Support for Carbon Neutrality through GX, DX, and Managed Services

Corporate management has been called on over recent years to address a variety of challenges, notably decarbonization, rising energy prices, and a shrinking workforce. To address these challenges, Hitachi has been making progress on support for carbon neutrality measures along with utilizing its Lumada models to facilitate a transformation in the business processes associated with energy and facilities. It has also sought to help companies strengthen their core businesses by offering managed services that make the operation, maintenance, and asset management of energy-related equipment less burdensome. This article presents existing examples and future prospects for measures that help to enhance corporate value by taking on tasks that support customers' core businesses, such as more sophisticated equipment management, in addition to the utilization of Lumada models to enable smarter energy use across multiple sites or areas.

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1. Introduction

The diverse challenges that confront today's corporate management can be broadly divided into the following three categories.

(1) Economic challenges

Uncertainty over energy costs caused by geopolitical risk is having a major impact on both operations and profitability.

(2) Environmental challenges

Having become an issue that no business can ignore, carbon neutrality now needs to be addressed as a business risk rather than in terms of advantage or disadvantage.

(3) Societal challenges

Shortages of maintenance workers and constraints on investment mean that little progress is being made on efficiency improvements or other upgrades to energy infrastructure constructed since Japan's bubble era of the 1980s.

However, as efforts that address these challenges on an ad hoc basis will find it difficult to resolve them in any fundamental or sustained manner, what is needed are enablers[*1] that can provide comprehensive and ongoing solutions and support.

2. Measures for Carbon Neutrality that Enhance Corporate Value for Customers

When embarking on work toward carbon neutrality, Hitachi first puts together a "to be" vision of what it wants to achieve so as to provide a clear indication of the direction and strategy, and also a portfolio and roadmap for doing so. Once agreement is reached with the customer, this is then used in subsequent progress monitoring. As this work proceeds over long periods of time, ongoing support is delivered using Lumada models.

*1 In a business context, enablers serve in roles that provide backup support, functioning as part of the core infrastructure essential for the business growth of other companies.

2. 1
Solution Building Blocks for "Hitachi Carbon Neutrality 2030"

Portfolio design (consulting) categorizes measures for achieving carbon neutrality into "reduction," "generation and procurement," and "offsets," setting targets based on the relative proportion of measures from each of these three categories.

To make this process work more effectively, Hitachi determines which model best fits a customer based on their energy use characteristics. To support rapid and flexible delivery, it treats the different solutions for achieving carbon neutrality as building blocks that can be combined as needed (see **Figure 1**).

The following are examples of how this use of solution building blocks might work.

(1) Reduction: A microgrid service for energy supply that combines digital transformation (DX) and green transformation (GX)

An example of how reduction can form part of a portfolio is a microgrid service for energy supply that combines DX and GX. The service is scheduled to commence operation in the latter half of 2023 at four adjacent Hitachi facilities in Hitachi City, Ibaraki Prefecture. Electricity generated by gas cogeneration is used at the four sites and the waste heat from generation is used for clean room air conditioning. As coordinating operation across the entire area allows for more efficient energy use than would be possible if each site operated independently, it is anticipated that this will reduce total carbon dioxide (CO_2) emissions across the four sites by 15%, equating to 4,500 t[*2] annually. The service works with a cross-industry consortium that includes energy and finance companies, making equipment operation, maintenance, and asset management easier by enabling the sites (consumers) to shift from an ownership-based to a usage-based model for their energy infrastructure. Future plans include the use of DX to further improve energy infrastructure and its operation.

(2) Generation: Multi-site energy management utilizing renewable energy generation and the "self-consignment" of electric power

