuan Forestry Department and the Sichuan Daduhe Forestation Bureau, as well as local communities.

Through restoration of the forest ecosystem, this project seeks to enhance carbon sequestration,

bolster biodiversity conservation, stimulate rural community development and enhance the climate adaptation capacity of surrounding nature reserves.

Project implementation

Novartis plans to invest 100 million yuan for the project span of thirty years. It is projected 120 kilotons of carbon dioxide will be sequestered when the forests have grown to its full maturity in 80 to 100 years' time.

With the project initiated in 2010, the sapling planting commenced in 2011. During the initial phase of the project, the low survival rate of saplings emerged as the foremost concern. This raised apprehensions that the carbon reduction delivered by the project might not meet the anticipated standards. Drawing inspiration from Novartis' carbon sink projects in Argentina and Mali, and guided by China's poverty alleviation policies, Novartis proposed an innovative approach by integrating the project with China's giant panda conservation and poverty alleviation efforts. This not only addressed concerns about potential carbon deficit but also ensured multiple benefits, aligning with both ecological and socioeconomic objectives.

While the carbon sink quantity issue was resolved, a new challenge emerged during the project's construction phase: the conflict between afforestation and grazing. Many residents primarily rely on grazing as their livelihood, and free-ranging cattle and sheep often nibble on saplings. For saplings that were already growing slowly, once the main stems were damaged, their growth points were lost. After careful negotiations, a compromise was reached: a total of 209,000 meters of fencing was built. The fencing allowed saplings to grow to a height where they would be out of reach for cattle and sheep. When trees reach a certain height, the fencing can be removed so that the area can be used for grazing to ensure local farmers' earnings.

Simultaneously, a series of complementary measures were put in place by local authorities and forestry departments, including developing village regulations, demarcating grazing buffer zones, and intensifying environmental awareness campaigns. These measures effectively alleviated the conflicts and tensions surrounding the project.

The project has also fostered a collaboration between residents and nature preservation initiatives. Around 80 residents have been trained as forest protection personnel to conduct regular inspections of the condition of newly planted areas.

The project progressed smoothly and generated further innovative ideas, primarily due to the establishment of a systematic collaborative mechanism. The project formed an expert committee comprising forestry experts from both domestic and international backgrounds. Additionally, a guiding committee was formed, including representatives from Sichuan Provincial Forestry and Grassland Bureau, China Nature Conservation Association, Novartis Group, Sichuan Academy of Forestry, and Sichuan Survey Planning and Design Institute. The expert committee provided suggestions to the guiding committee after on-site inspections and public surveys, and the final decisions were made by the guiding committee. If the expected goals were not achieved, the process would be reinitiated until the correct approach was identified.

Furthermore, the Novartis Southwest Sichuan Forestry Carbon Sink Project established a coordination office to oversee daily operations, management, and implementation from various angles. This well-structured management framework effectively leveraged the professional strengths of all participating parties, facilitating timely and effective communication to address challenges encountered during the project's progress.

Results and impacts

Carbon sequestration through managed forestry: Progress has already been made and measured in the past 12 years since the project launched in 2010. More than 21 million trees have been planted in 5 counties, restoring more than 4,000 hectares of land and creating land care and maintenance jobs that benefit over 4,000 rural families.

Biodiversity and restored ecosystems: Apart from carbon sequestration, the restoration of forest ecosystems is anticipated to enhance the climate resilience of both local ecosystems and communities. Furthermore, the initiative is anticipated to boost biodiversity, given that rehabilitated forests create improved environments for a diverse array of flora and fauna, including imperilled species like the giant panda and the red panda, a small tree-dwelling mammal indigenous to the area.

Jobs and income for residents: The project also increases the income of impoverished residents. Preliminary surveys indicate that the project has contributed to a per capita income increase of 2,160 yuan for residents, benefiting approximately 4,265 farming households comprising over 18,000 individuals. Notably, 97 percent of the population belongs to ethnic minority groups. It also fosters the enhancement of skills in seedling cultivation, afforestation techniques, and forest maintenance and management. By engaging the local communities, it raises the environmental conservation awareness of local inhabitants.

Public recognition and replication: The success of the project also serves as an inspiration for the initiation of other afforestation and reforestation carbon sequestration projects with cascading environmental, economic and social benefits. In 2018, the Dadu River Afforestation Bureau, in collaboration with Sichuan Agricultural University, initiated a Forest Carbon Sink Poverty Alleviation Demonstration Project. The demonstration site covered a total of 123.6 hectares and focused on afforestation in high-altitude mountainous areas, nurturing and management, planting of undergrowth economic crops, and intensive farming. The project provided technical training and demonstrations to guide and mobilize local impoverished farmers to participate in the construction of the demonstration site and related training activities, offering educational opportunities and income enhancement. It is believed that the benefits brought by the project will multiply over the next 30 years.

In 2013, the project achieved a significant milestone by obtaining registration as a Clean Development Mechanism project under the United Nations Framework Convention on Climate Change. Additionally, it was granted the distinguished certification of the Climate, Community & Biodiversity Alliance, further underscoring its commitment to climate action, community welfare, and biodiversity conservation.

Lessons learned

The project area was in dire need of an infusion of development momentum, and the project serves as an engine to fulfil this purpose. For companies and organizations aspiring to fulfil their corporate responsibilities, this project holds valuable lessons.

Local residents and developmental infrastructure considerations: The comprehensive approach of this project is also vital for its achievements so far. The project objectives should address local developmental pain points and challenges at a certain level. The five counties where the project is implemented are all designated as national poverty-stricken counties and are located within three giant panda nature reserves. From the perspective of afforestation and carbon reduction, the project continuously aligns with the local development challenges, integrating biodiversity conservation and poverty alleviation. The political momentum facilitates the progress of the project. Conversely, this approach has led to cascading benefits and political influence on both ecological civilization

construction and economic development in Liangshan Prefecture.

Organization and sustaining the project: The project's scientifically structured management framework, known as "Two Committees and One Office," is based on a comprehensive and accurate representation of the demands of various stakeholders. It orchestrates and coordinates resources from all parties involved, including Novartis, the Sichuan Forestry and Grassland Bureau, and the Daduhe Afforestation Bureau. This framework also enables Novartis to leverage its expertise in management, resources, and technology. Within this mechanism, challenges like funding shortages, seedling replenishment, and conflicts between forestry and animal husbandry have been tackled, ensuring the achievement of anticipated outcomes.

The project area was in dire need of an infusion of development momentum, and the project serves as an engine to fulfil this purpose. For companies and organizations aspiring to fulfil their corporate responsibilities, this project holds valuable lessons.

References

1. Novartis. (2017). Novartis carbon-sink forestry projects: An inclusive business approach to fighting climate change and supporting local communities.
https://www.novartis.com/sites/novartis_com/files/novartis-carbon-sink-forestry-projects.pdf
2. People.cn. (2017). Candidate Case: Novartis Southwest Sichuan Forestry Carbon Sink, Community and Biodiversity Project.
<http://gongyi.people.com.cn/n1/2017/1219/c151132-29717151.html>
3. Swissnex. (2022). Guarding the Healthy Mountains and Forests.
<http://swissnexinchina.org/art-science/2022/5/27/guarding-the-healthy-mountains-and-forests>
4. Novartis. (2019). Novartis Southwest Sichuan Forestry Carbon Sink Project Study Tour.
https://www.sohu.com/a/332298169_680770
5. SHINE. (2020). Novartis digs in to protect biodiversity in Sichuan Province.
<https://www.shine.cn/biz/company/2012312336/>

Case C4: One Billion Tree Initiative (Mongolia)



Figure 29: Planting Trees as Part of Mongolia's One Billion Tree Initiative.

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- **Country/City:** Mongolia
 - **Implementing agency:** Mongolia's national and regional government, major companies and corporates, and citizens
 - **Funding:** 33.8 billion MNT in last 5 years.
 - **Funding source:** Public and Private Funds
 - **Website:** -

Background

Mongolia is a landlocked country with 77 percent of its total territory affected by desertification and land degradation. Only around 8 percent of its land is covered by forests. Mongolia's annual mean air temperature has increased by 2.25°C over the past 80 years, while annual precipitation decreased by 7 percent, resulting in higher aridity across the country. Despite the influence of unreasonable human activities, climate change has been recognized as a major driving factor for Mongolia's recurring droughts and yellow dust storms.

Mongolia is vulnerable to climate change and desertification. According to World Bank Climate Change Knowledge Portal (2018), small inter-annual variations in precipitation can lead to severe drought events in Mongolia due to its special climate. Frequent high winds and heavy dust storms intensified by the climate change threatened the ecosystem and public health. The nation's food and water security were also eroded.

Not only natural ecosystem but also key socioeconomic sectors including agriculture and animal husbandry in Mongolia were severely affected by climate change. East Asian countries such as China, South Korean and Japan, were also suffering yellow dust storms originating from Mongolia. Mongolia's efforts in combatting climate change and desertification concerns not only Mongolians but the whole world.

