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Insight for Distributed Energy Technology: Focused on Korea and UK Cooperation

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Contents

1. 요약(Abstract)	01
2. 키워드(Keyword)	01
3. 본문	02
I. Global Trend of Distributed Energy Technology	02
II. Domestic Efforts for the Introduction of Distributed Energy	03
III. Insight from the FGI: South Korea-UK Distributed Renewable Energy Technical Cooperation	04
IV. Summary and Implications	06
4. 참조(References)	07



Insight for Distributed Energy Technology :

Focused on Korea and UK Cooperation

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Abstract

- Renewable Energy (RE) has ushered in a new era of global energy transition, and there is growing anticipation that distributed energy technology will promote carbon neutrality.
- Digitization has the potential to convert distributed energy resources (DER) into valuable assets for the power grid.
- The synergy between Korea's distributed system configuration technology and the UK's advanced RE technology holds the potential for creating technology-commercialization platform.
- Once the platform is set to produce cross-border regional government collaborative projects, it will serve as a catalyst for expansion into the Southeast Asian region.
- Integration of various renewable energy sources through the dynamically divergent networks of energy supply and distribution(energy-grids) is imperative in accelerating adoption of renewable energy ecosystems in every country and every community.
- Korea-UK collaboration effort should be focused on piloting actualization of a demonstrable renewable energy ecosystem integration platform that can catalyze and evoke agile approaches in other countries and communities to implement feasible and viable solutions that acutely adapt to specific environmental, economic, social and industrial conditions and circumstances of their own.
- It is suggested joint effort can be continued to explore pioneering opportunities to realize the economic ecosystem of integrated renewable energy systems and platform(s) that can practically incarnate such ecosystem.

Keyword

- Renewable Energy, Distributed Energy Technologies, Distributed Ledger Technologies, Korea, United Kingdom (UK), Technology-Commercialization Platform



I. Global Trend of Distributed Energy Technology

The New Era of Global Energy Transition

- The electrification as a key means of decarbonization is based on an energy system centered around Renewable Energy (RE)(Yang, 2022).
- In 2020, RE surpassed coal power generation for the first time in the EU, making the era of global energy transition.
 - * The average of RE is approaching 30% of power generation in G20 countries as of 2020. The increase in the use of RE resources indicates the influence of climate policies and economic conditions(Godinho, 2020).
- At a time when changes are occurring in the current power supply and demand system, distributed energy is one solution that can alleviate the instability of the power system caused by the limited power generation control of variable RE compared to conventional energy.
- Traditional electricity grids have uni-directional flow in a centralized model, which is not fit for prosumers in this era, challenging many developed countries resulting in curtailment at bottlenecks, power outages, and inflated electricity prices for consumers(Amicarelli, 2017).
- Redesign of the grid and the strategic plan that accounts for policy, market, and technological factors need to be developed to maximize peer-to-peer (P2P) trading and the transition to RE.
- The new energy-grids should be geared toward the holistic integration between legacy centralized energy grids with new decentralized energy grids while, at the same time, evolutionary business models based on flexible switching of different roles of energy-generator and energy-consumer.

Integration of Distributed Ledger Technologies and Renewable Energy

- Distributed Ledger Technologies (DLT)* could be integrated with RE to create future for communities by opening the prosumers to trade through Smart contracts and P2P platforms(KEEI, 2021).
 - * According to world bank, blockchain is one type of a DLT. Blockchain and/or DLT are the building block of “internet of value,” and enable recording of interactions and transfer “value” P2P, without a need for a centrally coordinating entity(HM Government, 2020).