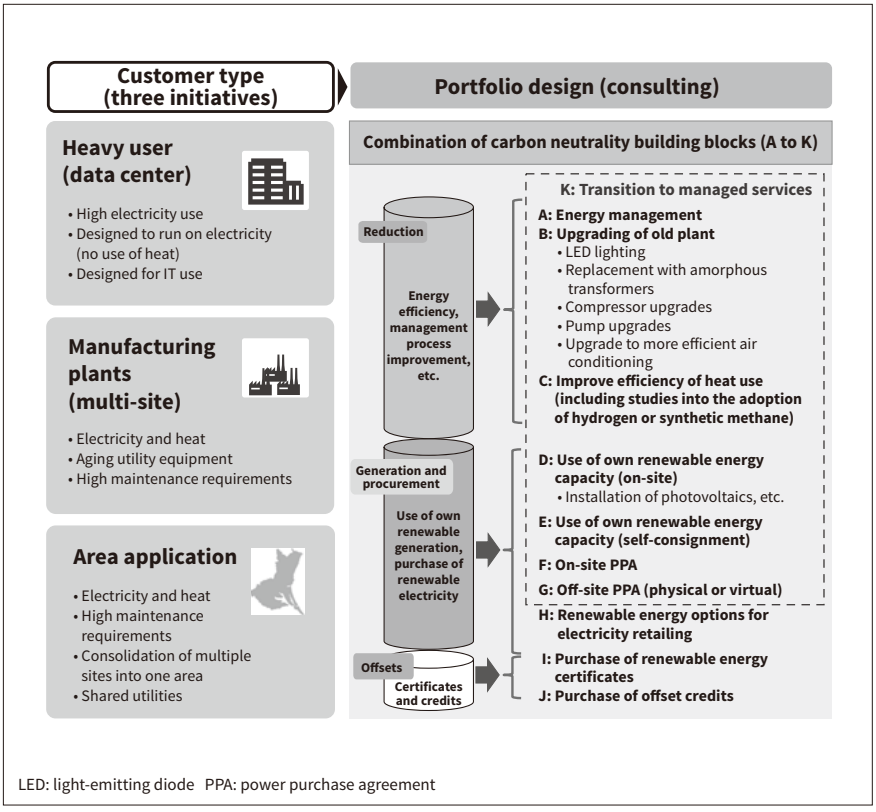
While photovoltaics are commonly used as a means of adding a generation component to a portfolio, this generation in many cases will not be located at the site where the power is to be consumed. For such customers, Hitachi has started working on how to combine resources such as renewable energy, grid monitoring and control systems, and artificial intelligence (AI) to enable customers with multiple sites to take advantage of self-consignment (delivery via the grid of electric power generated by their own remotely located plant) in their energy management.

As a pilot model, Hitachi is planning to commission a system in March 2024 that will utilize electric power generated by a photovoltaic power plant located at Hitachi's research and development facility in Hatoyama City (Saitama Prefecture). Any excess power not required by the Hatoyama facility is supplied by the system to a similar

*2 According to Hitachi Ltd.'s estimate

Figure 1 — Portfolio Design

Portfolio design combines different solution building blocks based on what fits best with the customer's energy usage characteristics.



LED: light-emitting diode PPA: power purchase agreement

facility in Kokubunji, Tokyo. The goal is to reduce CO_2 emissions at Kokubunji by a net 75% relative to FY2010 by FY2030[(1), *3].

By making use of energy across multiple sites based on their individual energy circumstances, this approach enables optimization across sites with different electricity use characteristics and amounts of space available for equipment installation. Furthermore, to achieve carbon neutrality in ways that would be difficult for individual sites acting alone, future plans include the sharing of electric power across a number of sites by using N:M configurations in which multiple generation sites supply multiple consumers.

3. Microgrid System for Local Sourcing of Energy

Following the 2020 announcement by the Japanese government of its 2050 Carbon Neutral Declaration, an increasing number of local government agencies around Japan have been making their own zero-carbon declarations.

It was against this background that Hitachi Power Solutions Co., Ltd. signed a memorandum of understanding on October 11, 2022 with Okuma Town in the Futaba District of Fukushima Prefecture for a project to build the Shimonogami smart community, Okuma having previously announced a zero-carbon declaration in February 2020.

The project includes plans to install a megawatt-class solar power plant, a battery energy storage system, its own transmission lines for delivering electric power to users, and a grid control system that provides optimal control of the overall network. By supplying electricity derived from renewable energy to the Shimonogami area around Ono Station in Okuma, it will support the establishment of a system for the local sourcing of energy.

The project will help Okuma in its goal of becoming a zero-carbon town through the use of locally generated renewable energy (see **Figure 2**).

