Technotalk

Energy Solutions for Social Innovation

Yasuo Sato Department Manager, Energy Management Systems Research Department, Center for Technology Innovation – Energy, Research & Development Group, Hitachi, Ltd.
Morimitsu Egashira Chief Project Manager, Energy Business Development Department, Energy Solution Business Development Division, Energy Solutions Company, Hitachi, Ltd.
Yoko Sakikubo Director of Planning Department, Energy & Transportation Information Systems Division, Information & Telecommunication Systems Company, Hitachi, Ltd.
Masayasu Takeiri General Manager, Electric Utility Sales Division, Hitachi, Ltd.
Yuji Nagashima Senior Engineer, Energy Systems Engineering Department, Infrastructure Systems Company, Hitachi, Ltd.
Tatsuya Yamada General Manager, Business Planning Division, Energy Solutions Company, Hitachi, Ltd.

Energy has grown in sophistication to become an important part of the infrastructure of society. Recent years, however, have seen the emergence of complex issues that need to be dealt with at a global level, including reducing carbon emissions in response to global warming, improving economic efficiency, and ensuring security of energy supply, while, in Japan, moves toward the reform of the electricity market are accelerating. Hitachi is striving to offer solutions to these numerous challenges by drawing on its strengths in IT and on the equipment and system technologies it has supplied to many different parts of the energy sector. Hitachi will support electricity market reform and contribute to Social Innovation through energy solutions based on its accumulated knowledge and technology.

Wider Adoption of Renewable Energy

Yamada: While energy is an important part of the social infrastructure that supports our way of life, it has been facing a variety of challenges in recent years, including increasing emissions of greenhouse gases, generation costs, and security of energy supply. Hitachi strives to develop energy solutions for overcoming these challenges and seeks to provide customers with three forms of value, namely environmental, economic, and reliability performance.

Starting with environmental performance, while the wider adoption of renewable energy is essential for dealing with global warming, it also poses a number of challenges.

Sato: Along with rising environmental awareness, the growing use of renewable energy in Japan has been underpinned by the feed-in tariff scheme. Unfortunately, the wider spread of power sources and their fluctuating output poses problems of voltage and frequency stability when connected to the grid. In response, the Research & Development Group at Hitachi is developing technologies for things like output smoothing and voltage stabilization. In particular, stabilization solutions for regional grids now need to be able to cope with continually varying conditions. This includes a

Yasuo Sato

Department Manager, Energy Management Systems Research Department, Center for Technology Innovation – Energy, Research & Development Group, Hitachi, Ltd.

Joined Hitachi, Ltd. in 1994. He is currently engaged in the research and development of stabilization and electricity trading solutions and monitoring and control of electric power transmission networks and regional energy grids. Mr. Sato is a member of The Institute of Electrical Engineers of Japan (IEEJ).

Morimitsu Egashira

Chief Project Manager, Energy Business Development Department, Energy Solution Business Development Division, Energy Solutions Company, Hitachi, Ltd.

Joined Hitachi, Ltd. in 1992. Having previously worked in general industrial sales, he is currently engaged in business development in the energy sector.

demonstration project for regional grid stabilization being run jointly with the Bonneville Power Administration (BPA) in the USA. We have been focusing on grid stabilization techniques that utilize our portfolio of technologies, which include such functions as prediction calculations and high-speed grid calculations developed for past projects like the online transient stability control (TSC) system supplied to Chubu Electric Power Co., Inc.

In the case of frequency instabilities that arise as a result of variations in the balance of supply and demand, we are also trialing the efficacy of using energy storage systems for grid stabilization, conducting a demonstration project in North America that uses the CrystEna container-type energy storage system.

Along with factors such as falling generation prices due to the spread of renewable energy and progress in battery storage technology, rather than simply selling whatever renewable energy is generated, what is needed are measures for regional energy management and solutions that use local consumption of local generation to make the best use of the energy produced. Hitachi intends to contribute to even wider adoption by taking this approach to its participation in projects in different parts of the world.

