Technotalk

Contributing to Realization of Low-carbon Society through Total Solutions Incorporating Various Technological Capabilities

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Amid concerns about ongoing global warming and a growing frequency of abnormal weather events throughout the world, such as localized heavy rain or cold snaps, there are calls for measures dealing with warming to be taken seriously, with the report of the IPCC of the UN having stated that future warming is inevitable. Renewable energy sources that do not emit CO_2 in the generation process are seen as having an important role in countering warming. In its development of renewable energy technology, Hitachi is striving to apply the power system technologies and know-how it has built up through its extensive experience with energy equipment and systems. To help realize a low-carbon society, Hitachi intends to contribute to the wider adoption of renewable energy through total systems that are underpinned by these technological capabilities.

Energy Technology Innovations Essential to the World's Future

Takashima: Renewable energy is gaining an increasing presence against a background that includes global climate change and a changing energy resource situation. Today, we have invited Nobuo Tanaka, the Global Associate for Energy Security and Sustainability at The Institute of Energy Economics, Japan to discuss what form renewable energy should take in the future and what role equipment suppliers should play. Mr. Tanaka was Executive Director of the International Energy Agency (IEA) for four years (2007 to 2010). In particular, he was instrumental in devising scenarios for reducing carbon dioxide(CO_2), one of the main missions of the IEA, and presented the Blue Map scenarios. These scenarios are used as reference models throughout the world.

Tanaka: The IEA produces two major publications, the annual World Energy Outlook, and Energy Technology Perspectives, which is published every two years. The Blue Map scenarios are included in the latter publication. They focus on the problem of global warming from a long-term perspective, presenting scenarios for halving the level of global carbon dioxide(CO_2) emissions by 2050 (relative to 2005), with different versions being presented with each new issue of Energy Technology Perspectives. These scenarios are based on a broad international consensus on the need to reduce carbon dioxide(CO_2) emissions to limit the rise in temperature over the 21st century to no more than 2°C. In terms of energy mix, the IEA has put forward its vision for achieving this in its "450 Scenario" (for stabilizing the level of carbon dioxide(CO_2) in the atmosphere at 450 ppm), which was published in the World Energy Outlook. The purpose of the Blue map scenarios is to look at the technical aspects of how this can be achieved.

If the level of carbon dioxide(CO_2) emissions is to be halved, the priority in the short term is to use low-cost technologies to improve energy efficiency. In the long-term, on the other hand, energy technology innovations will be needed to remove carbon from the electric power generation process. The target for the Blue Map scenarios is an energy mix of 50% renewable energy, 25% nuclear energy, and 25% thermal power generation with carbon capture and storage (CCS). The scenarios play an important role as a basis for debate and study, providing a road map for achieving this outcome at minimum cost and considering the technological innovations that will be needed to reduce carbon dioxide(CO_2) emissions, while also maintaining energy security and economic growth.

Takashima: The fact that the IEA has extended its role beyond its previous focus on oil and the maintenance of energy security to include presenting a vision of a

future energy mix for minimizing global warming is an impressive achievement.

Tanaka: In that context, the energy situation is currently undergoing major changes, the shale gas revolution being one example. Although a shift from coal to natural gas reduces carbon dioxide(CO_2) emissions, it is not an ultimate solution to the problem. The key issue at present is how we can quickly and sustainably invest in the development of carbon-free technologies.

Takashima: In this regard, what are you looking for in equipment suppliers such as ourselves?

Tanaka: To achieve a low-carbon or carbon-free society, we need the comprehensive deployment of usable technologies, including more efficient thermal power generation, the commercialization of CCS technology, and energy efficiency improvements across various different types of equipment. There remains considerable scope for the development of renewable energy technology. In the field of nuclear power generation, all of humanity could benefit from the wider adoption of the latest technologies with a high degree of intrinsic safety, such as the integral fast breeder reactor and dry reprocessing techniques using electrolysis that General Electric Company (GE) of the USA has plans to commercialize.

The importance of energy management technologies is also growing. Whereas energy security in the 20th century was all about the stockpiling of oil, in the 21st century it is about the sustainable supply of electric power, requiring technologies for the optimal control of supply and demand.

When you consider these challenges, the world's future will depend on such things as research and development capabilities, technical skills, and the ability to innovate. These are areas where suppliers like Hitachi have a very important role to play.

Multi-faceted Contribution to Wider Adoption of Renewable Energy

Ishizuka: Hitachi has built up extensive experience and technology in the energy sector, including generation, transmission, distribution, and demand-side management. In the case of renewable energy, we are able to contribute not only through the development and supply of our own technologies and products, but also through collaboration with corporate partners across all stages from planning and engineering to construction, and through business management aspects such as earning a return on investment.

Because renewable energy has a highly variable output, power system management technologies will be essential if it is to become more widely used. These include grid stabilization technologies for maintaining power quality (including frequency and voltage), technologies for efficient transmission and distribution, smart grids, and demand-side management (controlling the demand for electric power as well as its supply). Hitachi also supplies solutions that draw on its technology and experience in these areas.

Along with generation systems, management functions for interconnecting with the grid will be key to the wider use of renewable energy. Having taken over its wind power generation system business from Fuji Heavy Industries, Ltd. in 2012, Hitachi has established the capability to provide total solutions that incorporate grid interconnection and stabilization as well the development of wind turbine systems and their manufacture, delivery, and maintenance services.