*3 Combined reductions including the installation of energy-efficient equipment and other measures for reducing CO_2.

4. Energy Transformation to Carbon Neutrality

4. 1
Trends in Hydrogen and Methanation and Hitachi's Work in This Field

Along with an increased proportion of energy coming from renewable sources, serious attention is being given in Japan and elsewhere to the adoption of power-to-gas (P2G) as part of the transition to a carbon-neutral society in 2050. This involves the use of excess renewable electric power to produce hydrogen. At companies, industrial complexes, and ports, a lot of work is currently going into the development of supply chains for the production, transportation, storage, and use of hydrogen, with the participants working together in ways that take advantage of their respective corporate strengths and local circumstances.

Hitachi is directing its efforts toward the production and use of hydrogen and synthetic methane in particular. To enable low-cost hydrogen production and build a hydrogen value chain, engineering work is focusing on high-voltage electrolyzers and hydrogen distribution control as well as on providing a hydrogen dual-fuel option for gas turbines and gas engines. As one way of using hydrogen is in the form of synthetic methane, Hitachi is helping Japan's gas industry achieve its goal of 1% synthetic methane by 2030 and 90% by 2050, focusing on biomethanation and conducting studies aimed at commercialization. As well as supplying the key products for hydrogen and synthetic methane that serve as the heart of the overall P2G system, Hitachi is also looking to supply operational technology (OT) and IT for asset life cycle management, supply chain management, and the trading of carbon credits (see **Figure 3**).

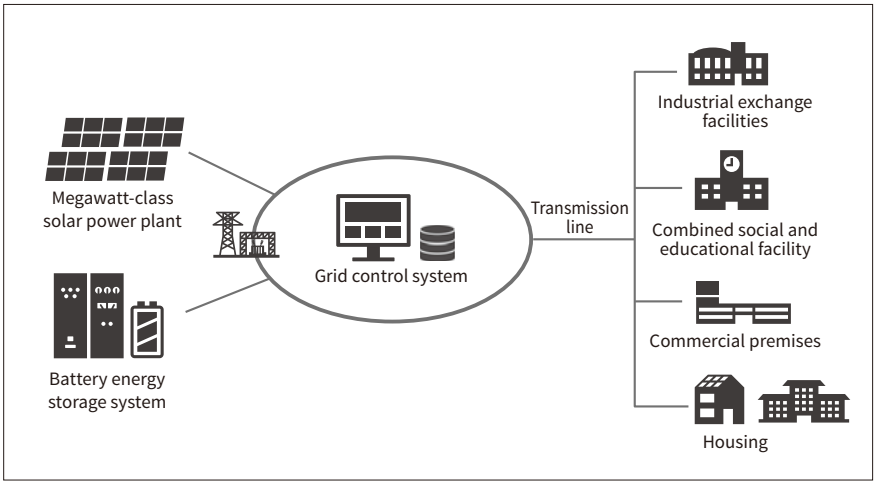
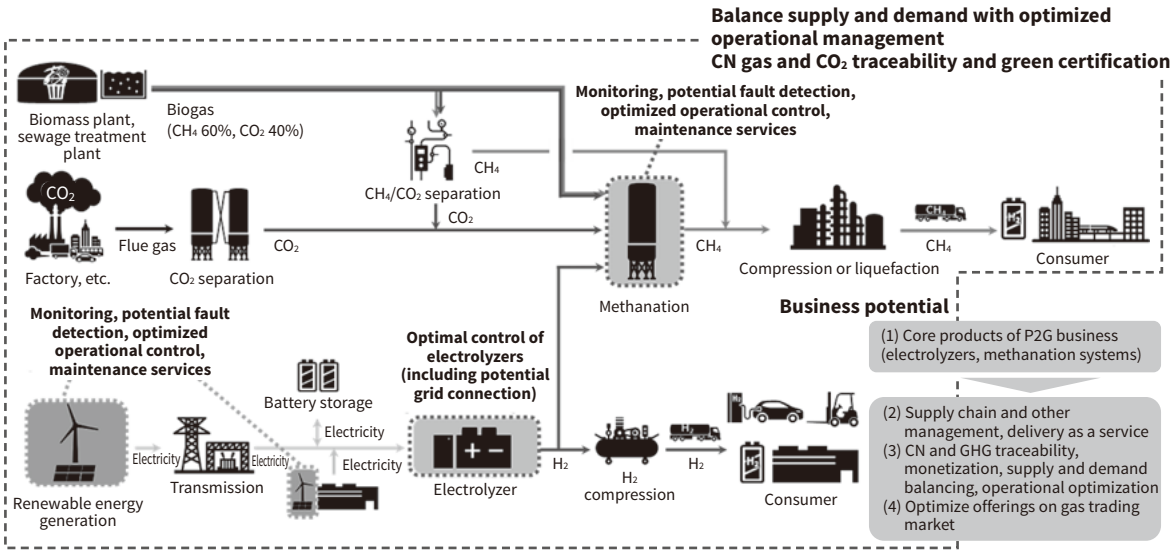