Yamada: Renewable energy is becoming even more unevenly distributed due to local factors such as the weather.

Sato: The uneven distribution of power sources and the associated redistribution of electric power over long distances is a problem shared by both Japan and other places. We have technology for incorporating output prediction functions for renewable energy into load dispatch office systems and are seeking to deploy this technology overseas as well as in Japan.

Yamada: Meanwhile, there is also interest in local consumption of locally produced energy. Please tell us about demonstration projects aimed at making this possible.

Egashira: Hitachi has since 2013 been participating in a smart grid demonstration project in the Hawaiian island of Maui with the New Energy and Industrial Technology Development Organization (NEDO) and other partners. One of the issues facing Hawaii is that it has the greatest dependency on fossil fuels of any state in the USA. Having set a target of increasing renewable energy capacity to 40% or more of total demand for electric power in the state by 2030, installation is proceeding steadily. The project is supporting the efficient management of renewable energy by providing an electric vehicle (EV) energy control center that handles battery control, a distribution grid control system, and a demand response system in order to create a smart grid that utilizes EVs.

Sato: Adapting to local circumstances is the key to regional energy networks. Examples such as the deregulation of electric power supply by stadtwerkes (communal service providers) in Germany and the expansion of the microgrid market in the USA demonstrate the importance of solutions that suit the characteristics and energy situation in the region. Adapting to local circumstances calls for solutions to be developed through consultation with the residents and other stakeholders, which is another way of saying the use of collaborative creation with customers that is such a focus of effort by Hitachi.

Comprehensive Support for Cutting Energy Costs

Yamada: The second form of value delivered to customers is economic performance. While users are increasingly taking steps to save energy, what sort of initiatives are underway to reduce the cost of energy?

Yoko Sakikubo

Director of Planning Department, Energy & Transportation Information Systems Division, Information & Telecommunication Systems Company, Hitachi, Ltd.

Joined Hitachi, Ltd. in 1994. Having previously worked in design and development in the energy information sector, she is currently engaged in business planning in the energy information sector.

Masayasu Takeiri

General Manager, Electric Utility Sales Division, Hitachi, Ltd.

Joined Hitachi, Ltd. in 1985. Having previously worked in commercial roles relating to information systems for electric power, he is currently engaged in coordinating sales of information systems for electric power.

Egashira: One example of an energy management business that includes energy efficiency is the Kashiwa-no-ha Smart City. Hitachi has participated from the initial planning, building the area energy management system (AEMS) that links the city's various facilities and power sources (including photovoltaic power generation and batteries) via a network to perform centralized management of energy, and has been responsible for its operation since completion. A feature of the system is that it collects and analyzes information such as weather conditions and energy use at each facility for the efficient redistribution of electric power throughout the city to save energy and reduce carbon dioxide (CO_2) emissions, while also keeping the city safe by maintaining electric power during emergencies.

Energy efficiency is also an ongoing concern for companies. However, identifying fundamental solutions that are suitable for all companies is not simple. Furthermore, at workplaces in Japan in particular, problems with energy efficiency are not immediately apparent. Accordingly, our current practice is to install an energy management system (EMS) at the customer site to collect and analyze data and diagnose the problems in order to uncover potential measures for saving energy. With little more that can be done to make energy savings at individual sites, we have reached the stage of looking at energy management across the entire company or multiple sites, offering comprehensive solutions that combine EMS with an energy service company (ESCO) scheme.

A feature of Hitachi's offerings is that they include consideration of life cycle costs 10 to 15 years ahead and adopt a business model under which operation can change in response to changes in the business environment.

Yamada: The second phase of electricity reform involves the full deregulation of the retail market from April 2016. Because ordinary households will now be permitted to choose where they purchase electric power, it is anticipated that their awareness and interest in energy will grow, and that it will prompt the electric power and other markets to offer greater diversity in the value they deliver to consumers in terms of energy and services.

