Scaling up Circular Economy through Sustainable Infrastructure: Transition to Electric Mobility and Renewable Energy in ROK

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Outline

- Background
- Green energy transition in ROK
- Circular economy implications
- “Future Waste Recycling System”
- Conclusions

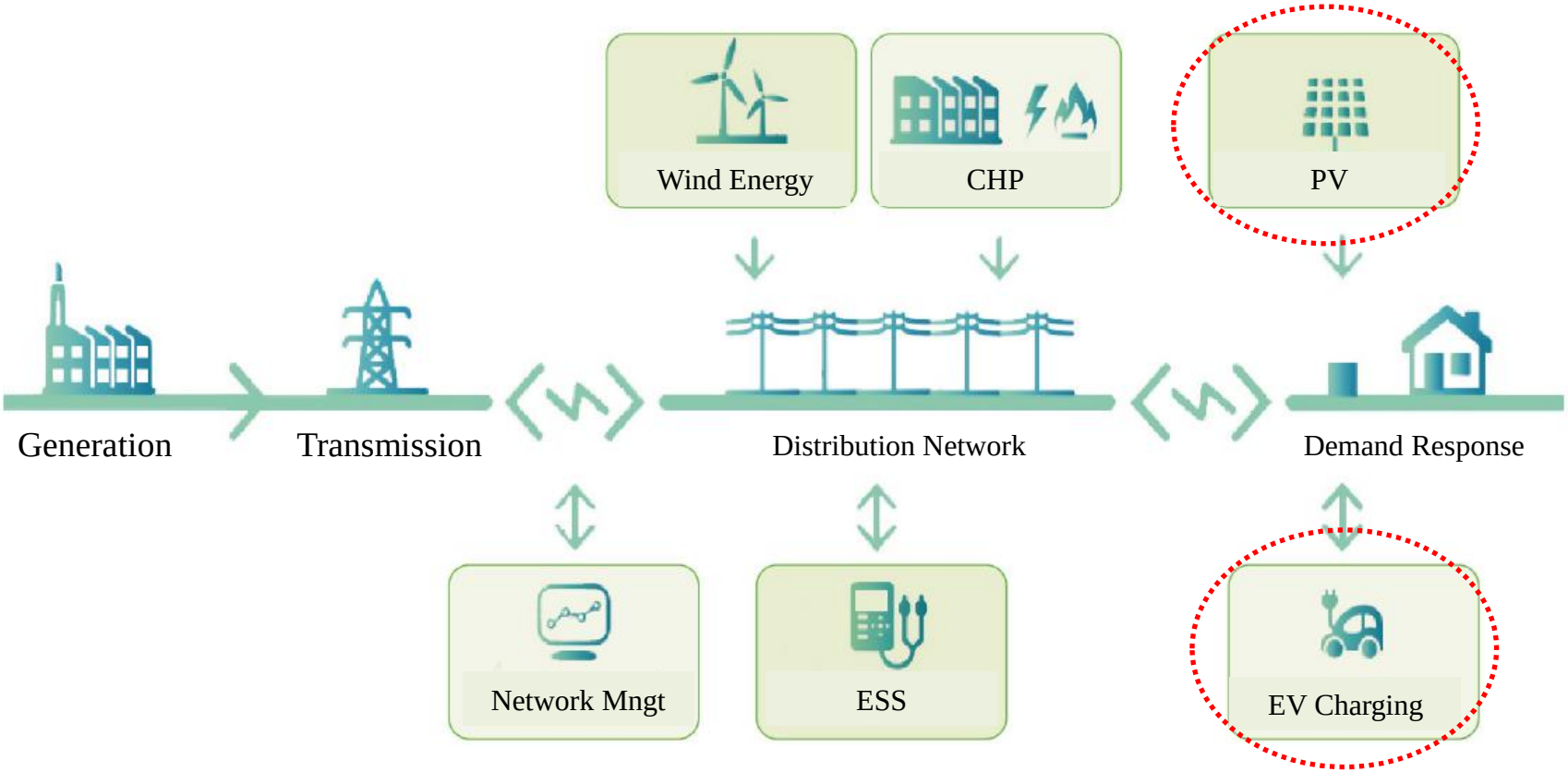
Background

- Sustainable infrastructure is the key enabler of green economy.
- The COVID-19 pandemic prompted an unprecedented fiscal stimulus globally.
- Though the green recovery plans, a great deal of infrastructure for renewable energy and electric mobility has been built in the power and transportation sectors.
- This massive investment has fostered the biggest energy transition in human history.
- The increasing share of RE and of EVs means that substantial and increasing volumes of used PV panels and EV batteries will be produced each year.
- This ROK case shows how green energy infrastructure can interact with circular economy objectives.

ROK's vision for the green energy transition

- *Demand*. Shift the energy policy focus to innovation in demand management
- *Supply*. Transition to a clean and safe energy mix
  - Expand the share of renewable energy generation to 30-35% by 2040.
- *System*. Expand the decentralized energy system and ensure broad stakeholder engagement
- *Industry*. Strengthen the global competitiveness of the energy industry
- *Infrastructure*. Secure the necessary infrastructure to accelerate the energy transition

Energy transition and the future of energy infrastructure in ROK



Source: ROK Government (2020)

The Korean New Deal

- The COVID-19 crisis has dramatically affected the economy of the ROK.
- In response, the ROK government has introduced an economic stimulus package, the Korean New Deal that is designed to stimulate the economy, while increasing the resilience of economic agents against the uncertainty of changing economic structures and transforming the country towards a more sustainable, climate-friendly and climate change resilient future.
- The key elements of the Korean New Deal are a Digital New Deal and a Green New Deal, coupled with a cross-cutting policy to strengthen the employment and social safety net in the ROK.
- Korea's Green New Deal aims to accelerate the transition towards a low-carbon, green economy and the shift to renewable energy and low carbon vehicles.

Korea's Green New Deal

Goals and fiscal expenditure