In order to combat climate change, desertification, deforestation, and food insecurity in Mongolia, the President Ukhnaa Khurelsukh announced at the United Nations General Assembly on the nationwide campaign to plant at least one billion trees by 2030, on September 22, 2021.

Project implementation

The Mongolia government drew up a three-stage plan for the campaign, with a preparatory phase planned for 2021-24, an intensification phase in 2024-26 and a sustainable implementation phase in 2027-30. This plan carried expectations of the President Khurelsukh that the One Billion Tree nationwide movement would continue insulated from the changes of national and provincial administrations.

Mongolia made a lot of efforts to ensure a stable supply of funds to support its national tree-planting campaign. The government promised to spend at least 1 percent of its annual gross domestic product (GDP) on a comprehensive national programme. Mongolia established a fund to create a structure and system to provide sustainable financing of afforestation, tree planting and other environmental activities. At least 2 billion Mongolian Tugriks (679,000 U.S. dollars) are expected to be donated annually to the fund by member organizations of the Mongolian Bankers Association. Meanwhile, the presidential press office claimed that green loans in the banking sector would be increased to 10 percent by 2030.

In addition to top-down approach, the government also leverages bottom-up climate actions. The Forest Law of Mongolia obliges every citizen to plant one tree and every organization to plant five trees per year. Regional governments have made their pledges towards the national objective. By June 2021, 21 provinces(aimags) and 330 sub-provinces (sum) participated in the seedling process. The province of Ömnögovi promises to grow at least 70 million trees and provides financial packages to people for conserving new trees in the area. Public-private sector partnerships are well-established. Several big firms have committed to planting 20 million to 120 million trees over the coming decade. In addition, attractive incentives are offered to corporations to contribute to environmental afforestation.

Results and impacts

Climate resilience enhancement and carbon reductions: A special report prepared by the IPCC released in 2019 revealed that native and other climate resilient tree species with low water needs can thwart misfortunes. The programme aims to increase the forest covered area proportion from 7.9 percent to 9 percent between 2020 and 2030. Those newly planted trees can reduce sandstorms, forestall wind erosion and contribute to carbon sinks. They can also improve soil nutrients and water preservation. 4percent of the extremely desertified land is expected to be restored. If the plan goes well, the sequestration of carbon dioxide was estimated to increase by 2.5 million tons annually in 2030.

Social awareness raising on climate change: Many citizens, enterprises and organizations across the country have joined the campaign. Major mining companies in Mongolia signed a deal to plant a total of 608.5 million trees by 2030. Many companies have also actively joined the campaign to fulfil their social responsibility. For example, the state-owned Erdenet Mining Corporation have promised to plant 100 million trees over the next 10 years, and the Erdenes Tavan Tolgoi joint stock company have agreed to plant 176 million trees by 2030.

Economic and conservational benefits: One Billion Tree Initiative have contributed to job creation. The country's nomadic herders can earn extra income by planting trees on their land. A billion dollars are expected by the government circulating through this project.

Lessons learned

Grassroots and local participation: While the government leverages its administrative power to make it as an obligation for individuals and companies to make efforts in greening the environment. Meanwhile, Mongolia has designated the second Saturday in May and October as national tree-

planting days, which are the country's largest tree-planting and nature care event, making planting trees a national activity. Grassroots participation has been critical, between 2011 and 2021, individuals and businesses contributed to the plantation of more than 13 million trees.

Coherency of funding and policies: Learning lessons from the past is important. Mongolian policymakers had endeavoured to initiate and enforce various environmental policies. However, these endeavours frequently encountered interruptions due to elections or other political shifts. The coherence of the plan was not only disrupted but also faced challenges in fundraising. To circumvent such circumstances, the One Billion Tree nationwide movement demonstrates significant commitment in establishing a robust fund operation mechanism, ensuring a consistent inflow of federal and local funds.

References

1. Xinhua News Agency. (2023). Why large parts of Mongolia are affected by desertification. <https://www.bangkokpost.com/world/2567414/why-large-parts-of-mongolia-are-affected-by-desertification>.
2. Han, J., Dai, H., & Gu, Z. (2021). Sandstorms and desertification in Mongolia, an example of future climate events: A review. *Environmental Chemistry Letters*, 19, 4063-4073.
3. World Bank Climate Change Knowledge Portal. (2018). Third national communication of Mongolia. https://unfccc.int/sites/default/files/resource/06593841_Mongolia-NC3-2-Mongolia%20TNC%202018%20pr.pdf
4. Misheel Lkhasuren (2021). Planting billion trees to combat climate change. <https://theubposts.com/planting-billion-trees-to-combat-climate-change/>
5. Xinhua News Agency. (2021). Mongolia intensifies efforts to combat desertification by planting trees. http://www.xinhuanet.com/english/asiapacific/2021-10/10/c_1310236223.htm
6. Bolor Lkhaajav. (2022). Mongolia's '1 billion tree' movement. <https://thediplomat.com/2022/06/mongolias-1-billion-tree-movement/>
7. Benedict Lopez. (2022). One billion trees by 2030: Mongolia's plan to curb eco-damage. <https://m.aliran.com/thinking-allowed-online/one-billion-trees-by-2030-mongolias-plan-to-curb-eco-damage>
8. Land Portal. (2022). Mongolia establishes fund for national tree-planting campaign. <https://www.landportal.org/news/2022/04/mongolia-establishes-fund-national-tree-planting-campaign>
9. IPCC. (2019). 2019 refinement to the 2006 IPCC guidelines for national greenhouse gas inventories. https://www.ipcc.ch/site/assets/uploads/2019/12/19R_V0_01_Overview.pdf

Case C5: Urban Forest (Pyeongtaek, Republic of Korea)



Figure 30: An aerial view of the wind road forest development project in Pyeongtaek - Tongbokcheon Stream section (Source: Pyeongtaek City)

- **Country/City:** Republic of Korea / Pyeongtaek
- **Implementing agency:** Project Developer: Pyeongtaek City Government, Project Implementer: Pyeongtaek City Government, Private companies (Geonhwa Corporation, Hwashin Corporation, others, Samsung Electronics) and NGO (Honam Fraternity), Citizens, Project Consultant: Korea Forest Service
- **Funding:** 20 billion KRW (10 billion KRW from the national government, 10 billion from the local government)
- **Funding source:** Government Grants
- **Website:** Pyeongtaek Green City Initiative +82-031-8024-4230

Background

Pyeongtaek City is an industrial city that used to serve as a gateway to foreign countries in the past. It has undergone significant development and has evolved into an international industrial city today, hosting the world's largest semiconductor factory and experiencing a substantial increase in its population. As a result, the city faces a shortage of green spaces, with a forest ratio of only 16.9 percent, significantly lower than the national average of 62.6 percent. This deficiency has led to various urban challenges, including the urban heat island effect. Due to its features as an industrial city and its geographical conditions, the city grapples with air pollution caused by fine dust originating from both domestic and international sources.

In response, the city has adopted nature-based approaches to address its environmental challenges and aims to expand its green areas. In 2018, the city promoted synergistic effects by participating in the 'Improvement of Quality of Life and Fine Dust Reduction Initiative' led by the Ministry of Economy and Finance and the Korea Forest Service. Through collaboration with the national government, relevant agencies, and public engagement efforts, the city is accelerating its urban greening initiatives, aligning with its vision of 'Pyeongtaek, Let's Breathe in the Wind Forest City'.

Project implementation

The city's goals of greening urban areas align with its plans for mid- and long-term initiatives, which include a five-year campaign to plant over 300,000 trees, the 'Pyeongtaek Greenway Project' spanning 30 years, and the 'Pyeongtaek Urban Forest 100-Year Master Plan'. The city strategically connects these initiatives to produce synergistic effects.

For example, the 'Greenway Project' aims to build the Wind Forest, Barrier Forest, and Coastal Green Belt. Simultaneously, the 'Pyeongtaek Urban Forest 100-Year Master Plan' intends to interconnect several types of urban forests, such as Riverside Forest, Mountain Forest, Coastal Forest, Street Forest, and Stepping Stones Forest. Moreover, the city is actively planting an additional 3 million trees in other areas.

To translate these goals and initiatives into a legislative framework, the city adopted the 'Ordinance on Pyeongtaek City Urban Greening and Management' in September 2022. This ordinance places a strong emphasis on tree protection, landscaping, and the establishment of the Urban Forest Review Committee. The forests are categorized into six groups: Wind Forest, Forest Parks, Industrial Zone Buffer Forests, Landscape Forests, School and Meditation Forests, Village Forests and Ssamji Forests.

1. Wind Forest Type: This is the most popular type, aiming to establish airflow pathways, connecting urban areas to the city's outskirts. It encompasses Riverside Forest, Coastal Forest, and Street Forest, tailored to the local landscape.

