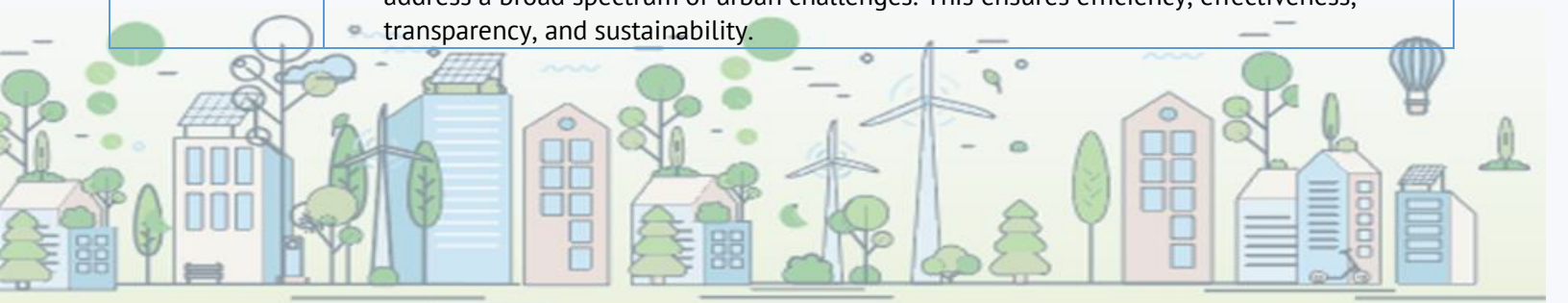
Circular Economy

Innovations 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.

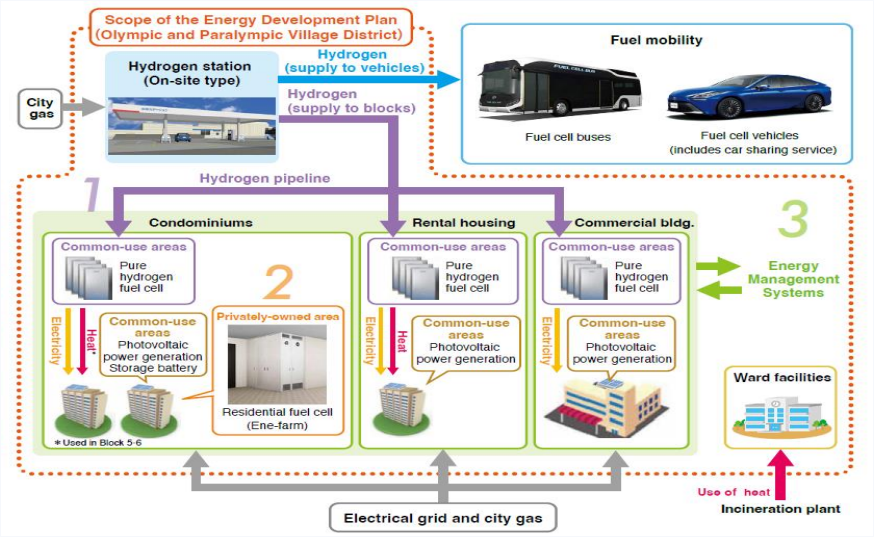
Title:	The World's First RESET Waste Certified Site - Brookfield's One East in Shanghai, China
Summary of Case:	To fulfil the requirements of the RESET Waste Standard[1], Brookfield's One East building complex deployed Akila's IoT-based smart scales and Environment SUITE software platform on site. The electronic IoT scales are able to send real-time data to the platform, which is visualised in dashboards. This uncovers some powerful data: • Waste tracking: It allows precise identification of waste sources by floor or tenant. • Waste categorisation: It categorises waste during weighing. • Waste-to-carbon conversion: The discarded waste is converted into carbon emissions. The collected data is centralised in Akila's platform for further analysis of tenants' behaviours. Simultaneously, data is streamed to the RESET Cloud, facilitating the auditing and benchmarking by third-party organisations.  The data allows tenants to better understand their waste and carbon footprints. In addition, it allows Brookfield to better monitor and refine their waste management operations, capacity and policies for tenants.
Key Stakeholders:	• Brookfield Corporation • RESET • Akila
Key Finance method:	• Private Financing
Key Messages and Lessons Learnt:	• 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.

[1] 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.

