NEC Smart Energy Solutions Business

Japan and other countries around the world see the time is ripe for a serious re-evaluation of energy infrastructure. NEC is one of the few corporations in the world that possesses both ICT and energy component technologies. Exploiting this strength, NEC aims at contributing to the realization of a new energy society through the provision of smart energy solutions that promote both the stability of the supply-demand balance and the self-sustained energy system.

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1 Introduction

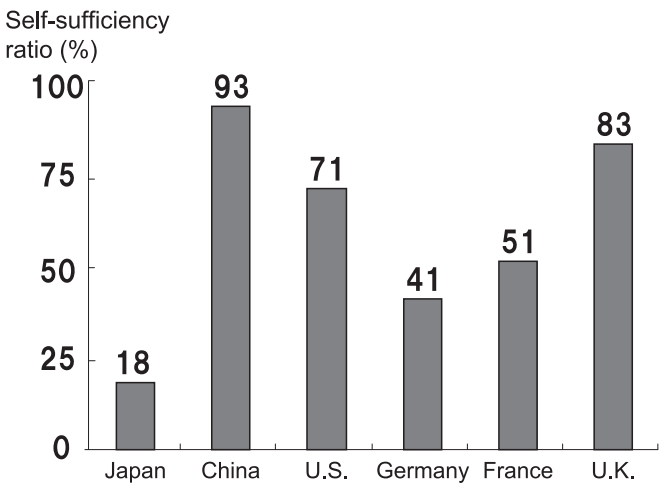
As a result of the Great East Japan Earthquake and the consequent Fukushima nuclear power plant disaster in 2011, the actual fragility of Japan's energy infrastructure, the reliability of which the nation had once boasted, was exposed to the world. This result brought about serious re-evaluation of energy policy not only in Japan but also in other countries with a significant nuclear power plant presence, and triggered debate on the building of a new energy society. With this paradigm shift as background, NEC committed a wide range of assets possessed by the company toward the development of a new smart energy solutions business.

In this special issue, we would like to introduce the reader to the various technologies related to the major areas of NEC's smart energy solutions business: "EV charging infrastructure", "Energy storage systems" and "Energy Management Systems (EMS), as well as the field of "Energy devices" that supports these technologies.

2 The Energy Issues Facing Japan and Directions to Be Pursued in the Future

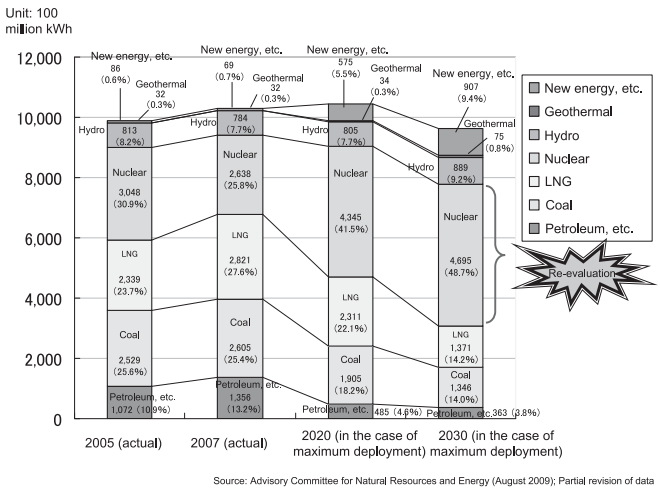
Japan is one of the world's leading consumers of energy. However, Japan's energy self-sufficiency ratio stands at a small 18% (and only 4% if spent nuclear fuel is excluded), the lowest among developed nations (**Fig. 1**) and poses a serious threat to energy security.

With this situation as background, Japan had previously declared its commitment to an energy policy that aimed at the



Source: Agency for Natural Resources and Energy "Energy in Japan 2010"

Fig. 1 Energy self-sufficiency ratio of major nations.



Source: Advisory Committee for Natural Resources and Energy (August 2009); Partial revision of data

Fig. 2 Trends in the composition of power generation capacity by energy source.

reduction of fossil fuel imports and the aggressive deployment of nuclear power and renewable energy in order to both lessen the risk to the country's energy security and reduce CO_2 emissions.

However in March 2011, the Great East Japan Earthquake and consequent Fukushima nuclear power plant disaster that rocked the nation in March 2011, exposed the fragility of the nuclear power plant infrastructure which supplied as much as 30% of Japan's electric power requirements. The nation came face-to-face with an unprecedented power supply shortage. As a result, the national energy policy, which had had nuclear power positioned as its nucleus, came under severe scrutiny (**Fig. 2**).

