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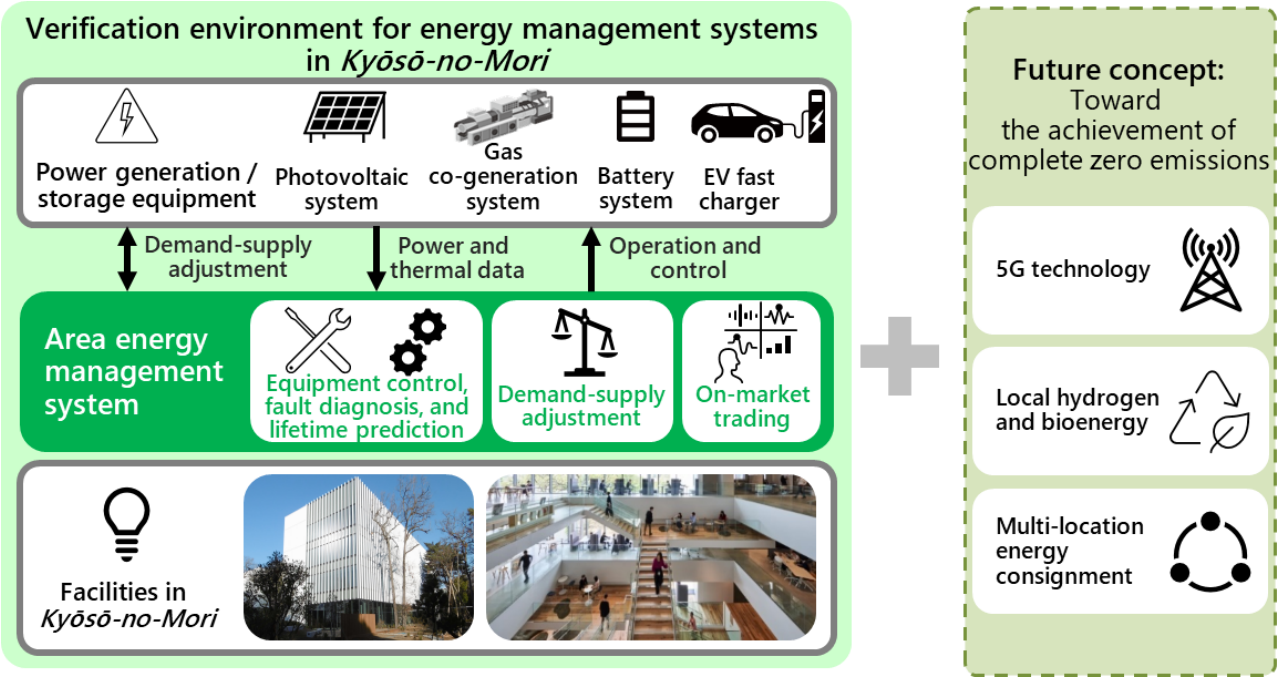
Hitachi Begins Operation of Verification Environment for Energy Management Systems Leveraging its De-carbonization Technologies in *Kyōsō-no-Mori*

Will boost environmental co-creation with customers and achievement of zero emissions



Verification environment for energy management systems using a DC distribution grid

Tokyo, October 8, 2021 --- Hitachi , Ltd. (TSE: 6501, "Hitachi") today announced that it has created and begun operation of a verification environment for energy management systems which brings together Hitachi's power generation, electricity storage, and equipment maintenance technologies in its research and development initiative, *Kyōsō-no-Mori*.(1) The verification environment combines energy management systems comprising a high-precision system for adjusting power demand and supply, technologies for power generation equipment to diagnose fault and to predict its lifetime, and an efficient, AI-based power trading system, with a DC distribution grid(2), to which are connected a photovoltaic power system, batteries, a gas co-generation system(3), and EV(4) fast chargers. It is now possible to provide customers who are seeking to achieve zero emissions and stable, efficient, and

economic operation from renewable energy, with a place for experimentation and verification of flexible combinations of actual systems and equipment. FY2020 verification of the effect of the energy management system at the Kokubunji site of Hitachi R&D group confirmed that when compared against FY2018, energy costs can be reduced 30 percent while reducing CO_2 emissions 20 percent.

Hitachi will use this environment to advance its own and customers' achievement of zero emissions while progressing environmental co-creation with customers to create new energy solutions. Hitachi will incorporate local hydrogen(5), bioenergy, 5G, and multi-location linkages leveraging energy consignment technologies(6), to further evolve the verification environment and contribute to achieving complete zero emissions and a sustainable society.

With the occurrence of natural disasters becoming more frequent globally, world leaders have issued a 2050 net zero CO_2 emissions declaration, and work has begun to raise the 2030 emissions reduction targets. While energy users are required to introduce non-fossil-based energies more than ever, they also need to consider cost reduction and resilience in the face of disaster. Progress has been made in development of energy management systems which harmonize large-scale power sources (e.g. thermal power) and distributed power sources (mainly renewable energy), but an issue for energy users has been the difficulty of controlling power imbalance(7) between energy demand and the fluctuating power generation capacity of renewable energies.

To address these issues, Hitachi has been to configure a verification environment in its *Kyōsō-no-Mori* research and development initiative, which combines a DC distributed grid, predicated on diverse industries having energy-consuming facilities, such as city blocks, factories, buildings, and data centers, with an energy management system that leverages control technologies developed by Hitachi in the semi-conductor and information & communications fields so as to enable customers to verify the introduction of renewable energies and to work with Hitachi to co-create new energy solutions.
The technologies which have made the energy management systems a reality have the following three features.

