Regional Co-creation in Pursuit of Models for Overcoming Challenges

Society 5.0: The Future of Hokkaido

Third Forum of Hokkaido University and Hitachi Hokkaido University Laboratory Part 2

Regional development initiatives are happening around Japan, taking a variety of different approaches to the goals of relieving the overconcentration of people in Tokyo, putting the brakes on depopulation in rural regions, and revitalizing Japan as a whole, including DX, human resource development, and regional co-creation. In response, Hitachi teamed up with Hokkaido University to open the Hitachi Hokkaido University Laboratory in June 2016 as a facility where they can collaborate on open innovation. A key focus of the laboratory is to conduct joint research on resolving the various societal challenges currently facing Hokkaido, which include aging demographics and a low birthrate, depopulation, a stagnating regional economy, and global warming. This article is one of three reports on the presentations given at the Third Forum of Hokkaido University and Hitachi Hokkaido University Laboratory held in February 2022. This part of the forum addressed the topic of local industry development and covered work on carbon neutrality and regional co-creation by HEPCO Group, Hitachi's development of self-sustaining local energy systems, and some ideas from Tomomi Marutani, Emeritus Professor at Hokkaido University, on how to go about adapting to climate change.

Lecture 2: Local Industry Development

Local Low-carbon Energy

Action on Carbon Neutrality and Regional Co-creation

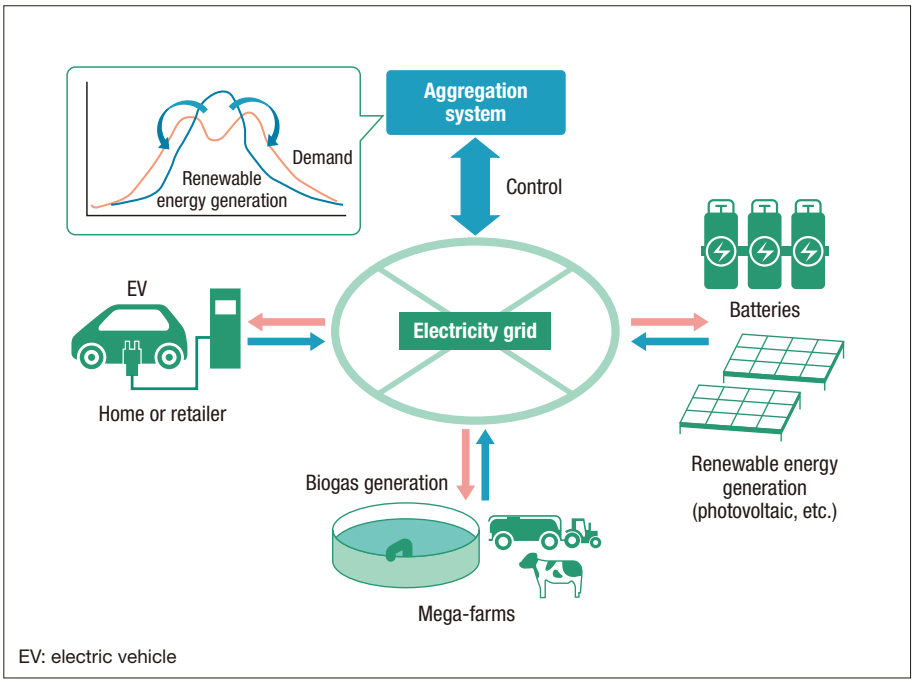
Shigeru Yonaga
Director and General Manager of Research & Development Department, Hokkaido Electric Power Co., Inc.

Based on Hokkaido Electric Power Company (HEPCO) Group's management philosophy of respect for humanity, contributions to local communities, and efficient management, Research & Development Department at Hokkaido Electric Power Co., Inc. is pursuing a number of initiatives aimed at achieving carbon neutrality by 2050.