Figure 2 — Diagram of Shimonogami Smart Community Project Planned for Okuma Town, Futaba District, Fukushima Prefecture

The project will use its own transmission lines to supply renewable energy generated by a megawatt-class solar power plant to consumers in the Shimonogami area around Ono Station in Okuma. Featuring a grid control system and battery energy storage, it will support the establishment of a system for the local sourcing of energy.

Figure 3 — P2G System for Hydrogen and Synthetic Methane

The system can supply either synthetic methane or hydrogen by combining methanation with the use of excess renewable energy to power the production of hydrogen by an electrolyzer. Demand information is used for optimal system-wide energy management.



P2G: power-to-gas CN: carbon-neutral GHG: greenhouse gas CH_4: methane CO_2: carbon dioxide H_2: hydrogen

4. 2
Trial Use of Hydrogen for Carbon-neutral Heat

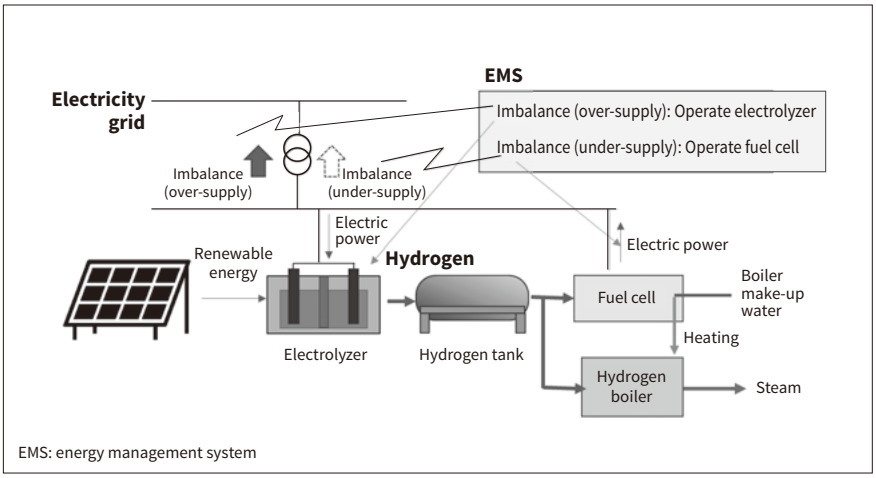
The bulk of corporate CO_2 emissions can be divided into those associated with electricity and those associated with heat. In other words, carbon neutrality needs to address not only the electricity-related CO_2 emissions that can be reduced through measures such as renewable generation, but also emissions associated with the supply of heat. This section describes a project in which hydrogen was used to supply carbon-neutral heat.

The project involves a corporate group that is undertaking trials with assistance from the Ministry of the Environment FY2022 Subsidy for CO_2 Emission Control Measures. As 50% of their CO_2 emissions are attributable to electricity and the other 50% to heat, carbon neutrality cannot be achieved without also addressing the latter. Accordingly, the group decided to trial the use of hydrogen to supply carbon-neutral heat on the assumption that adequate supplies would be available in the future. To achieve high operational efficiency, the project involves setting up a cogeneration system in which green hydrogen produced from renewable energy is supplied to a hydrogen boiler and fuel cell. The project also plans to trial control practices based on an energy management system (EMS) that balances supply and demand by using an electrolyzer as a sink for electric power and a fuel cell as a source (see **Figure 4**).

