The Current Status of Tokyo Gas's Smart Energy Network Initiatives

(Unofficial Translation)

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1. Introduction

"Smart" has entered the home design and urban planning vocabulary as part of terms such as "smart house," used by home builders, and "smart city," a community redevelopment concept similar to the "compact city." We at Tokyo Gas have made energy smartness a major priority in our long-term corporate strategy, "Challenge 2020 Vision," and we are presently verifying the performance of a smart energy network designed to optimize energy supply and demand at a community level. Further, the Smart Energy Business Development Department, established in April of this year, is tasked with gathering information on smart energy networks and related market trends in a centralized fashion, from both internal and external sources, and formulating an integrated strategy. Today, I will discuss the current status of Tokyo Gas's efforts in the smart energy network field and the challenges involved in their wider dissemination.

2. What Is a Smart Energy Network?

Under our "Challenge 2020 Vision," we at Tokyo Gas are studying and introducing smart energy solutions at several different levels: homes, office buildings, factories, and whole communities. Smarter energy use in homes and offices makes it possible to realize comfortable residential and working environments that are also more resilient in disasters. The formation of clusters of smart buildings can then lead to smart solutions at the community level, such as networked area energy use, thereby creating cities that, in addition to their energy-saving and CO_2 reduction benefits, offer pleasant places for all to live and work. Smart energy solutions are designed to enhance the value of buildings or entire urban areas. The following is an overview of Tokyo Gas's smart energy initiatives, with examples of applications already introduced.

2.1. Smart energy solutions at the community level

These solutions conserve energy, reduce CO_2 emissions, and provide better energy security through business continuity planning (BCP) and related measures. Those benefits are achieved by combining the electricity and heat generated by distributed energy systems, such as gas-fired cogeneration (combined heat and power, or CHP) and renewable energy systems, in an optimized operation serving multiple buildings or an entire community through networked area energy use. The latter is achieved through the application of energy networks and information and communications technology (ICT).

Based on Minato City's "Urban Development Vision for the Area North of the East Exit of Tamachi Station," Tokyo Gas is working with Minato City, the Aiiku Hospital, and other public- and private-sector partners to make the target district an eco-friendly and disaster-resilient urban area through smart energy solutions including networked area energy use and effective utilization of unused energy. The features of this initiative are shown below.

2.1.1. Control of supply and demand by SENEMS

The Smart Energy Network Energy Management System (SENEMS) makes active use of ICT to reduce CO_2 emissions for the area as a whole by managing and controlling the area's energy supply and demand in an integrated way. It does this by monitoring the external air temperature, energy use by air conditioners and other appliances, and the operation of heat source units, and controlling both the heat source units and the air conditioners in real time.

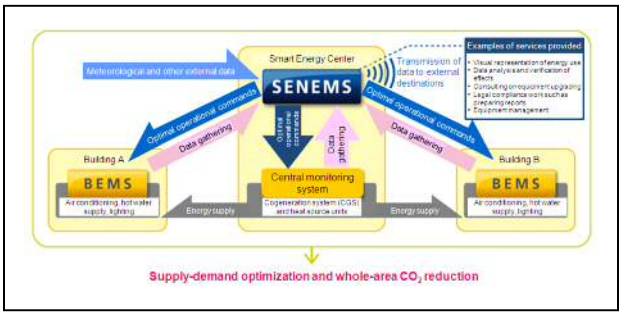

Fig. 1. SENEMS optimizes energy supply and demand

2.1.2. Large-scale solar energy use

Solar collectors, which are being introduced on a large scale, are used, together with waste heat from cogeneration, to power air conditioning for the whole area. Utilizing these forms of thermal energy to meet air conditioning demand—a major factor in power shortages—reduces the impact on the commercial power system to a minimum.

2.2. Smart energy solutions for offices and factories

The Great East Japan Earthquake led to scheduled blackouts and caused a serious power shortage in the national capital region, focusing awareness on the importance of BCP for office buildings and factories and the need to adjust supply and demand in business locations to cope with restrictions on power consumption. Tokyo Gas is developing products such as the "Gene-Smart" control system and the building energy management system "Raku-Sho-BEMS" to meet these new needs as well as to offer better environmental performance.

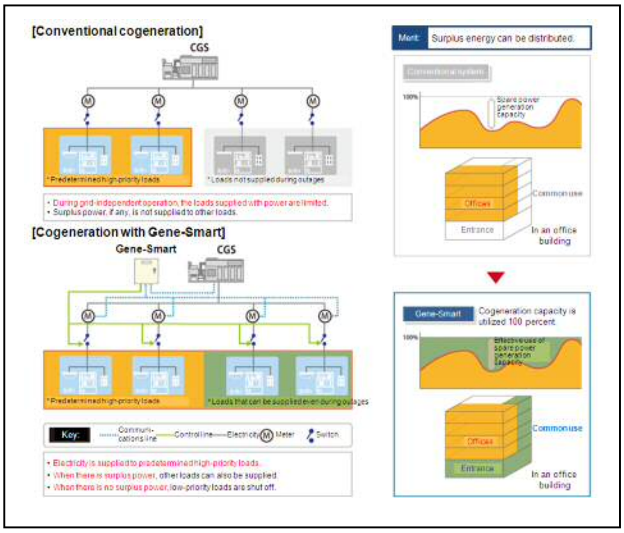

Fig. 2. Gene-Smart provides power supply during outages

In BCP, the focus of attention is cogeneration capable of grid-independent operation, but, until now, only predetermined loads received power during outages. Gene-Smart is a system that takes maximum advantage of the supply capacity of cogeneration during outages; it is more effective than conventional systems for BCP purposes because when there is a surplus it can supply power to other loads in addition to those assigned a high priority.