The department's work in the field of renewable energy has targeted its wider deployment, the establishment of a reliable and efficient electric power system, and the provision of emergency power during disasters. This work includes a demonstration project featuring the combined control of distributed energy resources including small-scale renewable generation and electric vehicles (EVs) so as to make the most of what they have to offer (see Figure 1). In our work on establishing a hydrogen supply chain powered by renewable energy, our aim is to put in place platforms for the reliable, low-cost production of hydrogen that take maximum advantage of existing infrastructure.

The department is also involved in a wide variety of initiatives aimed at overcoming local challenges in a range of areas, with a particular focus on the use of electric power.

Figure 1 | **Distributed Energy Resource Aggregation Demonstration**



EV: electric vehicle

These initiatives include promoting EVs as a way to maintain the region's transportation infrastructure in the face of aging demographics, a low birthrate, and a falling population, as well as local sourcing of renewable energy, business continuity planning (BCP) by local government, and the use of community currency to keep value circulating locally. We are also promoting the wider use of net-zero-energy buildings (ZEBs) suited to cold climates, encouraging agriculture through the trialing of closed-system farms for cold-climate regions, and participating in a co-creation initiative with the town of Niseko for reducing carbon emissions called the NISEKO Life and Model District Construction Project.

Local Low-carbon Energy

Development of Self-sustaining Local Energy System

Takashi Takemoto
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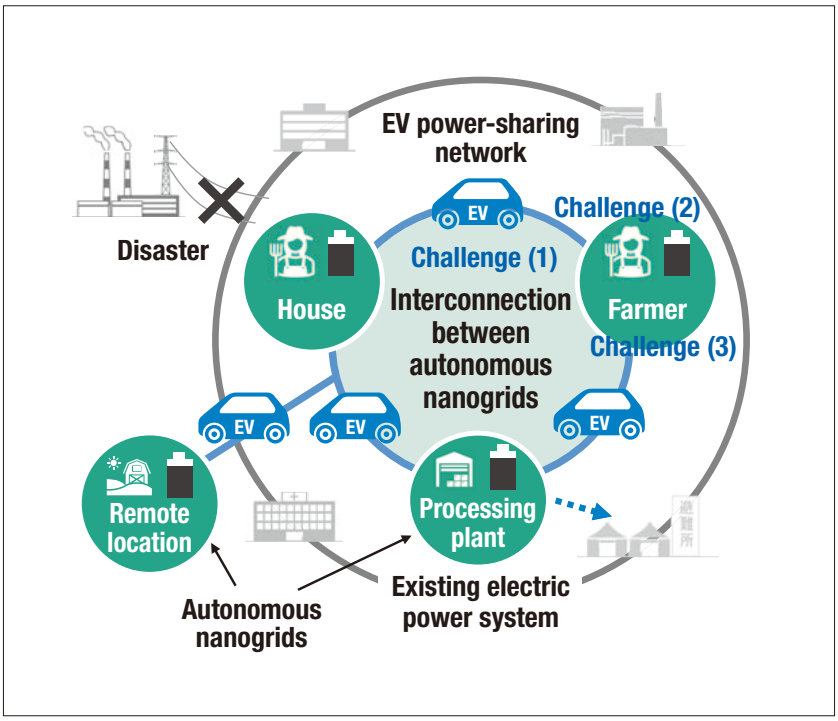
Demand for electric power in Hokkaido is spread across the region, influenced by factors such as depopulation and the concentration of the remaining population in Sapporo. This makes the development of local energy systems vital to the creation of a sustainable local communities that will avoid stagnation in our primary industries and the degradation of civil defense capabilities.

In response, Hitachi has been developing self-sustaining local energy systems based on local sourcing that will be small in scale and cheap to install as well as capable of operating on their own during disasters. The system is made up of community-level nanogrids that use EVs to share electric power with one another and provide more reliable operation of the electricity system and higher electricity revenue while also promoting regional revitalization and lower carbon emissions by local industry (see Figure 2).