Applications of blockchain in the renewable energy industry(Amicarelli, 2017)	
1) Smart metering/billing and security	5) Smart grid management
2) Decentralized energy trading	6) IoT, automation and asset management
3) Cryptocurrencies, energy tokens and investments	7) Electric transportation
4) Green certificates and carbon trading	8) Circular economy



II. Domestic Efforts for the Introduction of Distributed Energy

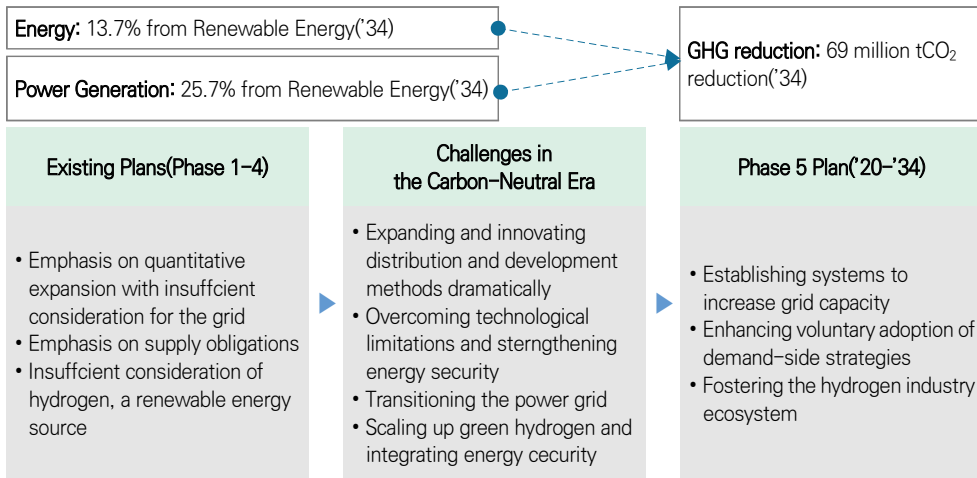
South Korea's Renewable Energy and Smart Grid Initiatives

- Korean government has announced its Fifth Basic Plan for New and Renewable Energy, which will drive demand for Distributed Energy Resources (DER) over a five-year period(MoTIE, 2020).

* Propulsion Strategy: Leap to the Main Energy Source by 2034 through the five innovations of renewable energy distribution, market, demand, industry, and infrastructure.

Fifth Basic Plan for New and Renewable Energy

Final Goal : Accelerate the transition to a low-carbon economy and society through the establishment of a sustainable foundation for the spread of renewable energy.



- South Korea is undergoing a paradigm shift by expanding distributed energy from a centralized supply structure, and the role of smart grids is increasing accordingly.

- In February 2023, the Ministry of Industry, Trade, and Resources announced The Third Basic Plan for an Intelligent Power Grid(2023-2027)(MoTIE, 2023).

* The Ministry of Industry, Trade, and Resources aims to increase the proportion of distributed resources and expand consumer participation to meet the growing power demand.

- The National Assembly enacted the Special Act on the Revitalization of Distributed Energy* in May 2023 scheduled to be implemented on June 14, 2024. The bill includes decentralizing the centralized power system to the regions and differentiating electricity prices by region.

* The key issue of the Act lies in properly compensating the benefits that distributed energy brings to the system. Through distributed energy, it is possible to mitigate the instability of fluctuating RE and minimize the construction of large-scale power plant transmission networks.

- In the domestic sphere, each local government is aiming for the designation of decentralized energy special zones. Decentralized energy special zones focus on granting exceptions that allow power transactions between producers and consumers.