1. **Power generation equipment control technologies which draw on semi-conductor technology and are capable of diagnosing equipment fault and predicting lifetime in a short time and with high precision**[8],[9],[10]

The technologies are used to control power generation equipment in a short time and with high precision, by applying semi-conductor modelling to analyze power data from photovoltaic power generation and batteries and by converting energy into digital data over small intervals of time. Managing equipment status in real time makes it possible to diagnose equipment fault and to predict lifetime in a short time.

2. **Control algorithms that resolve power imbalances and enable high-precision matching of energy demand-supply**[11]

The technology from 1 above is used to adjust power demand-supply with batteries. Power imbalances are eliminated by converting battery charging status to voltage and controlling battery and DC bus voltages in real time to achieve high-speed response to fluctuations in energy demand-supply and high-precision matching.

3. **An energy and environmental value trading system based on AI**[12]

The technologies from 1 and 2 above are used to reduce energy costs by quickly formulating an operating plan for energy adjustment capability (batteries, co-generation systems) identified as economically viable from energy market forecasts, and achieving high-precision timing of trades. The system operates in association with a system for certifying that power consumed in units of equipment and units of service is 100 percent renewable energy[13], to realize economically rational introduction of renewable energy.

Verification of the effect of the energy management system at Hitachi's Kokubunji site in preparation for commissioning the verification environment confirmed that when compared against FY2018, energy costs can be reduced 30 percent while reducing CO_2 emissions 20 percent. Precision of power imbalance control is typically in the order of 10 to 20 percent, but this high-precision system has imbalance of two percent or less, and the energy management system has been confirmed to address the expectations of energy users by enabling a response to a power control instruction within 30 minutes.

(1) Established on the Kokubunji site in Tokyo. News release, April 11, 2019: "A New Research Initiative to Accelerate Innovation through Open Collaborative Creation with Partners" https://www.hitachi.com/rd/news/press/2019/0411.html
(2) A small-scale energy network that does not rely on power supplied by large-scale power stations, but aims at local production and consumption from community-held energy supply sources and consumption facilities. The output from direct current energy supply sources such as solar power and batteries is not converted to alternating current, but is transmitted as is as direct current.
(3) A system fueled by gas in which electricity is generated at the site where it is needed and simultaneously generated heat is able to be used for heating, cooling, hot water, and steam.
(4) EV: Electric vehicle
(5) The "local hydrogen" concept involves manufacturing hydrogen from renewable energy within a domestic, small-scale power network and using it in the form of fuel cells or similar, which contrasts with "global hydrogen," which is cheap power generated from large volumes of manufactured and imported hydrogen.
(6) Technology to transmit electricity generated at a remotely located power station.
(7) The difference between the amount of power demanded (used) and the amount supplied. If demand and supply are out of balance, voltage and frequency become unstable.
(8) Presented at the IEEE 47th Photovoltaic Specialists Conference (PVSC 2020): (2020/11) T. Kohno, et. al., "Performance visualization algorithm of PV module for establishing life time estimation technology"
(9) Presented at the IEEE 4th International Future Energy Electronics Conference (IFEEC 2019): (2020/3) E. B. Miftahullatif, et. al., "Novel state-of-health prediction method for lithium-ion batteries in battery storage system by using voltage variation at rest period after discharge"
(10) Hitachi High-Tech news release, November 20, 2020: "Development of a Rapid Diagnostics of Battery Degradation to Instantly Evaluate the Performance Degradation and Remaining Lifespan of Lithium-Ion Batteries" https://www.hitachi-hightech.com/global/about/news/2020/nr20201120.html
(11) Presented at the IEEE 4th International Conference on DC Microgrids (ICDCM 2021): (2021/7) R. Wakabayashi et. al, "Battery control algorithm with voltage command for accurate response to imbalance of electricity supply and demand"
(12) A system of trading between the market and energy users in two environmental values; the value of electricity generated from renewable energy such as solar and wind power; and carbon dioxide emission reductions
(13) News release, January 22, 2021: "Hitachi Develops System That Visualizes Equipment or Services Usage of Renewable Energy with an Eye toward Realization of Decarbonized Society" https://www.hitachi.com/New/cnews/month/2021/01/210122.html

About introduction at Hitachi Social Innovation Forum 2021 JAPAN

The technology can be shown at the "Hitachi Social Innovation Forum 2021 JAPAN" from October 11th (Monday) to 15th (Friday), 2021.
We will showcase the technology in the "Expert session 13" to be held from 15:10(JST) on October 15th.

Hitachi Social Innovation Forum 2021 JAPAN Official Site

https://www.service.event.hitachi/en/

About Hitachi, Ltd.

Hitachi, Ltd. (TSE: 6501), headquartered in Tokyo, Japan, is focused on its Social Innovation Business that combines information technology (IT), operational technology (OT) and products. The company's consolidated revenues for fiscal year 2020 (ended March 31, 2021) totaled 8,729.1 billion yen ($78.6 billion), with 871 consolidated subsidiaries and approximately 350,000 employees worldwide. Hitachi is working to increase social, environmental and economic value for its customers across six domains; IT, Energy, Industry, Mobility, Smart Life and Automotive Systems through Lumada, Hitachi's advanced digital solutions, services, and technologies for turning data into insights to drive digital innovation. For more information on Hitachi, please visit the company's website at https://www.hitachi.com.

For more information, use the enquiry form below to contact the Research & Development Group, Hitachi, Ltd. Please make sure to include the title of the article.
https://www8.hitachi.co.jp/inquiry/hqrd/news/en/form.jsp

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