(1) Self-sustaining local energy system simulator

Hitachi has developed a simulator for self-sustaining local energy systems that allows for different operational objectives to suit different local circumstances. The simulator has functions for: (a) mathematical modeling of virtual environments, (b) optimizing day-to-day operations, and (c) long-term investment planning. In addition to calculating returns on investment over the long term and suggesting the best choice and configuration of equipment,

Figure 2 | Self-sustaining Local Energy System Based on Local Sourcing



the simulator can also determine the optimal use of EVs and provide robust calculations that allow for uncertainties together with long-term investment planning based on the evaluation of daily operations.

In partnership with Hokkaido University, the Hitachi Hokkaido University Laboratory runs an annual programming marathon involving a long-running cloud-based competition for ideas about solving a specific problem. The FY2020 and FY2021 events were on the topic of local energy systems, giving participants from around the world the chance to try out the simulator's optimization functions. Using the simulator, participants were able to demonstrate that the electricity demand situation could be improved considerably compared to past practice by improving the efficiency of EV use and practices for redirecting electric power.

(2) Establishment of nanogrid and islanding techniques based on the use of locally sourced energy

Hitachi has been conducting trials of an autonomous nanogrid that utilizes a multi-fuel engine that can generate electric power from a mix of different fuels, including low-concentration ethanol or methane gas given off by geothermal activity.

With the help of local companies, this work has now moved on to the establishment of an autonomous nanogrid in Iwamizawa City that runs on photovoltaic power and geothermally vented gas. Energy generated at the demonstration site was successfully used to charge a drone for spraying agricultural chemicals. Through real-time control of the generation output of the multi-fuel engine, the autonomous nanogrid was also able to maintain reliable operation (at around 25 kW) despite fluctuations in photovoltaic output caused by poor weather.

(3) Expansion of regional co-creation work on agricultural decarbonization

Utilizing intellectual property (IP) as a tool for ecosystem building and networking, Hitachi has put forward its IP for society concept for contributing to the resolution of societal challenges. Meanwhile, through their participation in a joint brainstorming session on the topic of agricultural decarbonization, the Research & Development Department of Hokkaido Electric Power and Hitachi Hokkaido University Laboratory have started identifying local challenges and investigating research ideas. The intention for the future is to expand the ecosystem by combining the strengths of both organizations to create solutions and to communicate a vision.

Climate Change Adaptation Practices that Draw on the Biological Resources of Hokkaido

Tomomi Marutani
Director, Hokkaido Research Organization
Emeritus Professor, Hokkaido University

Speaking as someone who has studied natural disasters, transforming nature by human effort is, in principle, impossible. Rather than changing the natural environment (mitigation), problems such as climate change call for changing people themselves (adaptation).

Generally, the more capital investment we pile onto the task of acquiring resources, the more sensitive we are to social (economic) change, while the more space we devote to resource acquisition, the more sensitive we are to natural (climatic) change (see Figure 3). Rather than everyone acting independently on global warming and other forms of climate change, it is important that we put measures in place that are founded on an integrated approach like this.

Japan has very low level of self-sufficiency in food. It depends on imports for most grains such as wheat and corn and routinely imports a higher percentage of fruit, beef, and seafood than it produces domestically. The key to overcoming this situation in this era of climate change lies in the extensive land area of Hokkaido. Our population may be low, but from a different perspective, Hokkaido has a large land area per capita. You could say that this is the region's greatest resource, and adapting to climate change is the greatest challenge we have to overcome.

Whereas Japan as a whole currently only produces 38% of its food, production in Hokkaido accounts for the largest part of the nation's primary industries of cropping, dairy farming, livestock, and fishing, equating to 222% (the highest percentage anywhere in Japan) of local demand when calculated on a calorie basis. If we are to put this great strength to use, what is needed, I believe, are innovative adaptation measures that make the most of our extensive land area, including aquaculture, farming, forestry, and the use of other new resources such as water and snow.

Figure 3 | **Relationship between Resource Production and Land**