Green New Deal	KRW: 42.7 trillion
1. Implement a green transition for cities, spaces and infrastructure (KRW 12.1 trillion)	a. Facilitate zero-energy in public facilities. b. Restore the green ecosystem of land, ocean and cities. c. Build a clean and safe water management system.
2. Expand low-carbon and distributed energy (KRW 24.3 trillion)	a. Build smart grids for efficient energy management. b. Create a foundation for renewable energy deployment and support a just energy transition. c. Promote green mobility, such as electric and hydrogen vehicles.
3. Establish an innovative ecosystem for green industries (KRW 6.3 trillion)	a. Develop promising green enterprises and establish low-carbon and green industrial complexes. b. Create a foundation for green innovation in the R&D and financial sector.

Source: IEA(2020)

Decommissioned PV panels

- The increasing generation of solar power will lead to a higher demand for PV panels and result in more decommissioned panels.
- The weight of decommissioned PV panels in the ROK is estimated to increase from 198 tons in 2019 to more than 988 in 2023 and even more than 28,153 in 2033.
- Current solar PV panels are mostly glass, but the glass can contain elements such as cadmium, lead, and antimony that make glass recycling difficult and, if the panels are improperly disposed of, have the potential to leach into the environment.
- Solar modules contain potentially dangerous materials, including silicon tetrachloride. Sulfur hexafluoride, a potent greenhouse gas, is also often used in PV panel manufacture.

EV batteries

- In 2020, the Ministry of Environment announced that with the help of a USD 17 billion government investment and subsidies it intends to catalyze an increase in the total number of electric vehicles in the Korean market from the 110,000 units on the road in September 2020 to 1.13 million units in 2025.
- Increasing production of EVs will result in increased demand for EV batteries and ultimately, as EVs become a larger part of the ROK vehicle fleet, more used EV batteries.
- The numbers of used EV batteries in the ROK is estimated to increase from 1,464 in 2020 to more than 9,000 in 2022.
- The production of EV batteries could bring negative environmental impacts as significant amounts of carbon dioxide and other pollutants are emitted during battery production processes, and metals like lithium, nickel, and cobalt need to be extracted to produce batteries.