III. Insight from the FGI: South Korea–UK Distributed Renewable Energy Technical Cooperation

- The FGI, to explore the current landscape of renewable energy, was held on 14 March 2023 and the organizers of the FGI are NIGT, DISTEP, SDX Foundation, BCI.
 - * Experts from industry–academia–research institutions held intensive discussions with the goal of designing collaborative projects between the local government of Daejeon in South Korea, and Glasgow in UK, and expanding these initiatives to the Southeast Asian region.
- Main actionable outcomes of the FGI were decision to establish a research group for the feasibility study on P2P RE trading network in Daejeon, and BCI’s intention to bid for innovate–UK* catalyst round 10.
 - * Innovate–UK, established in 2007, is an organization under ‘UK Research and Innovation’ that utilizes (Innovate UK, 2023) government funding as a financial resource to provide support in the form of grant to business
 - ** The joint funding call between Innovate–UK, the Korea Institute of Advancement of Technology, and the Career Institute for Energy Technology Evaluation and Planning will provide up to £5 million in co–funding to support new collaborative innovation in advanced manufacturing, artificial intelligence, future mobility, hydrogen, and energy storage technologies.
- Enhanced efficiency can be achieved by reducing the distance between attained by minimizing the distance between energy producers and consumers through Distributed Renewable Energy (DER).
- DER is particularly well–suited for renewable energy, which can now deliver efficiency comparable to centralized energy systems.
- Small–scale DER can be an effective way to pilot and validate the technology, starting with demonstrating the need for it.
- The success of DER hinges on strong IT infrastructure and collaboration between UK’s carbon–neutral and wind power expertise and Korean IT and infrastructure capabilities has substantial potential.

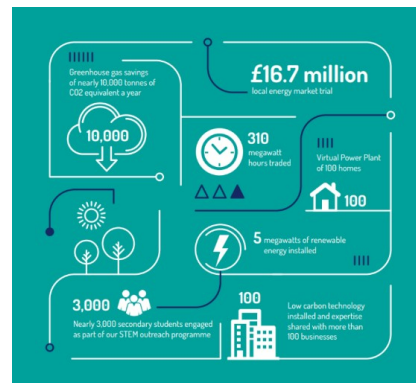
Case Studies for Integrating Energy with Users

CENTRICA in Cornwall, UK

In 2018, a project was initiated in Cornwall, UK to install solar panels, smart batteries, and monitoring equipment in 100 homes to create a ‘Virtual Power Plant’ (VPP) that produced energy that could be controlled remotely and fed into the local and national grid.

An online energy marketplace was created which allowed homes and businesses to adjust their energy demand or generation in response to the needs of the grid and receive payment for this service.

The project team helped deliver Cornwall’s first smart grid–connected wind turbine, a 1.5 MW lithium–ion storage battery, and a 2.5MW ‘smart’ solar farm that could power up to 500 homes.

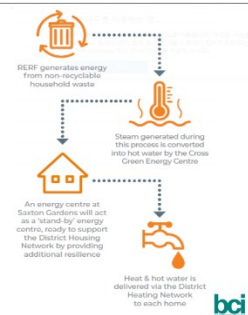


Leeds Council ‘Pipes’ Project, UK

Capture and utilize excess heat from buildings and industrial processes, providing affordable, reliable, and low–carbon heat and hot water to connected buildings.

The network has already reduced Leeds’ carbon footprint by over 2,000 tonnes and provides affordable warmth to around 1,800 homes, while also benefiting commercial customers with competitive and stable pricing for heat.

The network is expanding, with plans to become one of the UK’s largest heat networks, and has received funding from local, regional, national, and European sources.

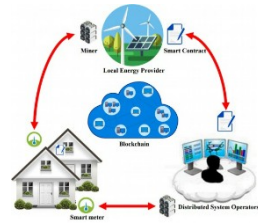




Plan for a Pilot Project in Daejeon, South Korea by April 2024
 Rooftop Solar PV integrated with a blockchain-based peer-to-peer renewable energy trading platform in Daejeon as a pilot site for demonstrating Energy Systems Integration.

(Source: South Korea-UK Distributed Renewable Energy Technical Forum. 2023)

Challenges of Energy System Integration, and Potential of Blockchain



〈Proposed blockchain distribution network in the presence of renewable energy systems〉

Challenges Involved in Energy Systems Integration (Gawusu et al, 2022)

The complexity of highly integrated energy grid systems, changes in institutions, model of ownership, and markets, multidisciplinary efforts in research and development, and strong policy support. This is where Blockchain can help.