Title:	A Clean Development Mechanism (CDM) Project led at the Local Level - Daegu Bangcheon-Ri Landfill Gas CDM Project in Daegu, Republic of Korea
Summary of Case:	Daegu 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. This project is the first certified CDM endeavour at the local level in the country and aims to capture and utilise landfill gas from the Daegu Bangcheon-Ri Landfill. Daegu Energy & Environment Co., Ltd 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. The project has been executed to convert landfill gas (LFG) with a potential reserve for 20 years, as determined by the feasibility study, into energy. The project employs a vertical LFG capture system which enhances its maintenance and extraction efficiency compared to the horizontal system. It also minimises 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). Beyond the sale of refined LFG, the project generates economic benefits by selling Certified Emission Reductions (CERs) in the global and domestic private markets. The sale of refined LFG generates revenue of 65 billion KRW (approximately equal to 49.1 million USD), while the revenue from the sale of CERs reaches 563 billion KRW (approximately equal to 426 million USD). Around 50 million m^3 of refined LFG is used annually to heat water for approximately 15,000 households in the city. Additionally, the system helps to reduce odours, and emission and supports the restoration and preservation of natural environment and ecosystems.
Key Stakeholders:	• Daegu Metropolitan Government • Daegu Energy & Environment Co., Ltd • Ecoeye Co., Ltd • Korea District Heating Corporation (Sale of LFG) • Private Market including Korea Exchange (Sale of CER)
Key Finance method:	• Private Financing
Key Messages and Lessons Learnt:	• Build-to-Order Contracts with concessions can help improve the return on investment for private actors to engage in clean development for capital intensive projects. • The lack of existing legal frameworks in supporting the project hindered the local government from engaging more actively in the overall process. Laws and regulations related to CDM schemes at both national and local levels are required to facilitate the involvement of public and private sectors and ensure proportionate distribution of economic benefits. • Synergy through multi-stakeholder engagement, encompassing the government, private sector, and academia, is crucial for adopting comprehensive strategies to effectively address a broad spectrum of urban challenges. This ensures efficiency, effectiveness, transparency, and sustainability.



Title:	Renewable Energy at the Community Level: A Biogas Plant in Hongseong County, Republic of Korea
Summary of Case:	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% of livestock manure is processed through public treatment facilities and fertiliser factories, while the remaining 67% is either self-purified or discharged by farms or converted into compost. Livestock manure management and the subsequent complaints about odour remain as persistent challenges for the county. Through the '*Livestock Waste-to-Energy Initiative*' led by the Ministry of Agriculture, Food and Rural Affairs (MAFRA). The National Government's Subsidy of 7 billion KRW, along with additional 5 billion KRW (approximately equal to 3.8 million USD) from private investment, led to the establishment of the '*Woncheon Energy Conversion Centre'* in Woncheon village, aimed at converting livestock waste into energy. The anaerobic digester biogas plant is completely sealed to reduce odour emission and it produces methane and liquid fertiliser through the breakdown of manure and organic waste. It has a capacity to process a total of 110 tons of livestock manure, 104.5 tons of liquefied fertiliser, and 5.5 tons of compost per day and generate power of 430 kilowatts per hour. 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"*, the *"Ordinance on Livestock Manure" and "Public Treatment Facility Operation Ordinance"*. An environmental 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.
Key Stakeholders:	• Ministry of Agriculture, Food, and Rural Affairs (Republic of Korea) • Seongwoo Agricultural Corporation
Key Finance method:	• Public Financing • Private Financing
Key Messages and Lessons Learnt:	• 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, in addition to resolving concerns about odour and highlighting the advantages of the plant beyond livestock manure disposal. • Due to the low service price set, long term profitability is a concern. Thus, frameworks should exist to ensure long term operation of facilities and effective guidelines and regulations are also necessary. • Community cooperative activities allows for effective distribution of liquid fertiliser and compost by-products for reuse in the agriculture cycle.

Title:	Harumi Flag - Hydrogen Town in Tokyo, Japan
Summary of Case:	The Tokyo 2020 Olympic Village, Harumi Flag has seamlessly evolved into a testing ground for sustainable and clean energy solutions, particularly focusing on a hydrogen-centric society. As a part of the "Residential Development for the Olympic Village after the Tokyo 2020 Games" in 2016, hydrogen technologies are planned for installation within Harumi Flag to deliver power and heat to 5,632 individually owned or rented residences, as well as other public and commercial facilities within Harumi Flag by the year 2024. This initiative builds upon the initial hydrogen infrastructure that was established for fuel cell buses used during the Olympics. 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, acts as a beacon of hydrogen production and supply. The station caters to both fuel cell vehicles and the diverse spectrum of residential clusters. Underground pipelines channel hydrogen from the station to fuel cell generators nestled within residential blocks, providing electricity and heat. In addition to the hydrogen grid, solar panels, battery systems, and an energy management system are also installed to minimise the amount of external grid power required to power the town. 
Key Stakeholders:	• Tokyo Metropolitan Government • Tokyo Gas • Affiliated Businesses
Key Finance method:	• Public Financing
Key Messages and Lessons Learnt:	• A notable challenge lies in the method of hydrogen production. Presently, the hydrogen station relies on natural gas. Optimally, hydrogen would be provided through hydrogen production using renewable energy sources. • Public and private cooperation has become essential in the transformation of Harumi Flag to a hydrogen utilising town and allowed the testing of tangible renewable energy solutions. • Forward thinking urban development or redesign is needed in ensuring adaptation towards global scale sustainable and innovative energy designs.