One of the major features of our systems is the wind turbine itself. In 2003, Hitachi and Fuji Heavy Industries, Ltd. jointly developed a downwind turbine, a configuration rarely used elsewhere in the world. Although more difficult technically than other types of wind turbines, the

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development was able to draw on the knowledge built up by the aeronautical division of Fuji Heavy Industries, Ltd. for the blades, tower, and other turbine components, and also on Hitachi's expertise in the design and manufacture of generators and other power system control equipment.

Tanaka: What is meant by a downwind configuration?

Ishizuka: It means a wind turbine with the rotor on the downwind side of the tower. Most wind turbines have the rotor on the upwind side. Turbines are designed with the rotor tilted so as to prevent the flexing of the blades under wind load from causing them to collide with the tower. With a downwind rotor, this tilting means that the rotor is oriented downward in the direction opposite to the incoming wind. That is, a feature of downwind turbines is that they can make more efficient use of wind energy than an upwind configuration at sites where updrafts are common, such as the mountainous terrain where most wind turbines in Japan are located, because they can align themselves perpendicular to the wind direction. Also, having the blades downwind of the tower is safer in strong winds, meaning this configuration is seen as being more suitable for conditions in Japan, where typhoons are common.

Along with their use in Japan and in other parts of Asia and elsewhere with similar environmental conditions, the downwind configuration will also offer superior generating efficiency in future floating offshore wind power generation systems because of its ability to make efficient use of wind energy even when the tower is tilted. We also aim to satisfy demand for larger turbine sizes by taking advantage of the fact that everything from design onwards is handled in-house.

Takashima: What about large (megasolar) photovoltaic power plants?

Ishizuka: An important factor in photovoltaic power generation is to have total system integration encompassing a layout that maximizes generating efficiency, power conditioners and other equipment, and grid interconnection technology. In our role as a plant supplier, Hitachi has built up engineering technologies that are both efficient and reliable, and we are applying these technologies to the construction of megasolar power plants.

Other important factors for power generation businesses that use renewable energy are obtaining the required land and ensuring the best possible connection to the grid.

In addition to providing consulting services, we can help expedite the adoption of renewable energy in a variety of different ways, not only through technology, but also through schemes, which also include finance, offered by Hitachi Capital Corporation, one of our group companies.

Tanaka: There has been growing interest over recent years in the local production of energy for local consumption (distributed generation). Does Hitachi also have a model for supporting this approach?

Takashima: The different parts of Hitachi have worked together to satisfy the recent growth in demand from customers who want to implement local production of energy for local consumption, including local governments installing renewable energy or seeking to attract data centers. We also offer support for the development of smart farms, including the use of renewable energy and information technology (IT) in dairy farming and other forms of agriculture.

New Energy Systems that will be the Envy of the World

Takashima: It is recognized that the wider adoption of renewable energy needs to be underpinned by government policy in a variety of ways. Based on your experience, which includes both policy development and working for an equipment supplier, what is the best way

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to coordinate policy with the role of a supplier?

Tanabe: I recently read a very interesting report from the Institute of Energy Economics, Japan. It concerned the limit on the total capacity of wind power that can be installed due to its highly variable, wind-dependent output, which it estimated at 10 GW assuming nothing is done to deal with this variability. However, given the ability to limit output by 5% based on wind conditions, and a 5% margin for using demand response to control demand, this limit could be raised to 51 GW. This five-fold increase represents a very large potential.

When electric power pricing is based exclusively on sale through a feed-in tariff (FIT) scheme, however, it makes sense for generators to produce as much power as possible regardless of what is happening on the grid. Achieving the above level of output fluctuation control requires not only technology, but also the policy incentives to use it. What is needed is to combine both policy and business considerations.

Tanaka: This means designing a framework that puts a price on flexibility as well as capacity. This has been the subject of much debate in Europe, and is something that Japan should be considering in the future.

Ishizuka: In technical terms, there remains considerable potential for progress on grid management to help ensure grid stability. In developed economies, load dispatch offices and other similar facilities currently manage the grid with reference to changes in the weather and fluctuations in supply and demand. There has also been interest recently in grid management technology based on high-speed computation that uses computers to provide continuous estimates of demand fluctuation so that the system can know in advance where to shed generator output or which load to turn off when a given situation arises. At Hitachi, we are developing a management system that can perform high-speed calculations to determine the state of supply and demand across the entire grid at 30-second intervals, make predictions 30 seconds in advance, and take the necessary steps. The system is now undergoing customer trials.

In addition to automatic regulation of output and providing the ability to utilize large amounts of renewable energy without the need for storage batteries, we also see these leading-edge technologies as being able to help optimize supply and demand in emerging economies and elsewhere.

Tanabe: Given the ongoing changes in the world's energy situation, I believe that energy policy considerations demand that we improve resiliency, both at a national level and in terms of corporate practices. At Hitachi, meanwhile, although we are improving coordination between operating divisions to pursue renewable energy initiatives, we also need to demonstrate greater effort and speed in the future in both our operations and technology development.

While energy policy in Japan has been a success when viewed in global terms, the aftermath of the Great East Japan Earthquake has raised numerous issues. Through efforts by companies to resolve these issues, and through policies that encourage such efforts, I hope we can once again develop new energy systems that will be the envy of the world.

Tanaka: I agree. As I said earlier, technology is the key to creating a low-carbon society, and we need to expedite measures for achieving this by having policies that take technology into account. I have learned much from today's discussion and would like to thank you for inviting me. I look forward to Hitachi utilizing its comprehensive capabilities to improve energy security, not only in Japan, but around the world.

Takashima: By combining Japanese technology, our own Hitachi technology, and effective policies, we can contribute globally to the creation of a low-carbon society. Thank you for your time today.