- **Riverside Forests:** These urban forests, near both wide and small rivers, boast diverse species and thematic elements that reflect the city's history and culture. They offer a range of activities to the public. The city's efforts to infuse cultural elements into these urban forests have been acknowledged by the Korea Culture and Tourism Institute, featuring in the 'Everyday SOC for Tourism Utilization Plans.'
- **Coastal Forests:** Urban forests aligned with the Green Belt Construction plan for the West Coast Harbour Hinterland, spanning from 2020 to 2025.
- **Street Forests:** These urban forests are situated along streets such as Seodong Road, Pyeongtaek Station Railway Forest Plan, and Banancheon Stream Bicycle Path. For instance, the street forest along the national highway 'Route No. 1' incorporates central green islands, pedestrian green strips, and traffic island greenery.

2. Forest Parks: These urban forests utilize existing mountainous areas, adding environmental and functional value while providing spaces for recreation and promoting psychological well-being among the public.

3. Industrial Zone Buffer Forests: Urban forests located in industrial areas, specifically designed to mitigate fine dust concentration. Collaboration with the private sector is essential for their success.

4. Landscape Forests: Urban forests created to enhance environmental and aesthetic aspects of urban areas. This category encompasses public office forests, vertical forests, artificial ground forests, traffic island forests, and parking lot forests.

5. School and Meditation Forests: Urban forests established in school areas dedicated to health and education for students. This category includes school forests, educational forests (preschools), and welfare facility forests.

6. Village Forests and Ssamji Forests: Urban forests developed in unused urban areas, including the Community Center Village Forest and others in Deogu-ri in Anjung-eup.

It is noteworthy that the city has been utilizing trees discarded from urban development and construction since 2018 to construct urban parks. This innovative and sustainable approach not only enhances urban circularity but also reduces expenditure on building urban forests. Furthermore, the city actively encourages public involvement from the initial stages of urban forest development.

In 2020, it conducted a public survey for the Wind Forest Project from February to April and held a naming contest to pique public interest in their initiatives. Additionally, the city established the Urban Forest Citizen Committee, fostering collaborative governance involving government, private sectors, and citizens. Moreover, the city extends public engagement to tree planting through tree donations and tree planting activities

Results and impacts

The city has gained widespread recognition for its remarkable achievements in greening urban areas within a short span. Over 3 million trees have been planted in urban forests, carefully considering various local landscapes, including national highways, industrial zones, and harbour areas. This urban forest building initiative has significantly increased the city's green area ratio, rising from 16.9 percent in 2019 to 18 percent in 2020.

Reduction of dust and urban heat island effect: The expansion of green urban areas has led to a remarkable reduction in average fine dust (PM10) concentration by 20.8 percent and ultrafine dust (PM2.5) concentration by 23.9 percent in 2020. These reductions surpass both the national level, which was 17.4 percent, and provincial level, which was 17.7 percent. Additionally, it has contributed to decreasing urban temperatures, mitigating the urban heat island effect, restoring urban ecosystems, reducing noise levels, expanding recreational open spaces for the public, and enhancing their psychological well-being.

Recognition by public: The city's efforts in greening urban areas have been widely acknowledged as a leading model for urban forest development. It has received several prestigious awards, including the 'Green City Grand Prize' in the Fine Dust Blocking Forest category of the 2020 Green City Excellence Awards, 'Excellence' in the School Forest category of the 2020 School Forest Awards, the 'Minister of Agriculture, Food and Rural Affairs Award' at the 2022 Republic of Korea Landscape Awards, the first national certification in the 'Exemplary Urban Forest, Everyday Forest category' of the 2022 Urban Green City Excellence Competition, and the 'National Urban Forest Grand Prize' at the 2022 Green City Excellence Competition in October. Additionally, the city joined the 'Smart Green City' programme organized by the Ministry of Environment in 2020.

Furthermore, the city's achievements and contributions are also widely appreciated by the public. According to a public survey, 60 percent of respondents acknowledge the positive changes, with 93percent recognizing its contribution to fine dust reduction and landscape improvement. More than half of the respondents reported visiting Tongbokcheon Stream more often, and many underline their desire for more green urban areas.

Lessons learned

Conflict with existing laws and regulations: The promotion of urban forest development must be undertaken with careful consideration of existing laws and regulations. For instance, the planting of multi-layered trees within traffic islands in the Bijeon-dong concurrently conflicts with the Flat Intersection Design Guidelines, which impose a height limit (60 cm or less) for plants within traffic islands. To build and manage urban forests sustainably, it is crucial to take a comprehensive approach that considers existing laws and regulations. The city should either revise the design of urban forests in traffic islands or amend the relevant laws and regulations to ensure alignment.

Lack of public awareness: While the city has actively encouraged public engagement in urban forest development from an early stage, a significant challenge arises from a lack of public awareness. This limited awareness has resulted in reduced participation in initiatives such as tree planting events. The city aims to expand public engagement, ensuring the long-term sustainability and effectiveness

of its urban greening efforts. To achieve this, it is imperative to increase public awareness and interest in the initiative through various channels, including the city government's website, local broadcasting, SNS and more. Providing educational opportunities to the public, such as the Urban Forest Citizen and Eco-class, as well as organizing activities like forest yoga and forest art galleries, will enhance public understanding of the importance and benefits of urban forests and encourage active and independent participation.

Sustainable forest management: The city is extending its urban forest development initiative by connecting existing and potential urban forests throughout the city. In this regard, the establishment of urban forest governance, involving multiple stakeholders, will support the sustainable and effective management of urban forests over the long term. For instance, the city has already formed an advisory group consisting of experts and plans to establish a consortium for management and an organization dedicated to promoting public engagement.

References

1. Ahn, K. (2020, November 25). Pyeongtaek City Forest Green Division, overlooking accident risk? 평택시 산림복지과, 사고위험은 '나몰라라?' Pyeongan News 평안신문.
<http://www.panews.co.kr/news/articleView.html?idxno=21749>
2. Han(한), C. (2019, August 8). "In Pyeongtaek City, utilizing discarded trees to create an 'urban forest' ... achieving a 'two birds with one stone' effect." (평택시, 버려지는 수목을 활용 '도시숲 조성' ... '일석이조' 효과). 경기1뉴스.
<http://gyeonggi1news.com/news/view.php?no=9220>
3. Kang, D., & Song, I. (2022, June 24). Pyeongtaek City won the Minister of Agriculture, Food and Rural Affairs Award for the "Pyeongtaek Wind Road Forest" Korea Landscape Award 평택시, '평택 바람길숲' 대한민국 조경대상 농림축산식품부장관상 수상. 아주경제.
<https://www.ajunews.com/view/20220624114052884>
4. Kim(김), Y. (2022, October 5). The goal is to make a greenway that connects all of Pyeongtaek in green (평택 전역을 녹색으로 잇는 그린웨이가 목표). 평택시민신문.
<https://www.pttimes.com/news/articleView.html?idxno=66455>
5. Koo, W. (2021, February 1). Pyeongtaek City, Gyeonggi Province's highest level of fine dust reduction 평택시, 미세먼지 감축 경기도 내 최고 수준. Pyeongtaek News 평택신문.
<http://www.iptnews.kr/news/articleView.html?idxno=10230>
6. Lee(이), C. (2023, February 12). Korea Urban Forest Project, Pyeongtaek, a leading city 대한민국 도시 숲 사업, 선진도시 평택. Pyeongtaek News 평택신문.
<http://www.iptnews.kr/news/articleView.html?idxno=21604>
7. Oh, W. (2022, May 11). Pyeongtaek City's 'Urban Forest' Promotion...A goal of 1 million trees in 10 years 평택시 '도시숲' 추진...10년 100만그루 목표. Incheon Daily.
<https://www.incheonilbo.com/news/articleView.html?idxno=1040535>
8. Pyeongtaek City. (2021, May 6). [May] Pyeongtaek City stands tall as a green city! [5월] 평택시, 녹색도시로 우뚝! : 네이버 블로그. Naver Blog 네이버 블로그. Retrieved July 26, 2023, from
https://blog.naver.com/pt_story/222340459367
9. Pyeongtaek city. (2021, July 6). Three environmental revolutions achieved by the industrial city of Pyeongtaek! ② Urban Forest Creation 산업도시 평택시가 이룬 3가지 환경혁명! ② 도시숲 조성. Naver Blog 네이버블로그. Retrieved August 21, 2023, from
https://blog.naver.com/PostView.nhn?isHttpsRedirect=true&blogId=pt_story&logNo=222422283826
10. Pyeongtaek City. (2022, March 31). Pyeongtaek City's 7th Government Pledge Project Management Card (평택시 민선7기 공약사업 관리카드).
11. Pyeongtaek City. (2023, May 30). Wind-drawn Pyeongtaek City Forest 바람이 그린 평택 도시숲. Pyeongtaek City.