Sakikubo: What consumers are looking forward to most from full retail deregulation is that the cost of electric power will fall. While I myself am interested as a consumer, I also believe it is important that tariffs are set in a balanced way that does not compromise security of supply and safety. As the installation of smart meters will enable households to view their electric power usage history in 30-minute intervals, I expect it will lead to progress on their adopting data-based energy efficiency measures.

Yamada: While a greater diversity and number of players in the energy business is evident in the lead up to full retail deregulation from 2016, are you aware in your contact with customers of a new mood in the air?

Takeiri: While Hitachi supplies a wide range of systems to its power company and other energy business customers, including customer information systems (CISs), meter data management systems (MDMSs), and smart meters, rather than simply supplying equipment and standalone systems, customers are increasingly asking how we can contribute to the expansion of their service businesses in the form of total solutions, by, for example, developing electricity pricing plans. In response to this change, there is scope for us to make use of our expertise in information and operation technology (IT × OT) to provide support that encompasses customer cost reduction and the adoption of business intelligence (BI) to allow management to see what is happening in their business. The aim of our sales force is to work with the customer and create new value by treating the electricity reforms as an opportunity for business expansion.

Yuji Nagashima

Senior Engineer, Energy Systems Engineering Department, Infrastructure Systems Company, Hitachi, Ltd.

Joined Hitachi, Ltd. in 1991. Having previously worked on the design of monitoring and control systems for thermal power plants, he is currently engaged in the design and development of energy storage systems.

Tatsuya Yamada

General Manager, Business Planning Division, Energy Solutions Company, Hitachi, Ltd.

Joined Hitachi, Ltd. in 2002. He is currently engaged in strategic planning for the energy solutions business.

Yamada: While the installation of smart meters is costly, there are also potential economic benefits from the application of big data techniques to the data collected by these meters.
Sakikubo: Measuring household electric power use in 30-minute intervals provides detailed information on usage that was not available under the previous practice of taking a monthly meter reading, and it also opens up possibilities that include different billing options. Similarly, equipping meters with communications not only improves the efficiency of meter reading by allowing it to be automated, the ongoing accumulation of data offers other possibilities such as optimal equipment configuration and predictive maintenance using condition-based maintenance (CBM).
Sato: Rather than just electric power data, what is likely to be important is how to provide benefits to users through its use in conjunction with such things as gas, telecommunications, and commerce. For the use of data also, I believe that expanding the range of possibilities lies at the heart of electricity reform.
Egashira: Electricity reform has seen a series of new entrants to energy markets from outside the sector.

This involvement of outsiders may lead to breakthroughs that go beyond what the industry has taken for granted in the past.

Maintaining Security of Energy Supply

Yamada: Given that electric power is fundamental to the social infrastructure, I believe that the third form of value, namely reliability of performance, is something that must be maintained regardless of deregulation. The government's energy policy is based on the "3E+S" concept of energy security, economic efficiency, environment, and safety, and Hitachi is engaged in a variety of work aimed at contributing to security of supply.
Nagashima: The expansion of cross-regional grid operation to help ensure security of supply is included as part of the electricity reforms. While Japan is constrained by the use of different frequencies in the east and west of the country, it is seeking to strengthen capabilities for balancing supply and demand during both normal operation and emergencies, and is also making progress on establishing the transmission and distribution network needed for cross-regional interconnections, with a central role being played by the Organization for Cross-regional Coordination of Transmission Operators, JAPAN that commenced its activities in April 2015. Hitachi is working on the development of systems for managing grid interconnections in preparation for their entering service in 2016.

