Building a Stronger New Power Network with Distributed Generation and Large-scale Conventional Centralized Power Generation Technology

Satoshi Yoshida
Manager
Energy System Department
The Japan Gas Association

The wider use of distributed energy resources is a necessity if we are to enjoy an energy-efficient and highly secured power supply.

The scenario for future development, however, cannot be based solely on distributed energy resources, which can have major advantages only in the context of a well-balanced network system.
In our interview with Satoshi Yoshida, a manager at the Energy System Department of the Japan Gas Association whose position involves promoting the use of natural gas cogeneration systems, we asked him about the prospects of distributed generation.

Distributed generation capacity is expected to reach 20%

Q: Why is an emphasis currently being placed on distributed generation?

Yoshida: Before I answer your question, let me brief you on what Japan are facing today as regards to global warming. The Kyoto Protocol took effect in February 2005, and Japan is officially committed to achieving the Kyoto Protocol Target. When we look at our energy consumption, it is showing a steady increase. Japan's annual greenhouse gases (GHGs) emission has increased 7.4% in fiscal year 2004 compared to the 1990 baseline level. Unfortunately, Japan is furthering away from the promised target in spite of all the efforts.

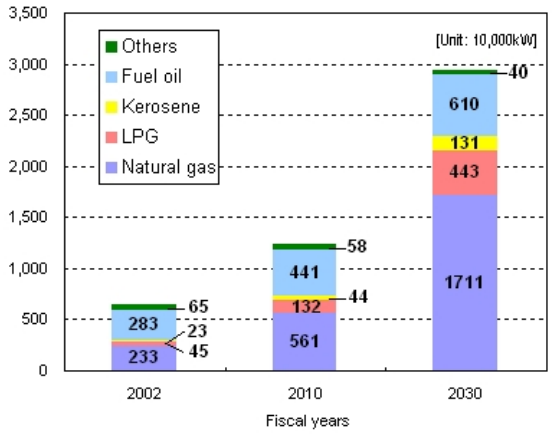
Reducing GHGs and cope with global warming is no easy task for Japan, where industry and buildings are quite energy-efficient. Japan is pretty much energy-efficient in itself. Further efforts are daunting task often described as "squeezing out one last drop of water from a dry towel." But Japan had declared to the world that it will do more and I believe we can.

To cope with this very difficult task, the Government has announced a "Kyoto Protocol Target Achievement Plan" last year. In this Achievement Plan, distributed generation system is introduced as an effective measure to reduce CO2 emissions. Embedding distributed generation systems into the existing power grid is something to be expedited from the view of total GHGs emission reduction.

A 2004 report from the government, entitled "Energy Demand and Supply Forecast for 2030," writes that the expected installed capacity of natural gas cogeneration systems will reach approximately 17million kW by the year 2030. According to this estimation, total capacity of cogeneration will be five times greater than what we have today. This figure may seem significant and it is of course so when we compare with what we have today. But once we turn our eyes to other countries in Europe and US, the figure is not such that we cannot achieve.

We need to understand, however, that the figure given in the 2004 report only represents an expectation or possibility. We all need to work together in order to make this happen.

<Forecasted capacity growth of distributed energy systems up to 2030>



Source: "Energy Demand and Supply Forecast for 2030" (2004, METI)

Q: What could be the key for expanding the use of distributed generation?

Yoshida: Apart from the need to further improve the efficiency of generators, an important keyword in this matter is "networking." Networking will allow distributed generation systems to become important elements of power infrastructure. Distributed generations systems can contribute to the efficiency and stability of overall power networks.

Conventional power infrastructure relied solely on large-scale conventional power generation technology. It's a complete hierarchy system, top down, one-way flow of power. To some extent, the conventional system has been supplying stable power in Japan. But facing the daunting task of further pursuing efficiency and energy security, large-scale conventional generation and distributed generation technology can and should work together.

Q: What are the strengths of distributed generation?

Yoshida: The first and most advantageous feature is energy efficiency as I have pointed out earlier. One, heat obtained in the process of power generation can be recovered on-site and used. Two, the power is used on-site, thereby eliminating the transmission loss that is inevitable with large-scale power plants normally situated in remote areas. I must add that it also offers a higher flexibility in investment activities as related to the power infrastructure thanks to the small size of distributed generation. Having a power generator on-site also ensures a stable supply of power in the case of a power outage. We can enjoy these advantageous features once both large and small power generators are in place supplementing each other.

Sharing energy with neighbours

Q: What does "district energy" mean?