D

CIRCULAR ECONOMY CASES

Case D1

Renewable Energy at the Community Level: A Biogas Plant (Hongseong County, Republic of Korea)

Case D2


Harumi Flag - Hydrogen Town (Tokyo, Japan)

Case D3

The World's First RESET Waste Certified Site - Brookfield's One East (Shanghai, China)

Case D4

A Clean Development Mechanism (CDM) Project Led at the Local Level - Daegu Bangcheon-Ri Landfill Gas CDM Project (Daegu, Republic of Korea)



D: CIRCULAR ECONOMY CASES

Cases under the circular economy reflect the fact that one waste stream serves as the input to another process which is useful in society. Recycling initiatives, reuse, upcycling, and remanufacturing constitute components of what would be considered part of a circular economy.

Case D1: Renewable Energy at the Community Level: A Biogas Plant (Hongseong County, Republic of Korea)



Figure 31: Aerial View of Biogas Plant.

- **Country/City:** Republic of Korea / Hongseong County
- **Implementing agency:** Local Government, Private Sector
- **Funding:** 12 Billion KRW
- **Funding source:** National Government, other sources
- **Contact:** Seongwoo Corporation

Background

Hongseong County is known for having the largest concentrated livestock farming in the country, raising over 580,000 pigs and over 50,000 cattle. However, only 33 percent of livestock manure is processed through public treatment facilities and fertilizer factories, while the remaining 67 percent is either self-purified and discharged by farms or converted into compost. In this regard, livestock manure management and the subsequent complaints about odour remain as persistent challenges for the county.

In 2018, the county participated in the 'Livestock Waste-to-Energy Initiative' led by the Ministry of Agriculture, Food and Rural Affairs (MAFRA), with a national subsidy of 7 billion KRW. This initiative led to the establishment of the 'Woncheon Energy Conversion Center' in Woncheon village, aimed at converting livestock waste into energy. This facility captures and utilizes methane (CH₄) generated from organic waste, such as livestock manure and food waste. The initiative aims to contribute to sustainable livestock manure treatment, carbon neutrality through nature-based agriculture, and the reduction of environmental pollution including water pollution and odour.

Project implementation

Before joining the national project led by MAFRA, Woncheon Village had developed interest in and discussions about sustainable development at the community level. The village formulated its local master plan and energy self-sufficiency plan. In 2014, the local committee was established to oversee the implementation process. In 2016, a proposal from Seongwoo Agricultural Corporation (Seongwoo Corp.) provided the village with a fresh perspective on utilizing livestock waste as energy resource, leading to discussions on the establishment of a facility for energy conversion.

In 2018, a wide range of support from financial, legislative, and technical dimensions intertwined and accelerated the construction of the biogas plant. In terms of finance, the actual budget is collected through an investment of 7 billion KRW from the national government and 5 billion KRW from the private sector, which is more than the initial estimate of 9.8 billion KRW. The legislative support was based on Act on The Management And Use Of Livestock Excreta, Act on New and Renewable Energy Development, Utilization, and Dissemination Promotion, and the Ordinance on Livestock Manure Public Treatment Facility Operation Ordinance. An environment impact assessment in 2019 and plans for reduction of odour effects, along with management measures incorporating local voices, enabled an inclusive technical approach based on scientific data. In 2020, with the adoption of the Eco-friendly Energy Conversion Resident Declaration at the community level, the biogas plant was constructed. It has been in full operation since 2021.

Results and impacts

Production of fertilizer, electric power and odour reduction: The plant has the capacity to process a total of 110 tons of livestock manure, 104.5 tons of liquefied fertilizer, and 5.5 tons of compost, per day and generate power of 430 kilowatts per hour. It improves efficiency for waste treatment while minimizing inconvenience its inconvenience and damages. Unlike other facilities, it adopts technology that neither separates solid from liquid nor uses coagulants, ensuring safe, simpler, and eco-friendly treatment. It is completed sealed, installing odour detectors to reduce odour effects. Additionally, it features earthquake-resistant architecture, unit-type electrical distribution panels, and a storage tank for storing liquid manure for over four months. In this regard, it serves a model for biogas plant that meets the standards set by MAFRA and received a Renewable Energy Certificate also known as REC.

This case demonstrates promotion of sustainable energy transition at the community level and its contribution to climate actions led by both national and local governments. It aligns the establishment of the plant with the local energy transition goals and consequently encourages support from residents in the village and nearby areas, which is remarkable achievement. As a result, the village has been awarded the title of an Eco-friendly Village and has attracted additional funds of 1.7 billion KRW for the next two years. The village is participating in the 2022 Agriculture and Rural RE100 Demonstration Support Project led by MAFRA.

Lessons learned

Lack of local consensus: Considering local industrial ecosystem relying on livestock, complaints about odour effects have been a persistent obstacle to constructing a biogas plant. This case experienced turbulence due to objection from residents in early stages, although it would well align with the local energy transition goals eventually. Therefore, government support to raise awareness of the advantages of biogas plants, based on scientific data, is required to encourage local consensus. Despite the increasing local demand for livestock treatment, which has been further amplified by the rising prices of chemical fertilizers and environmental certificates, the plant has a limited capacity to fully accommodate local demand.

Community engagement is a decisive factor in establishing the biogas plant. Convincing the community that the construction aligned well with its energy transition goals encouraged a change in perspective and garners community support. This case also has implications for roles and responsibilities of local governments. They should raise local awareness about the various advantages of the plant beyond livestock manure disposal. They should incorporate local voices into the entire process and seek solutions for concerns raised by residents, such as odour effects and environmental pollution. Moreover, they should provide support in terms of financial benefits, such as offering the community shares, energy voucher, and tax reductions on their electricity bills.

Profitability Considerations: Although the plant is designed to assist small-scale farmers without facilities for livestock manure treatment, its low service price poses financial difficulties to its operation. Ensuring the long-term stability and profitability of a plant is crucial. Seongwoo Corporation is dedicated to highlighting the significance of an expanded approach to waste treatment within the community. The company emphasizes the potential profits that can arise from treating organic waste originating outside the village, encompassing diverse waste types like livestock manure, food waste, and sewage sludge. This case underscores the necessity for advanced technologies to transform a broader spectrum of organic waste, such as agriculture by-products, energy crops, waste wood, forest residues, into valuable resources. Additionally, it underscores the importance of establishing relevant guidelines and regulations for effective implementation.

Utilization of waste products: The community is actively exploring additional financial benefits through the treatment of by-products generated from the energy conversion process. In the process of converting methane from livestock manure into energy, primarily electricity, waste heat and effluent are generated. Waste heat is utilized to support low-emission greenhouse models managed by the community, which have been developed into a tour programme. In this regard, the community has established its own local cooperative named Meonae, derived from its historical name. This cooperative is dedicated to conducting various community-driven activities in a highly efficient and effective manner. Furthermore, the community manages liquid fertilizers and composts, which are also by-products from the conversion process, in safe and effective ways. They outsource liquid fertilizer to a dedicated center while distributing composts to nearby farmlands free of charge.

References

1. Cho, J. (2019, January 29). [Hongseong Comprehensive] Based on a smart farm, as a role model for 'eco-friendly livestock'. ChungNam Internet News. <http://www.shanews.com/news/articleView.html?idxno=332506>
2. Cho, S. (2022, October 21). "Manure is the energy source" Schlöven-Leppo, Germany without an energy crisis. Magazine Hankyung. <https://magazine.hankyung.com/business/article/202210110667b>
3. Chung, H. (2019, November 28). Current Status and Countermeasures of Animal Manure Bioenergy. Response to Climate Change, Challenges of Animal Manure Bioenergy. http://www.climateforum.or.kr/archives/59?sst=wr_datetime&sod=desc&sop=and&page=2
4. Han, W. (2021, March 9). The village and livestock business met to prepare for the climate crisis. Korea Agricultural Administration Newspaper. <http://www.ikpnews.net/news/articleView.html?idxno=43469>
5. Hong, J. (2021, June 22). 'Renewable Energy Conversion Center' Agriculture Corporation (Corp.) - Seongwoo. <http://www.aflnews.co.kr/news/articleView.html?idxno=212488>
6. Hongseong-gun County. (2022, September 16). Hongseong-gun issued REC (Renewable Energy Certificate) for the first time at livestock manure energy facility. https://www.hongseong.go.kr/bbs/BBSMSTR_000000000842/view.do?bbsId=BBSMSTR_000000000842&nttlId=B000000243696Eq7mB2
7. Kim, H. (2015, October 14). Status and Tasks of Disposal of Livestock Excreta in Hongseong / Status of