By keeping imbalances in electric power to a minimum using the fuel cell and electrolyzer in tandem with generation equipment that is to be installed by Hitachi in the future, the goal is not only to achieve carbon neutrality in the supply of heat, but also to make the electricity supply more reliable. Hitachi has served as a long-term energy

Figure 4 — Block Diagram of System for Carbon-neutral Supply of Heat

The electrolyzer runs on electricity generated by photovoltaic panels and the hydrogen it produces is stored in tanks. By supplying the stored hydrogen to either a hydrogen boiler or a fuel cell, depending on whether there is an under- or over-supply of electric power, the system makes the power supply more reliable while also achieving carbon neutrality in the supply of heat.



EMS: energy management system

partner for the group, including by helping them to develop a roadmap for carbon neutrality and assisting with equipment installation. Hitachi also plans to utilize the know-how it has developed on this project in co-creation with other companies that have made a commitment to carbon neutrality.

5. Process Improvement and Managed Services

Along with the use of digital technology for continuous monitoring, action on carbon neutrality also calls for ongoing progress accompanied by repeated analysis and testing. Because data appreciates (grows in value) over time whereas equipment depreciates (deteriorates), this gives rise to improvements in process (operations and maintenance).

5. 1
Managed Services for Equipment Management

This section describes a solution for transforming equipment management that was supplied to a food retailer. The challenges that the company faced with regard to equipment operation were: (1) how to deal with the complexity of maintenance work while keeping costs low, and (2) how to make progress on carbon neutrality.

In response, Hitachi offered a package that combined the following two systems.

(1) Equipment management system

A single point of contact was established for equipment maintenance and more sophisticated equipment management practices were adopted in which Hitachi was responsible for all steps from data entry to management.