Yoshida: It's difficult to describe district energy in few words. There's no clear definition for the concept of "district energy" that I know of. Roppongi Hills, a well-known urban redevelopment project in the heart of Tokyo may give you an idea of what is "district

Roppongi Hills

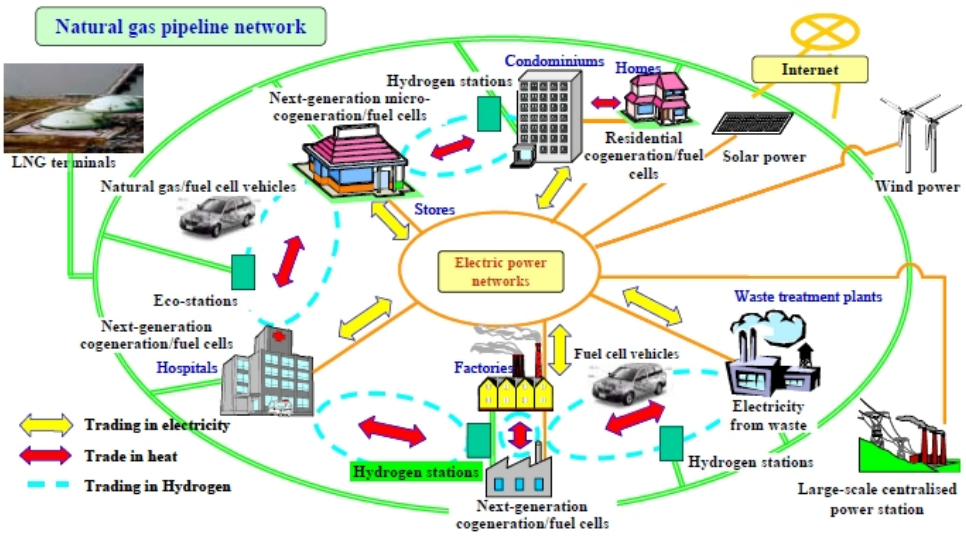
energy". Cooling & heating, hot water and electricity, all the required energy used in the district is produced at central energy plant with natural gas fuelled cogeneration system. The term "district energy" refers to such forms of energy utilisation that are represented by the installation of distributed generation system in a single or couple buildings, and acquired energy, both heating/cooling and electricity, is shared by surrounding buildings. You might wonder, then, how does that differ from the conventional "district heating and cooling (DHC) system?" District energy system does not need to be as extensive or rigid as conventional DHC. On the top of heating & cooling, electricity can also be shared among buildings. It could be a smaller form of energy sharing in the spirit of neighbours supporting each other. For example, a certain building may need a great deal of electricity, but does not need all the heat recovered from its cogeneration system. In such a case, the heat can be shared among adjacent buildings for air-conditioning. If these practices become common, energy savings at the district level can be expedited. Every city and district has different energy needs. Therefore, it is essential that the people living and working in the community and local government work together close with developers and energy suppliers to design their own "district energy system". There's no fit-for-all district energy system.

Another noteworthy and advantageous feature of district energy with distributed generation fuelled by city gas is that the system can expedite the use of renewable sources. Renewable energy solutions like photovoltaic, wind turbine, and biomass generation, are expected to feed environmentally friendly power to the grid. However, the supply is rather unstable. This is where DG comes in. Natural gas-fuelled cogeneration systems can compensate this unstable aspect. Natural gas-fuelled cogeneration systems serve such ancillary roles.

Given all of these advantageous features, we should be able to build an energy efficient and strong power grid. The era of relying fully on large-scale centralized generation has now entered the phase of major transformation.

Q: Can you say more specifically about "efficient and strong"?

Yoshida: In the summer of 2003, the northeast region of the US suffered a massive power outage. The economy and people's daily lives were hit hard. If community or district in the area had just enough energy of its own, district energy represented by distributed generation, that might had made a big difference in securing the least and limiting the damage. Such local-based, cell-like power grids, which are normally interconnected to the larger grid, are called "micro grids." If the larger power grid is designed to encompass such micro grids, disturbances can be contained within a small area. I guess it is fair to say that "efficient and strong" energy supply system is such a system that a district or area can go independent or survive in the case of an unexpected power supply disruption from large-scale conventional power plant or power line failure.



Q: What is the role of Government and municipalities in this?

Yoshida: The district energy concept is more advantageous in highly dense urban areas where energy consumption is large. Government both federal and local play an important role. One idea is to incorporate this idea in city planning and ask building owners and developers for cooperation.

A certain mechanism can be incorporated in the process of city design to conduct a

preliminary study focusing on energy efficiency and energy security at an early designing stage. It is also recommended that local government building complexes introduce these ideas to lead the public. While public incentives are essential, checklist-based grants, with a whole series of requirements, will not fit our time. Rather, proposal-based grants, supporting good initiatives, look more adequate. This process is time-consuming and requires pertinence, but once the system is in place, the district can enjoy the advantageous features I have mentioned earlier.

This district energy concept with natural gas-fuelled district energy systems as a key technology is also applicable to other Asian nations, where energy consumption is showing a sharp rise thanks to economic growth. This is one of the areas in which Japan can make a contribution towards forming a efficient and strong energy supply system in those countries.