Key challenges

A. Institutional arrangements: Handling of used EV batteries and decommissioned PV panels has not been fully incorporated into existing resource circulation policy frameworks for long in the ROK, resulting in insufficient institutional support for recycling of these materials compared with conventional sources of waste.

B. Technology and capacity: Technology is a challenge for all waste and recycling management. Recycling EV batteries and PV panels requires more specialized knowledge than for recycling of many other types of materials, and specific technologies to handle and process them, as well as to handle the intermediate materials produced by recycling processes. In addition, life-cycle resource management capacities must be developed in order to implement circular economy policies.

Key challenges

C. Collection: Used EV battery and decommissioned PV panel waste collection systems are currently inadequate in the ROK. There is a need to develop public collection systems in partnerships with the players in the private sector, including users of EVs and PVs, recyclers, and EV/PV producers.

D. Immature markets: Without supporting infrastructure and institutional arrangements, the cost of recycling EV batteries and PV panels will be high in comparison with the costs of managing conventional waste resources. This high cost will be a barrier to recycling market growth, particularly in the early stage of market development when EV and PV producers must be induced to incorporate recycled materials into their production processes.

The new recycling system for EV batteries and PV panels

- The Ministry of the Environment announced plans to establish a new system for collecting EVs batteries and solar panels in “Future Waste Resource Collection Centers”, which are e-waste treatment facilities specialized in either used EV batteries or PV panels.
- The role of the Collection Centers goes far beyond the simple collection of e-waste from either EVs or PV panels.
- It aims to establish basic infrastructure services and institutional arrangements that can facilitate the e-waste management market in Korea.

The Future Waste Resources Collection Centers

	Seoul	Chungcheong	Jeolla	Youngnam
Area	1,480 m^2	1,075 m^2	1,362 m^2	1,456 m^2
Storage capacity: EV batteries (ea)	1,097	636	1,320	400
Storage capacity: PV panels (ton)	130	221	180	236

Institutional setting

- In 2018, recognizing the growing need to assure the safe and effective recycling of a broad range of e-wastes, such as used EV batteries and decommissioned solar panels, the Ministry of Environment announced revisions to the “subordinate regulations to the Act on the Resource Circulation of Electrical and Electronic Equipment and Vehicles and the Waste Control Act”.
- The key elements of the announced revisions include:

- expanding the extended producer responsibility (EPR) regulations to an additional 23 products including decommissioned solar panels, starting in 2023
- preparing methods of and criteria for the recycling of future wastes, especially for used electric car batteries and decommissioned solar panels that require proper treatment and handling in the course of recovery and recycling because they contain hazardous substances.