Similarly, as the technology for direct current (DC) transmission is key to the greater use of cross-regional interconnections, Hitachi is working on the development of related technologies. As there is also growing international interest in the operation of wide-area grids and DC transmission technology, we are considering possible applications.
Sato: Hitachi has established a joint venture between ABB of Switzerland and our domestic high-voltage direct current (HVDC) transmission business with the aim of being an integrated provider of HVDC systems, covering everything from design to engineering, equipment supply and after-sales service. HVDC transmission poses some technical challenges, and looking ahead to the greater use of renewable energy in the future, we are speeding up the development of technology such as the optimal operation of HVDC transmission systems. In parallel with this, to help maintain stability despite greater long-distance redistribution of electric power, we are also pushing ahead with enhancements to alternating current technologies such as the grid stabilization systems being trialed by the demonstration project with BPA mentioned earlier.
Egashira: There is also a move towards the decentralization of power sources for reasons of resiliency. The USA is seeing rapid growth in microgrids, and along with the traditional aim of making grids more robust, there has been a shift in thinking based on considerations of energy self-reliance, business continuity, carbon emissions reduction, and energy efficiency. In anticipation of future market growth, Hitachi is hopeful of using its experience, past success, and technologies to also contribute to energy reform in the USA.

Enhancements to Energy Solutions Based on IT × OT

Yamada: As Takeiri-san mentioned earlier, IT × OT is a strength of Hitachi, and there is potential for the use of IT in the energy sector.
Takeiri: In regard to IT × OT, we are directing our efforts toward offering services that utilize the cloud and other IT platforms. Examples include enabling customers to create value by offering them total solutions that use IT as a base, such as cloud services that utilize human big data techniques for data analysis to help customers make operational and efficiency improvements.
Sato: Hitachi in the past has covered a wide variety of customer business domains. Along with implementing IT × OT in these sectors, it is also important to achieve synergies by coordinating a number of different initiatives as in the smart grid demonstration project in

Maui. Accordingly, in our research and development, we are working to create value by linking different domains together based on the symbiotic autonomous decentralized systems concept.

Egashira: For our customers in manufacturing, we are attempting to combine energy data and production planning data to help produce production plans that use minimal energy. For example, we have found that simulation gives completely different results for things like production sequence and the design of production sites when the priority for production planning is shifted from minimizing inventory to minimizing energy consumption. As energy is essential in all industries, there is a potential for new possibilities to open up depending on how it is utilized in other fields, such as linking energy data to a variety of different management indicators.

Sakikubo: The Information & Telecommunication Systems Company is putting effort into the use of big data, and the energy sector is among the areas where we are looking at how we can combine different forms of data to identify value of benefit to society. In the future, the Internet of things (IoT) and other similar technologies should make possible practices such as the detailed energy management of individual machines. Being a form of personal information, energy data from smart meters and other sources must be handled carefully, and we intend to support its secure use through Hitachi's technologies for things like encryption and anonymization, in compliance with security standards.

Yamada: Batteries are seen as having the potential to transform the model of energy supply.

Nagashima: The international market for batteries is forecast to reach 20 trillion yen in 2020, and I believe batteries will play an important role in energy solutions. We are focusing on the ancillary service market and capacity market, including the CrystEna demonstration project we are running in North America, one of a number of battery solutions from Hitachi. There is also growing interest in batteries in Japan, and along with supplying battery solutions for applications like peak cutting and peak shifting, I also see a need for consulting on how they can be used to help customer businesses.

Egashira: The shift from owing to renting is a major trend in the IT industry, and a similar change is also underway in the energy sector. The battery business, for example, includes a service delivery model that, rather than selling the products themselves, involves providing things like peak shifting and business continuity planning (BCP), or the ancillary services we are already providing in North America. We intend to supply more flexible energy solutions by expanding this business model and shifting to selling outcomes rather than products.

Yamada: Batteries have an important role in all three types of value provision (environmental, economic, and reliability performance) and they are expected to find a wider range of uses in the future. We want to devise solutions that can contribute to society as we go about overcoming the issues of cost and how they are to be supplied.

If electricity reforms are to provide customers with business opportunities, Hitachi has an obligation to develop solutions jointly on the basis of collaborative creation with customers. For ourselves at the Energy Solutions Company, our aim is to collaborate with the research laboratories and other operational divisions and to have those of us in frontline roles who deal directly with customers work as a team alongside engineering staff in order to supply energy solutions that create new value by solving customers' problems. Through these activities, I hope we can contribute to Social Innovation from the energy sector.