-
- Hongseong-gun. Hongseong News. Retrieved August 8, 2023, from <http://www.hsnews.co.kr/news/articleView.html?idxno=72404>.
8. Kim, J. (2021, July 8). How did Woncheon Village build a biogas power plant? Farminsight. <http://www.farminsight.net/news/articleView.html?idxno=7792>
 9. Lee, S. (2021, 11 19). Measures to Promote the Energy Conversion of Livestock Manure in Chungbuk Province for Achieving Carbon Neutrality. Chungbuk Focus, 2021-09(196), 38.
 10. Lee, S. (2023, May 15). Electricity made from pig droppings, pellets made from mushroom waste. Energy & Environment News. <https://www.e2news.com/news/articleView.html?idxno=253820>
 11. Lee, Y. (2020, December 5). Hongseong-gun conducts a small-scale completion ceremony for livestock manure energy facilities. Newstnt. <http://www.newstnt.com/news/articleView.html?idxno=68115>
 12. Park, G. (2022, March 10). Hongseong-gun to create an eco-friendly energy independent model. Daejeon-ilbo. <http://www.daejonilbo.com/news/articleView.html?idxno=1509565>
 13. Roh, J. (2021, April 5). The Pork Dung Factory, built by a financial expert, doesn't just make money. Ohmynews. https://www.ohmynews.com/NWS_Web/View/at_pg.aspx?CNTN_CD=A0002730506
 14. Sungwoo Corporation. (2019, February). Environmental impact assessment of livestock manure biogas initiative in Hongseong-gun (disclosure of decisions on environmental impact assessment items, etc.). Hongseong, Chungcheongnamdo Province. Retrieved August 09, 2023, from https://www.hongseong.go.kr/skin/doc.html?fn=FILE_000000000134770_1&rs=/viewer/result/old/BBSMSTR_000000000139//

Case D2: Harumi Flag - Hydrogen Town (Tokyo, Japan)



Figure 32: Harumi Flag after completion - bird's eye view and hydrogen supply conceptual schematic.

- **Country/City:** Japan / Tokyo
- **Implementing agency:** Bureau of Urban Development of Tokyo Metropolitan Government, Tokyo Gas, and private companies)
- **Funding:** -
- **Funding source:** Government Funds
- **Website:** <https://www.toshiseibi.metro.tokyo.lg.jp/bosai/sensyumura/>

Background

Hydrogen has emerged as a key component in the global transition towards low-carbon energy systems. Acknowledged for its potential to drive sustainability, clean hydrogen has been hailed as a promising solution capable of decarbonizing challenging sectors, facilitating the seamless integration of renewable energy through robust storage mechanisms, and bolstering energy security. However, the current landscape depicts clean hydrogen as holding only a marginal share in the broader hydrogen market, a situation attributed to a constellation of challenges encompassing elevated costs, intricate technical barriers, and an absence of standardised protocols. Nonetheless, governments across the world have embarked on strategic trajectories, unveiling comprehensive plans and funding initiatives intended to catalyse transformative strides in clean hydrogen technology by the culmination of this decade.

Tokyo, a global hub of innovation, has notably positioned itself at the forefront of hydrogen technology development and pragmatic applications. An instrumental milestone transpired in 2016, when the Tokyo Metropolitan Government unfolded its visionary ambitions to cultivate a hydrogen-powered society, a vision seamlessly interwoven within its environmental and sustainability blueprints. Post the Tokyo 2020 Olympic Games, Tokyo pivoted towards the establishment of the ground-breaking Harumi Flag, a residential enclave functioning as a hydrogen-powered township. This monumental endeavour stands as Japan's maiden practical foray into hydrogen on such a significant scale, enveloping an expansive developmental expanse of 133,906.26 square metres. The Tokyo Metropolitan Government further unveiled the Tokyo Hydrogen Vision in 2022, delineating the instrumental role of hydrogen in realising Tokyo's resolute commitments of attaining a 2030 Carbon Half and accomplishing Carbon Neutrality by 2050.

Project implementation

Originally designed to serve as the Tokyo 2020 Olympic Village, Harumi Flag has seamlessly evolved into a testing ground for sustainable and clean energy solutions. In 2016, the Tokyo Metropolitan

Government unveiled its resolute vision of fashioning a hydrogen-centric society, a mission that was strategically enshrined within its environmental and sustainability frameworks. Noteworthy objectives, including doubling hydrogen power generation and usage by the Tokyo 2020 Games and orchestrating the operation of a comprehensive hydrogen supply system for the Olympic Village, were unveiled. This vision materialised through the establishment of temporary hydrogen stations within the Harumi district, meticulously calibrated to provide the requisite hydrogen for fuel cell buses that diligently transported athletes during the Tokyo Olympics. Simultaneously, the government introduced the "Residential Development for the Olympic Village after the Tokyo 2020 Games" in 2016, delineating pivotal hydrogen technologies slated for installation within Harumi Flag. The prevailing plan articulates a hydrogen-dominant energy ecosystem poised to deliver power and heat to 5,632 individually-owned or rented residences and other public and commercial facilities within Harumi Flag by the year 2024.

The journey of the hydrogen town project at Harumi Flag has been navigated through a meticulously orchestrated process. The Tokyo Metropolitan Government, acting as the vanguard, conceived the paradigm of reimagining Harumi Flag as a dynamic hydrogen hub. This transformative notion crystallised in 2016 when a corporate group was selected through an open solicitation procedure. Represented by Tokyo Gas in its capacity as a private development operator, the group is a composite entity comprising six private enterprises. Charged with the practical execution of projects harnessing hydrogen technology, these enterprises span various facets of the hydrogen system, encompassing hydrogen stations, pipelines, and comprehensive generators. Concomitantly, the government forged the Olympic Village Energy Committee in 2016, an entity boasting the insights of external experts. This committee was entrusted with assessing the public and commercial feasibility of projects tendered by the corporate group. In the subsequent year, the Energy Infrastructure for Olympic Village Area project was formally affirmed, underscoring the steadfast trajectory of the endeavour.

The integral hydrogen system adorning Harumi Flag comprises a triad of components: a hydrogen station, underground pipelines, and fuel cell generators. The hydrogen station, strategically positioned within proximity to the township, spans an expansive 4,800 square metres. Functioning as a beacon of hydrogen production and supply, the station aptly caters to both fuel cell vehicles and the diverse spectrum of residential clusters. Underground pipelines weave a tapestry, channelling hydrogen from the station to fuel cell generators nestled within residential blocks. The ensuing synergy culminates in the co-generation of electricity and heat, accomplished by fuel cell generators. This twin stream of energy effectively powers residential clusters and communal facilities, including provisions for the elderly housing sector. Each residential neighbourhood is endowed with 30 kW-capacity fuel cell generators. As encapsulated within Figure 30 below, this integral power source is complemented by electricity generated from other power plants. Anchoring this dynamic architecture are an array of surveillance instruments, from seismometers to pressure gauges, deployed to safeguard the integrity and resilience of the hydrogen supply system.

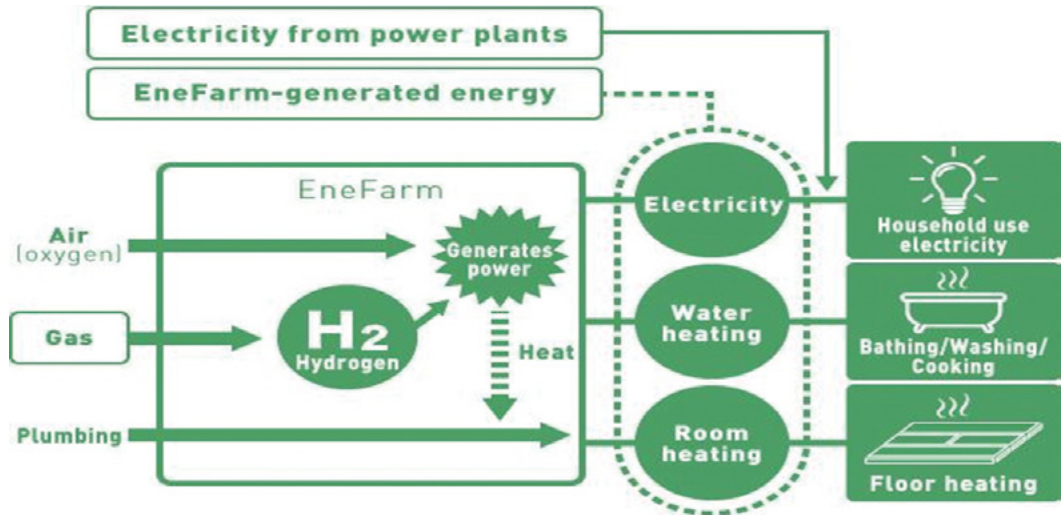


Figure 33: Working mechanism of the residential fuel cell generators. (Source: Panasonic Group)

In addition to the hydrogen infrastructure, other technologies are also applied to build a stable renewable energy system in Harumi Flag. Energy management systems will be installed to monitor energy consumption, forecast energy demand, and cut peak demand, and therefore reduce the demand for grid-supplied power. Solar panels and storage batteries are also installed for electricity generation and supply. Harumi Flag amalgamates an array of other technologies to forge a resilient renewable energy ecosystem. Foremost among these are energy management systems, poised to be deployed for the oversight of energy utilisation. These systems predict energy demand, curtail peak demand, and thereby attenuate the reliance on grid-derived power, ultimately fostering a reduction in carbon emissions and grid electricity bills. Solar panels and storage batteries are also integrated to harness solar energy to meet the community's electricity requisites. Figure 31 below shows the overall energy system in the Harumi district.