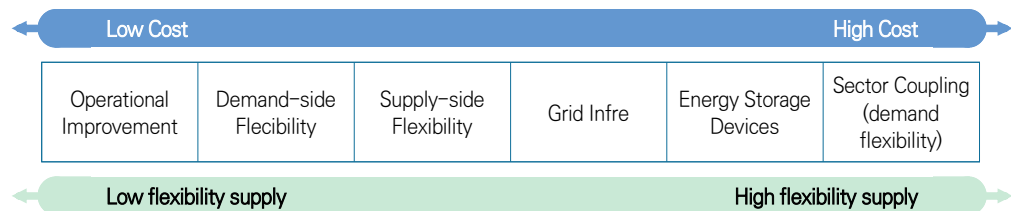
Blockchain democratizes energy supply by:

- ① Increasing accessibility in all markets globally
- ② Distributing benefits more equally
- ③ Decentralizing decision-making (to balance the grid)

(Source: South Korea-UK Distributed Renewable Energy Technical Forum, 2023)

Strategies to Overcome the Limit of Accepting Distributed Renewable Energy (Baek, 2023)

- Korea Institute of Energy Research (KIER) is currently developing new technologies for DER, focusing on ① customized local DER technology development, ② integrated storage system establishment and operation, ③ inverter-based grid forming technology, ④ advanced energy-router operation technology.



(Source: South Korea-UK Distributed Renewable Energy Technical Forum, 2023)

A New Driver to Feed into the Ongoing South Korea-UK Strategic Dialogues

- In a situation where there is a need to enhance domestic technology levels in the field of carbon neutrality, international cooperation with the advanced countries is for securing national competitiveness and penetrating global markets (Shin et al, 2023).
- At a time when R&D collaboration with overseas advanced institutions is being emphasized, it is timely to establish a cooperation foundation with the climate technology advanced country, UK.
- Co-developing a pilot in distributed energy application and models for commercialization in Daejeon could inform:
 - ① investors from both countries of new market opportunities in the renewable energy sector, as well as
 - ② both governments of the favorable policy and regulatory environment required to materialize these opportunities.

- It may be able to create a new driver that feeds into the ongoing Korea–UK Strategic Dialogues and Bilateral Framework for Closer Cooperation in the realm of clean energy.



IV. Summary and Implications

- Innovative changes in the power grid are necessary to achieve carbon neutrality through the expansion of renewable energy and distributed energy technology which is suitable for renewable energy.
- Distributed energy technologies are expected to contribute to the alleviation of excess power and stabilization of the power grid by generating and storing energy near demand points. However, due to high costs to get high flexibility supply, it is deemed necessary for the government to provide incentives until self-sustainability can be ensured.
- Small-scale distributed energy resources can be an effective way to pilot and validate the innovative technology, starting with demonstrating the need for it, particularly in the applications of distributed ledger technology, which holds significant potential for resolving complex governance challenges.
- The combination of South Korea's small-scale distributed system configuration technology and the UK's advanced renewable energy technology holds the potential for creating technology-commercialization platform geared towards advancing into developing countries.
- It is expected that once a platform for future collaboration between Daejeon in South Korea and any equivalent city or region in UK is established to produce cross-border regional government collaborative projects, it will serve as a catalyst for expansion into the Southeast Asian region.
- The joint effort, through successfully implementing pilot projects and new renewable-energy based prosumer business models, between Korea and UK, shall prove the case of RE-based energy-grids integration and possibility of new business models and invoke ambitions for energy-transformation for many countries.
- The outcome of the intended joint effort will include the followings:
 - Policy and regulatory frameworks
 - Reference technological architecture as a roadmap of integration of all the related technology components and solutions: legacy energy sources, renewable energy sources, centralized energy grids, decentralized energy grids, Distributed Ledger Technology, AI, Smart Sensors, energy-trading business platforms, and so forth
 - Reference new renewable energy ecosystem business models
 - Guidelines for adoption, extension and scale-up
- This collaboration shall be a momentum that can bring strong sense of action to other regions in Korea and other countries, and be case that can demonstrate opportunities of expansion and serve as the trigger of business-to-business cooperation and engagements between Korea and UK.



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