Raku-Sho-BEMS features the ability to control not only electrical but also gas-fired systems such as cogeneration and gas heat pumps (GHP). It addresses the need to reduce peak electricity demand not only by reducing the electrical load, but also by partially substituting gas for electricity, thus enabling even greater power savings.

2.3. Smart energy solutions in the home

"Smart" houses generally incorporate home energy management systems (HEMS) and solar power generation. By combining these with its Ene-Farm home fuel cell system, Tokyo Gas aims to achieve higher environmental performance, greater comfort, and a more effective role in life continuity planning.

In one such initiative, since April 2012 we have been testing smart apartments in our own company housing in Isogo Ward, Yokohama. At the Isogo Smart Housing Complex, we aim to reduce energy consumption by 40 percent through measures operating at three levels: architectural design features such as insulation, lighting, and ventilation; equipment features, such as a system to circulate waste heat from the Ene-Farms and renewable energy among the units; and measures in daily living, such as promoting energy-saving behavior through the use of HEMS. In fiscal 2012, the first year of the program, we tested the effectiveness of measures at the first two levels, and in practice we have confirmed a primary energy reduction of about 30 percent. The employees who live in the complex have commented on their lower heating and lighting bills due to energy savings, and on how comfortable the apartments are thanks to design features that provide good ventilation and natural lighting. Besides demonstrating energy conservation, the Isogo Smart Housing Complex also plays an important role in publicizing the advantages of smart housing that uses a gas system. In fiscal 2012, over 5,000 visitors were given tours of the complex, including university professors and other technical experts, local government personnel, developers, and home builders. As another smart energy solution in daily living, we are demonstrating a trial HEMS service for about 600 homes. In addition to the general visual representation of energy use, this program is expected to lead to the creation of new businesses such as energy-saving advice services, provision of content that will help promote the use of mist saunas, and cooperation with bulk electric power purchasing for condominium buildings.

3. Future Challenges

As we have seen, smart energy solutions help create comfortable, disaster-resilient, secure communities at the same time as they optimize energy supply and demand. Such initiatives are expected to expand and spread, but there are many issues still to be resolved.

3.1. Promotion and recognition of the value provided by smart energy networks

Smart energy networks require distributed energy systems and interchange equipment, and if these are to be utilized effectively and at high efficiency, energy operators must be actively involved. The inputs required, including plant investment and optimizing of operations, will yield not only direct energy benefits (EBs) such as lower utility bills, but also non-energy benefits (NEBs) such as better environmental performance and robustness of the energy supply, and the vibrancy that these attractive features can bring to community life. These benefits will, in turn, help raise property values.

If smart energy networks are to be adopted more widely, the stakeholders must correctly identify their benefits and create a structure to ensure that the profits are shared commensurately among all the operators involved in building and operating a network. It is also important that energy operators promote awareness and seek a wider social recognition of the benefits of smart energy networks.

3.2. Challenges posed by the introduction of cogeneration

Smart energy networks involve the introduction of distributed energy systems. Cogeneration has a particularly important role to play in this area: not only does it conserve energy and reduce CO_2 emissions, but because it is a stable distributed power source, it can also serve to reduce peak demand for grid electricity, mitigate the intermittency associated with renewable energy, and act as a grid-independent power source during grid power outages.

In June 2012, the government established a "distributed-model green electricity selling market" for the trading of small amounts of surplus electricity generated by private power generators (such as manufacturers) or cogeneration systems. It is hoped that the bar for introducing cogeneration will be lowered as such markets mature, giving rise to an active trading environment and reasonable prices.

3.3. Challenges in urban development

New urban infrastructure projects, such as community redevelopment, present obvious opportunities for introducing smart energy, because they can accommodate the need to build infrastructure such as distributed energy systems, systems for networked area energy interchange, and ICT networks. However, it does not automatically follow that smart energy networks are able to achieve their full potential in the community redevelopment setting.

Where, then, are smart energy networks best able to contribute? The answer is urban areas that have been made compact, resulting in a high density of energy demand. In the past, urban planners tended to place the highest priority on convenience and amenities, while the effective use of energy in the community as a whole was of secondary interest. But as concern for the global environment mounts and the importance of BCP has become clear, energy is growing increasingly important to planners and has come to rank as a property value enhancer. In future urban development projects, it will be necessary for energy operators to become involved from the design concept stage onward.

4. Conclusion

In addition to global environmental issues and the power shortages that Japan has experienced since the March 2011 disaster, the nation also faces the problem of population decline. The future for gas companies, which are community-based, might thus appear to be less than bright. Yet going smart could prompt these companies to make the transition to the integrated energy business, which includes supplying electricity, and also to secure the new added value (i.e., revenue sources) afforded by non-energy benefits. At Tokyo Gas, we will continue working to promote public awareness of the value of smart energy networks and to encourage their spread and expansion through practical demonstrations and policy-based guidance.