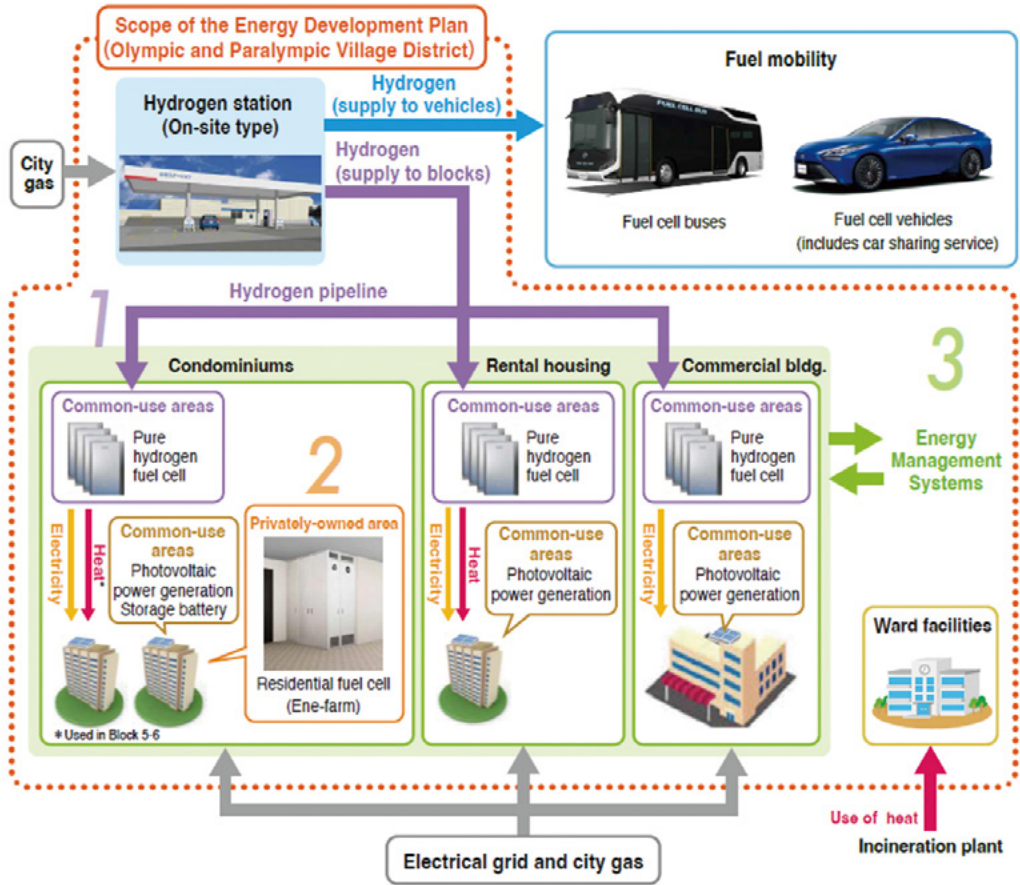


Figure 34: The Energy System in the Harumi district. (Source: Bureau of Urban Development, Tokyo Metropolitan Government)

Results and impacts

Testbed of hydrogen infrastructure: The significance of Harumi Flag transcends its physical dimensions, resonating profoundly with Tokyo's climate aspirations. The comprehensive orchestration of the hydrogen energy infrastructure united with solar panels, energy storage mechanisms, and energy management systems can lead to a tangible reduction in the carbon footprint of this community nexus.

Unveiling itself as Japan's inaugural community-scale hydrogen infrastructure, Harumi Flag inherently embodies the potential to yield invaluable insights and expertise essential for the prospective expansion of hydrogen-based infrastructure. This collective pursuit resonates with Tokyo's quest for hydrogen integration and the pursuit of carbon neutrality. Notably, the Tokyo Metropolitan Government unveiled the Tokyo Hydrogen Vision in 2022, delineating hydrogen's pivotal role in ushering Tokyo towards Carbon Half by 2030 and Carbon Neutrality by 2050.

Building public acceptance: Of distinct significance is Harumi Flag's role in catalysing Tokyo's hydrogen and carbon neutrality ambitions. Constructed within a residential milieu, this project bears the potential to efficaciously augment public acceptance of hydrogen energy, an innovative concept that, for some, engenders trepidation due to its novelty.

Lessons learned

Renewable hydrogen requirements: Within the Harumi Flag context, a notable challenge lies in the method of hydrogen production. Presently, the hydrogen station relies on natural gas, a process that generates carbon emissions and falls short of the optimal standard associated with hydrogen production through renewable energy sources.

Public and private collaboration: The pivotal role of public and private collaboration has been underscored in the evolution of the Harumi Flag. The Tokyo Metropolitan Government has cultivated a symbiotic partnership with a corporate group led by Tokyo Gas. Augmenting this dynamic alliance is the formation of the Olympic Village Energy Committee, an assembly of external experts engaged in review of projects. The public-private synergy emerges as an indispensable cornerstone, underpinning the development of Harumi Flag in a manner that is both transparent and practical.

Moreover, the development of new urban spaces presents a promising canvas for the application of cutting-edge technologies. The Tokyo Metropolitan Government seized the opportunity presented by the Tokyo 2020 Olympic Games to tangibly manifest renewable energy solutions. This success has a universal resonance, advocating that other cities can similarly embrace a clean energy ethos when crafting new urban spaces or redeveloping existing areas. This forward-thinking approach unveils a compelling pathway towards the propagation of sustainable and innovative energy paradigms on a global scale.

References

1. Bureau of Urban Development, Tokyo Metropolitan Government. (2022). Urban Development as a Legacy of the Tokyo 2020 Games.
https://www.toshiseibi.metro.tokyo.lg.jp/bosai/sensyumura/pdf/pamphlet_harumi27.pdf
2. Panasonic Group. (2019). HARUMI FLAG, the City That Brings the Future to Today's Tokyo (Part 2 of 2) | Business Solutions | Products & Solutions | Feature Story. Panasonic Newsroom Global.
<https://news.panasonic.com/global/stories/860>
3. Tokyo Updates. (2021). Lighting the Olympic Flame with Hydrogen—Tokyo's Message for the Future.
<https://www.tokyouupdates.metro.tokyo.lg.jp/en/post-345>

Case D3: The World's First RESET Waste Certified Site - Brookfield's One East (Shanghai, China)

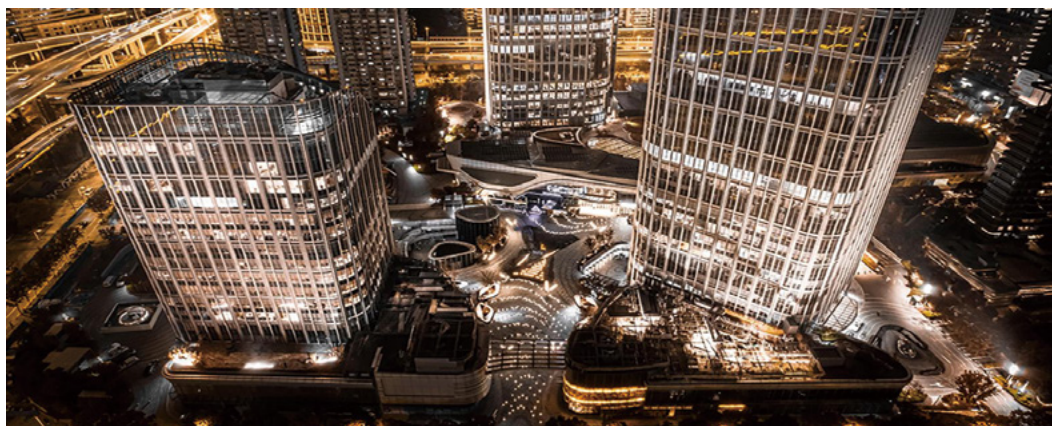


Figure 35: Photo of Brookfield's One East Complex (Source: RESET)

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- **Country/City:** China / Shanghai
 - **Implementing agency:** Brookfield Corporation, RESET, Akila
 - **Funding:** -
 - **Funding source:** Private Financing
 - **Website:** -

Background

Although it often goes overlooked as a prominent source of carbon emissions, waste generates the largest GHG emissions, second to energy consumption, from building operations. It is due to the methane produced while wet waste decomposes in landfills and the GHG emissions from waste collection, transportation, and incineration.