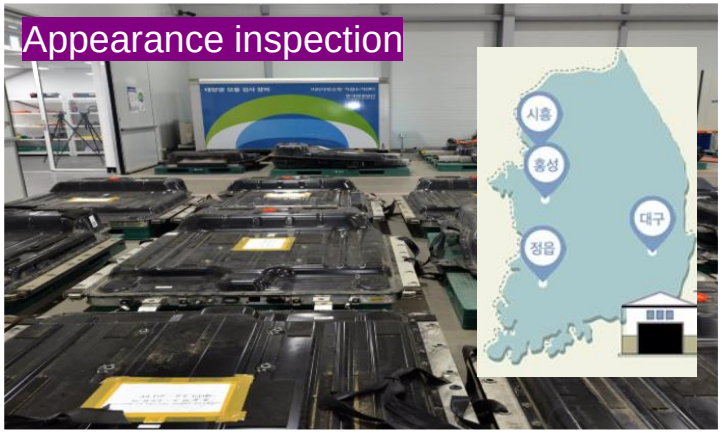
Collection

- The "Future Waste Resources Collection Centers" will be set up by the government in order to make sure that collection infrastructure is in place when large volumes of used EV batteries and decommissioned solar PV panels begin to require management.
- The Collection Centers responsible for the collection of used EV batteries will be tasked with recovering the used batteries, performing primary inspections, storing them safely, and delivering them to recycling businesses when demand for used batteries arises. Four collection centers will be responsible for the collection of used EV batteries.
- Decommissioned PV panels disposed of as municipal waste will be collected and managed by the local government, whereas the responsibility for delivery of waste panels produced by businesses (such as power generators) lies with the owners of the solar PV generation, who must deliver decommissioned solar panels to the relevant PV panel collection centers.

Recycling

- The Collection Centers will be tasked with encouraging the application of private sector-driven recycling technologies that meet the needs of manufacturers for recycled material inputs to new solar panels and batteries and building relevant infrastructure for recycling.
- Through a combination of experimenting with new methods and collecting data on the effectiveness of recycling processes, under the updated legislation, the Collection Centers will be tasked to promote the development of decommissioned PV panel recycling technologies and cultivate the growth of expert recycling companies by implementing demonstration EPR projects in joint ventures with PV panel manufacturers and importers.
- Collection Centers will be tasked with encouraging manufacturers to share costs incurred in the recovery, evaluation, and recycling of used batteries by applying EPR to the automobile sector, thus activating private recycling markets for used EV batteries.

Collection center workflow



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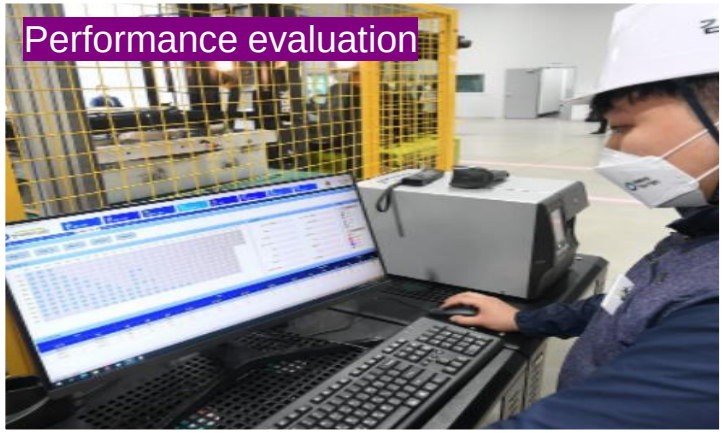

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Expected benefits

- The Future Waste Recycling System(FWRS) will be established in response to the increasing production of EVs and enhanced generation of solar power and the resulting need to establish an integrated recovering and recycling system for used EV batteries and decommissioned solar PV panels.
- The FWRS will be introduced in order to avoid environmental impacts of the transportation and energy sectors resulting from used EV batteries and decom-missioned solar PV panels.
- FWRS will enhance the circularity of the e-mobility and renewable energy sectors and increase resource efficiency through enabling recycling and reusing. It will thereby decrease resource extraction and the various associated adverse effects on biodiversity and eco-systems.
- “Future Waste Resource Collection Centers” will create new jobs and business opportunities within local economies. The resulting establishment of recycling markets will lead to further employment and business opportunities.

Conclusions

- This case study demonstrates how low carbon transitions in the transportation and energy sectors can be aligned with circular economy goals.
- It details how the development and deployment of sustainable infrastructure not only helps to scale up a circular economy and improve resource efficiency, but also helps to make the e-mobility and renewable energy sectors more sustainable.
- By planning to extend circular economy regulations and policy frameworks and developing the integrated “Future Waste Recycling System” the ROK is working to anticipate and respond to the changes and challenges induced by low-carbon transitions in the transportation and energy sectors
- This effort to plan for the management of future waste streams underlines the need for integrated strategic infrastructure planning.

END