As a consequence of the scheduled power outages and power consumption restrictions in the aftermath of the earthquake, the sense of values of the citizens of Japan underwent a dramatic change as everyone became conscious of the energy problem in the course of everyday life. In order to come to grips with the difficult issue of how to achieve the stable supply of power with a non-nuclear infrastructure and realize this economically, national government agencies as well as local municipalities and the private sector began earnest efforts to tackle the problem. Responding to public opinion, the government is considering the introduction of competition by reforming the Electricity Utilities Industry Law and separation of electrical power production from power distribution and transmission.

In North America, the Green New Deal policy was announced, and the deployment of the so-called Smart Grid is being advanced as a means to address the ongoing issue of the fragility of the power grid by making the grid more stable and robust through large-scale deployment of renewable energy for end-users and power management using ICT. Also in June 2011, the German cabinet agreed to an accelerated phasing out of nuclear energy with all 17 plants to be shut down by 2022. Their far-reaching policy shift also calls for their replacement with renewable energy and thermal power generation fueled by natural gas.

With such action being taken in various major countries as the global context, Japan is also promoting an energy mix that puts an increasing weight on natural gas and renewable energy while shifting the focus of the energy policy to an appropriate balance of large-scale centralized infrastructure provided by the electric power utility companies and a self sustained and distributed type of infrastructure comprising the end-users. In other words, it could be said that Japan has come to a major turning point in the evolution of the energy infrastructure as we take the path to reduction of energy security risk, the realization of economy, and mitigation of gas emissions that contribute to the greenhouse effect.

3 NEC Technology's Contribution to Power Self–Sufficiency

NEC is one of the few companies in the world that boasts both globally leading ICT and Energy Component Technologies such as energy storage systems and quick-charging systems for Electric Vehicles (EV). By exploiting these strengths to provide smart energy solutions every step of the way from the grid to the end user, NEC is contributing to making the vision of a self-sufficient New Energy Society a reality.

Solving energy problems will require society-wide action to use energy with higher efficiency. Because of the necessity to temporarily store energy and its subsequent mutual interchange in order to fully utilize energy whether it is produced on the grid side by utilities or by the end user, energy storage technologies will be indispensable.

Also for disasters and other emergencies, the optimized distribution of electric power must be considered. Where is power needed? Where is there a surplus of power? A more advanced system for managing the supply-demand balance and the exchange of power is demanded. NEC believes that ICT and the Energy Cloud will play a key role in realizing this system.

4 Energy Storage Systems – the Hub of the Diversified Energy Network

As the adoption of renewable energy and fuel cells spreads, the means of access to electric power for the end user will

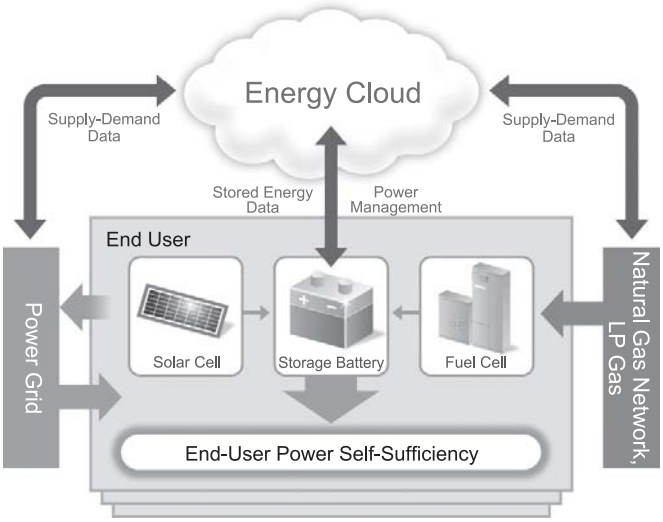


Fig. 3 Energy storage system to support end-user power self-sufficiency.

become increasingly diverse. Achieving ever higher performance, residential-use fuel cells are delivering not only power generation efficiency equal to or better than thermal power plants, but also low CO_2 emissions, and as a result, the gas network could come to play a role equal to the power grid. At the same time, as is evidenced by the penetration of all-electric products, cases in which electricity is used in the final stage of consumption are on the rise.