Digitized waste management presents a solution for mitigating the carbon footprint of waste. Through the integration of smart technologies, the process of waste tracking and management becomes more streamlined, facilitating the implementation of targeted reduction strategies in areas such as procurement, consumption, and disposal practices like recycling and composting. The adoption of digitalized waste management also enhances the diversion of waste away from landfills, thereby reducing the carbon emissions linked to waste disposal.

As one of the world's largest property owners and investors in renewable energy, Brookfield Properties has collaborated with Akila to implement the world's first RESET Waste pilot project at their One East property in Shanghai. Utilizing the RESET Waste Standard empowers Brookfield to effectively manage waste in ways that were previously complex, providing a means to directly measure carbon emissions from waste on a per-tenant basis, along with diversion rates. Through the digitalization of waste management supported by Akila, Brookfield has been also proactively addressing landfill-bound waste reduction and lowering their scope 3 emissions.

Project implementation

To fulfil the requirements of the RESET Waste Standard, One East deployed Akila's internet of things (IOT)-based smart scales and Environment SUITE software platform on site. The electronic IOT scales as depicted in figure 36, can send real-time data to the platform, then being visualized in dashboards.

This uncovers some powerful data:

- waste tracking: it allows precise identification of waste sources by floor or tenant.
- waste categorization: it categorizes waste during weighing.
- waste-to-carbon conversion: the discarded waste is converted to carbon emissions.

Data collected is centralized in Akila’s platform for further analysis on tenants’ performance. Simultaneously, data is streamed to the RESET Cloud, facilitating the auditing and benchmarking by third-party organizations.

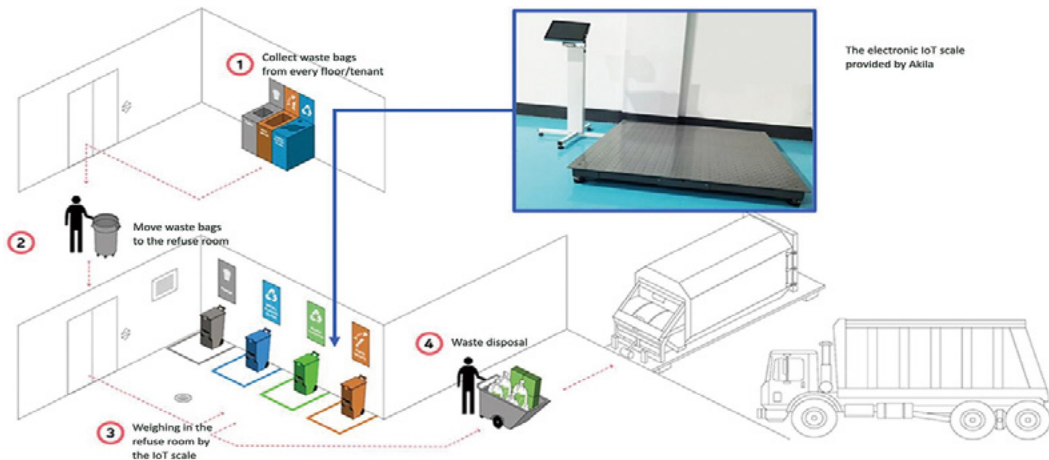


Figure 36: Waste management process optimized supported by Akila. (Source: RESET)

RESET’s waste tracking approach can also empower Brookfield to anonymously rank and benchmark each tenant’s performance, creating an incentive for tenants to proactively reduce their waste-related carbon footprint, thus aligning with sustainability goals and complying with environmental reporting obligations. Brookfield can leverage the analytical data to take initiatives that reduce the amount of waste across different categories. Utilizing the data and analytics dashboard as visualized in Figure 34, Brookfield can also oversee and assess the results of these actions, enabling ongoing refinement of their waste management operations.

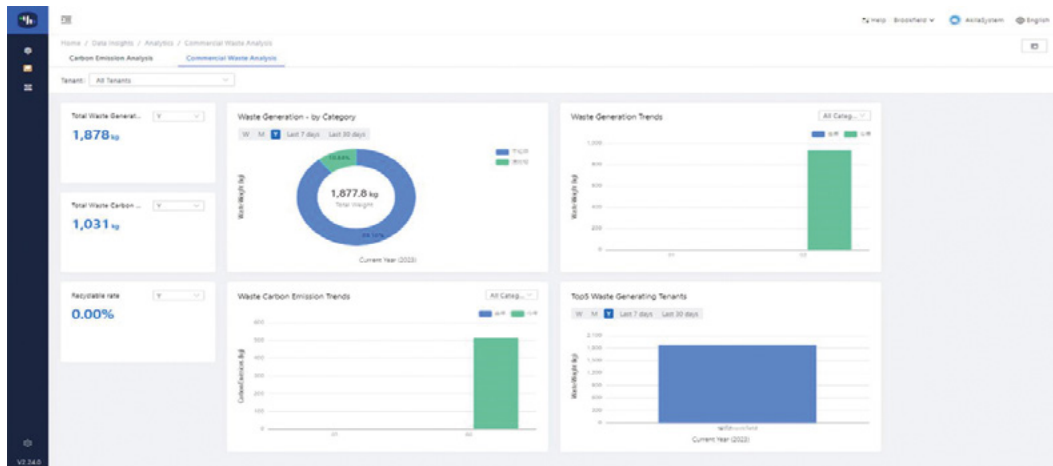


Figure 37: Waste Management Dashboard (Source: RESET)

Results and impacts

Digital data on waste: The digitalized waste management system supported by Akila has not only replaced the previous manual management procedures, but also improved the quality of waste data. The continuous monitoring translates waste generation metrics into actionable insights, enabling Brookfield to enhance decision-making for sustainability and waste reduction.

Benchmarking of data: The pilot project bridges the gap between the waste measurement and the related carbon footprints. The programme also creates a more reliable baseline for similar projects and individual tenants to benchmark against. As the waste-to-carbon project is still in an ongoing state, the joint efforts of both parties are expected to discover further opportunities for waste management and reductions.

One East has received the world's first RESET Waste certification. It proves that Brookfield is leading the way in the built environment's sustainable waste management practices and carbon reductions, serving as an inspiration for others in the industry to follow suit.

Lessons learned

Standards important for digital waste monitoring: The pilot project highlights the importance of adaptation of standards such as RESET in ensuring transparency and accountability in waste management and carbon reduction efforts. The project also showcases that collaborations and cutting-edge technologies can drive positive change within the built environment and contribute to the global efforts of combating climate change.

References

1. James B, Phil M, Amy G, Robert B. (2021). Your Trash Is Emitting Methane In The Landfill. Here's Why It Matters For The Climate.
<https://www.npr.org/2021/07/13/1012218119/epa-struggles-to-track-methane-from-landfills-heres-why-it-matters-for-the-clima>.
2. ZWE S. (2020). Understanding the carbon impacts of Waste to Energy incineration.
<https://zerowasteeurope.eu/2020/03/understanding-the-carbon-impacts-of-waste-to-energy/>
3. RESET. (2023). Brookfield Launches first RESET Waste-to-Carbon Tracking Program.
<https://reset.build/newsroom/347>
4. Akila. (2023). Brookfield leverages Akila at the world's first RESET Waste certified site.
<https://www.akila3d.com/blog/client-stories/akila-brookfield-environment>
5. The RESET Waste Standard is a data-driven standard for evaluating the building performance as it pertains to waste and recyclables by standardizing the continuous monitoring requirements of waste generation in built environments.

Case D4: A Clean Development Mechanism (CDM) Project Led at the Local Level - Daegu Bangcheon-Ri Landfill Gas CDM Project (Daegu, Republic of Korea)



Figure 38: Daegu Bangcheon-ri Landfill site before and after (Source: Yongnam Ilbo, Daesung Eco-energy)

- **Country/City:** Republic of Korea / Daegu
- **Implementing agency:** Project Developer - Daegu Metropolitan City, Project Implementer - Taegu Energy & Environment Co., Ltd, Project Consultant - Ecoeye Co., Ltd., Project income source: Korea District Heating Corporation (sale of refined LFG), Private market including Korea Exchange (sale of CERs)
- **Funding:** 23 billion KRW
- **Funding source:** Private investment through BTO contract with 20-year concession period
- **Website:** <https://cdm.unfccc.int/Projects/DB/LRQApercent20Ltd1168417374.37/view>

Background

Daegu Metropolitan city, known as 'Apple City', due to its high-quality apple production, has now acquired a new nickname 'Daefrica', a fusion of 'Daegu' and 'Africa'. The new moniker highlights the adverse impacts of climate change on the city, particularly its vulnerability to heatwaves. Moreover, the city faces a persistent waste management challenge as its sole landfill reached its capacity limit in 2006, posing a threat to the city's sustainability.