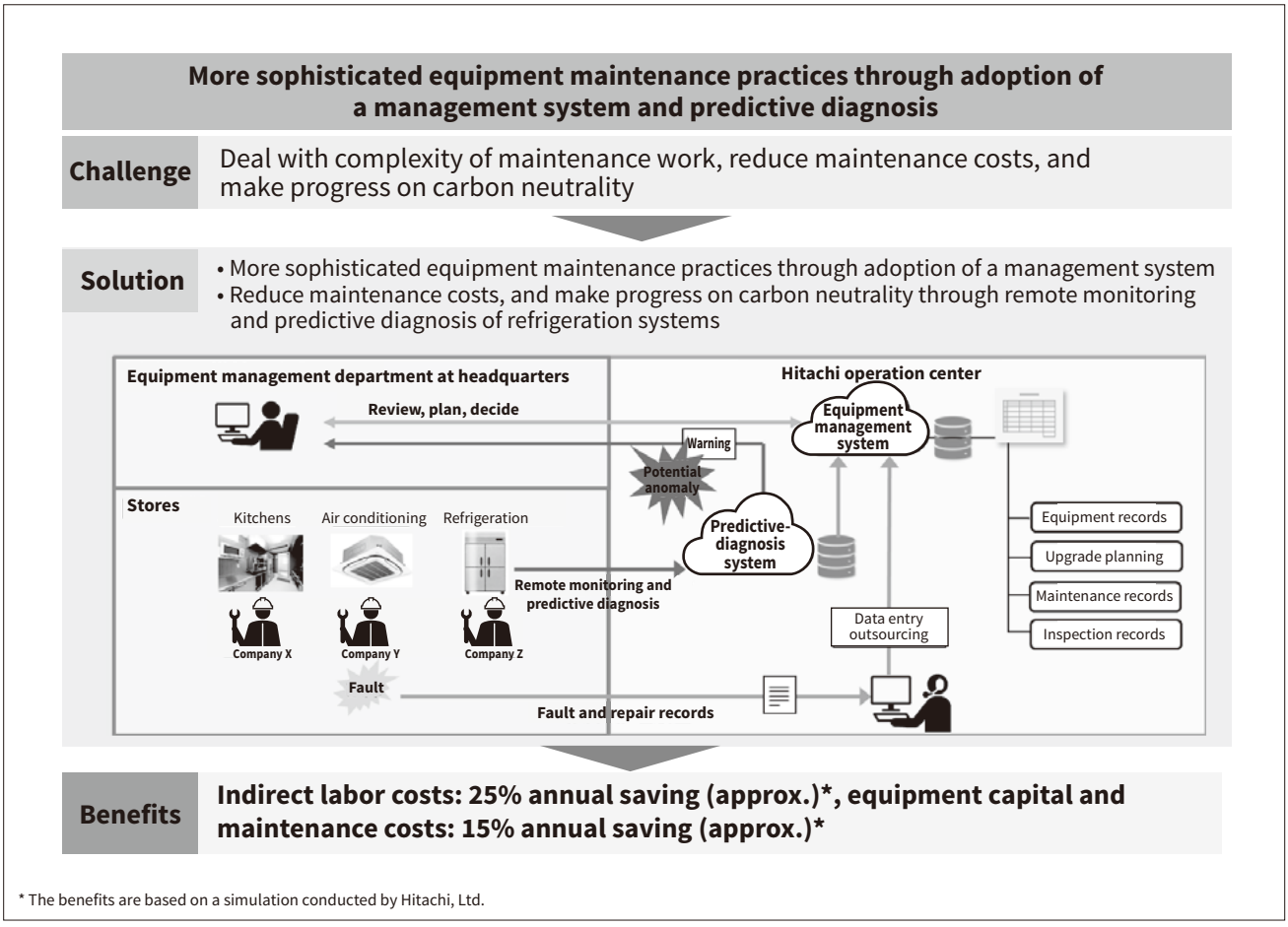
(2) Predictive-diagnosis system

Through the remote monitoring and predictive diagnosis of energy and operating conditions for chiller and freezer systems, this system reduces food wastage while at the same time cutting maintenance costs through preventive maintenance. It provides ways to deal with the impacts that unexpected faults in this equipment have on retail operations and promotes carbon neutrality by the early detection of refrigerant leaks.

After an initial rollout to 10 stores, the plan is to expand the predictive diagnosis system to cover all 100 stores while also making use of data on the managed services for energy and facilities. In practice, this will include putting data to practical use in areas like vendor selection and store design

Figure 5 — Provision of Managed Services for Equipment Management to Retailer

The figure illustrates the operational issues facing the food retailer, the solutions provided, and the benefits it has delivered. The solution took the form of an equipment management system and a predictive-diagnosis system combined as a single package.



* The benefits are based on a simulation conducted by Hitachi, Ltd.

by taking account of statistical trends in predictive detection and operational data as well as in faults. Data will also be used for the development of optimal equipment upgrade plans and in investment decision-making.

By combining carbon neutrality with more sophisticated equipment management, this will resolve the customer's societal and environmental challenges while also extracting new value from data (see **Figure 5**).

Furthermore, by adopting consistent practices across different sites, it is anticipated that the service will deliver new benefits to the company as a whole by establishing not only an Internet of Things (IoT), such as equipment management systems, but also resource platforms for things like spare parts and maintenance staff. Beyond that, there is also scope for greater shared benefits by deploying resource platforms that transcend the borders between companies to encompass multiple sites, including those of other customers.

6. Conclusions

As the business environment in which companies operate becomes increasingly difficult, requiring that the investment of resources be focused on strengthening core operations, the time has come to reassess whether it is a good idea to continue keeping operations that support the core business (energy equipment and management) in-house, including measures for achieving carbon neutrality.

Hitachi's goal is to contribute to the core business activities of its customers by enabling them to make the change from an ownership-based to a usage-based model by outsourcing these tasks on a comprehensive and ongoing basis.

By combining GX (including green electricity generation and energy efficiency) and DX (including energy management, asset management, and the IoT), Hitachi also aims to enhance the corporate value of customers.

Reference

1) Hitachi News Release, "Hitachi Begins Operation of Verification Environment for Energy Management Systems Leveraging its De-carbonization Technologies in Kyōsō-no-Mori" (Oct. 2021), https://www.hitachi.com/New/cnews/month/2021/10/211008.html

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