In response, Daegu city launched a Clean Development Mechanism (CDM) project as a novel initiative for low-carbon development, addressing both climate change and waste management concerns. This project, the first certified CDM endeavour at the local level in the country, aims to capture and utilize landfill gas (LFG) from the Daegu Bangcheon-Ri Landfill. This initiative step towards establishing a low-emission and sustainable urban environment also contributes to fostering the city's green economic growth.

Project Implementation

Multi-stakeholder engagement, leveraging the advantages of Public-Private Partnerships, serves as the driving force behind the project implementation, its establishment and relationship shown in Figure 39. Taegu Energy & Environment Co., Ltd, a Special Purpose Company jointly invested by Hwasung, Daesung Holdings, and SGC e TEC E&C through a public bidding process, assumes a leadership role throughout the entire process from development to maintenance. This entity holds authority over management and finance during a 20-year concession period.

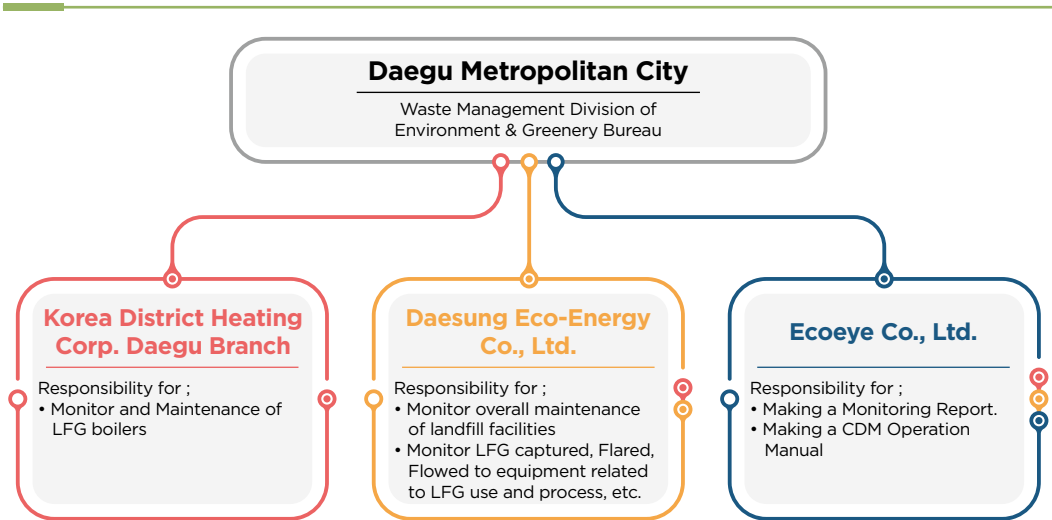


Figure 39: Roles and Responsibility of Stakeholders involved (Source: UNFCCC)

The project has been executed to convert LFG with a potential reserve for 20 years, as determined by the feasibility study, into energy. Its LFG utilization systems encompass four stages: LFG capture, refinement, supply, and utilization. The project employs a vertical LFG capture system which enhances its maintenance and capturing efficiency compared to the horizontal system. It also minimizes the risks of facility erosion, pollution emissions, and odour effects during the refinement process. The refined LFG is supplied for electricity generation and household use in collaboration with Korea District Heating Corporation (KDHC). A simplified diagram of the LFG system is showed in Figure 40 below.

Beyond the sale of refined LFG, the project generates economic benefits by selling Certified Emission Reductions (CERs) in the global and domestic private markets.

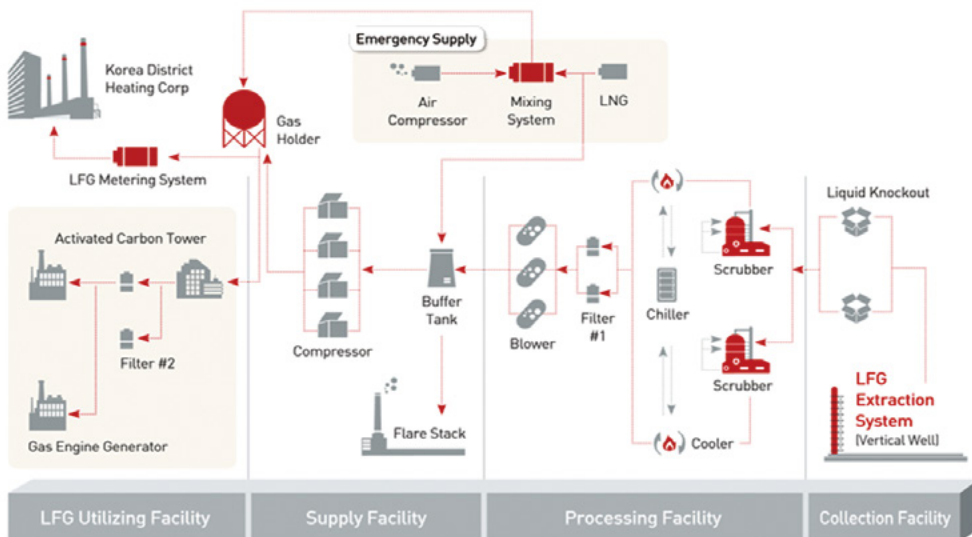


Figure 40: Flow Diagram of LFG Utilization System (Source: Daesung Group website)

Results and impacts

CO₂ reductions: The Landfill Gas-to-Energy CDM project has yielded significant environmental, economic, and social benefits to the city since its initiation in 2006. Environmental: It contributes to a substantial reduction of approximately 3.77 million tons of CO₂ equivalent emissions, which is equivalent to about 400,000 tons of CO₂ reduced yearly.

Increased revenues: The city derives economic benefits through sales of refined LFG and CERs since its initiation. The sale of refined LFG generates revenue of 65 billion KRW, while the revenue from the sale of CERs reaches 563 billion KRW. The total actual economic benefit expects to be even higher when considering its financial viability and its contribution to a greener economy.

Heating gas provision: In collaboration with the KDHC, around 50 million m³ of refined LFG is used annually to heats water for approximately 15,000 households in the city. Furthermore, it contributes to enhance the sustainability of the urban environment by reducing odours and supporting the restoration and preservation of nature environment and ecosystems.

Lessons learned

Regulatory and legal frameworks: The absence of legal frameworks supporting the project hinders the local government from engaging more actively in the overall process. Laws and regulations related to the CDM scheme at both national and local levels are anticipated to facilitate the involvement of public and private sectors in balanced and complementary manners. Furthermore, such frameworks aim to prevent disproportionate distribution of its economic benefits. Additionally, the limited technical knowledge of government officials has extended the implementation period, exceeding the initial project budget by more than 10 billion KRW.

The project has a great significance as the pioneering efforts to localize the CDM scheme. Despite the limited regulative support from governments, leading to occasional turbulence and limitations, the project stands as a testament to bold and innovative local climate actions. Moreover, it serves to expedite the creation of domestic environment conducive to the CDM scheme, as evidenced by the adoption of the Carbon Emission Trading Law in 2015.

This initiative implies legislative backing to execute activities that align with the visions of both national and local governments. Furthermore, it underscores the value of enhancing synergy through multi-stakeholder engagement, encompassing the private sector and academia. This approach is crucial for adopting comprehensive strategies to effectively address a broad spectrum of urban challenges, ensuring efficiency, effectiveness, transparency, and sustainability.

References

1. Lee, S., (2007). Correlation between Estimated LFG Emission Rate and Actual LFG Extraction Rate for Daegu- Bangcheon-ri Landfill Site.
2. UNFCCC, (2016). Project Design Document
3. Daesung Group (n.d.)" LFG : Landfill Gas-to-Energy". http://www.daesung.com/en/html/sub02_02_02.asp
4. Daegu Metropolitan City (2019) The 1st Korea International Cooling Industry Expo 2019 to beheld in July!
https://www.daegu.go.kr/english/index.do?menu_id=00000844&menu_link=/icms/bbs/selectBoardArticle.do&bbsId=BBS_00131&nttlId=410917&bbsTyCode=BBST03&bbsAttrbCode=BBSA03
5. Choi,I. (2023) Over the past 16 years, Daegu city has successfully generated a substantial revenue of 56.3 billion KRW through the sale of CERs
https://news.kmib.co.kr/article/view.asp?arcid=0018365248&code=61122020&stg=ws_real

This compendium of best practices was prepared by the United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP) Subregional Office for East and North-East Asia in collaboration with the International Council for Local Environmental Initiatives (ICLEI) - Local Governments for Sustainability of East Asia Office and the Institute for Global Decarbonization Progress (iGDP). The designations employed and the presentation of the material in this compendium do not imply the expression of any opinion whatsoever on the part of the United Nations concerning the legal status of any country, territory, city or area, or of its authorities, or concerning the delimitation of its frontiers or boundaries. This compendium follows United Nations practice in references to countries. Where there are space constraints, some country names have been abbreviated.