Featuring grid connectivity and "cloud" energy management functions, NEC's energy storage system facilitates connectivity with not only the power grid and solar power cells but also the gas network via fuel cells. In short, it plays the key role of a hub linking a network of diverse types of energy access and distributed-type power sources. In addition, the cloud service connectivity supports end user to implement the "demand response (DR)" mechanism and self-sustained energy systems, and in the future will contribute to the self-sustained energy system on a community level through power exchanges among end users (**Fig. 3**).

5 NEC Smart Energy Solutions Business

NEC's Smart Energy Solutions Business is focusing its efforts on (1) EV charging infrastructure and (2) energy storage systems which will serve as the axis for the development of (3) energy management systems (EMS) and (4) energy devices. In this next section, we would like to introduce the reader to the technologies that support these four business domains of our Smart Energy Solutions Business.

(1) EV Charging Infrastructure

NEC is pursuing the development and commercialization of EV quick-charging systems and a cloud-type EV charging infrastructure, and will provide basic EV charging services including authentication, billing, operation and maintenance on a nationwide scale. Charging maps, FULL/EMPTY status information of the charging device, stored charge information and other data are shared among the many stakeholders, creating new service opportunities. Once the widespread EV penetration is reached, the large amount of electric power that will be supplied under quick charging systems is expected to lead various problems including increased utility contract fees and instability in grid power. In order to respond to these challenges, NEC is also tackling the development of an EV charging infrastructure that will support the regional/area power supply-demand balance. At the same time, power electronics technologies will be the heart of the hardware for EV charging. These technologies will lead to not only quick charger systems but also various devices and testing devices that will support EV production itself.

(2) Energy Storage Systems

NEC's pursuit of lithium-ion battery development since the 1990s has led to the industry-leading manganese-type lithium-ion battery, which is nearing commercialization. This innovative battery achieves a balance of high output, safety, large capacity and economy. Recognizing our past record of achievements, NISSAN Motor Company selected NEC's storage battery technology for adoption in the "Leaf" electric vehicle in 2010. The development of the actual battery was a collaborative effort by NISSAN and NEC, but it was NEC's mass-production technologies and years of experience combined with advances in the practical commercialization of a stationary energy storage systems capable of meeting diverse needs ranging from power grid-sourced energy to end-user utilization that are making this vision a reality. These energy storage systems possess the power grid connectivity and cloud service connectivity functions described in section 4 of this special issue, and while they will serve as the nucleus of the smart energy solutions business, they are supported by ICT-integrated power conditioners. Anticipating the integration of energy storage systems in solar cells and other energy generation equipment, and the necessity of power conditioners in complex systems comprising multiple power sources, NEC is seeking to raise performance of these critical devices.

(3) Energy Management Systems (EMS)

Via the Energy Cloud, NEC will provide Energy Management Systems (EMS) that will optimize and make energy management "visible" for diverse levels of end users from single household units to buildings and retailers. In addition, the Energy Cloud contributes to community's self-sustained energy system by providing a demand response platform connected with the Community Energy Management System (CEMS), which manages district power supply-demand and coordinates EMS of individual end users and smart meters.

(4) Energy Devices

This special issue also introduces new energy devices that will support the future of the above-described systems. Specifically we will explain our ongoing development of infrared sensors that facilitate energy savings by responding to user behavior, organic radical batteries that will drive the next evolution of energy storage, and non-volatile logic for electronics with zero standby power requirements.

6 Conclusion

A renewable energy-centric energy mix and a self sustained and distributed energy infrastructure should be central to future energy policy. However, this trend should not be seen as replacing the conventional large-scale centralized infrastructure, but paving the way for the shape of the future Japanese version of the smart grid which is well-balanced system of centralized and distributed infrastructure. The Japanese-version of the smart grid is expected to be an exportable industry that will contribute to the Energy Society tomorrow as framed by the Germany and other countries around the world that are increasingly leaning towards phasing out the use of nuclear power. The creation of such an industry must be a society-wide endeavor, and cannot be achieved by the private sector alone. It will require various corporations transcending conventional industry boundaries, working in collaboration with the public sector, the convergence of technologies and specialized know-how, and facing the numerous challenges and trials. Working in close cooperation with various partners, NEC is driving the advance of the smart energy solutions business, and paving the way for the next-generation Energy Society (**Fig. 4**). In this special issue, we look forward to giving the reader a better understanding of our mid- to long-term approach to this challenge.

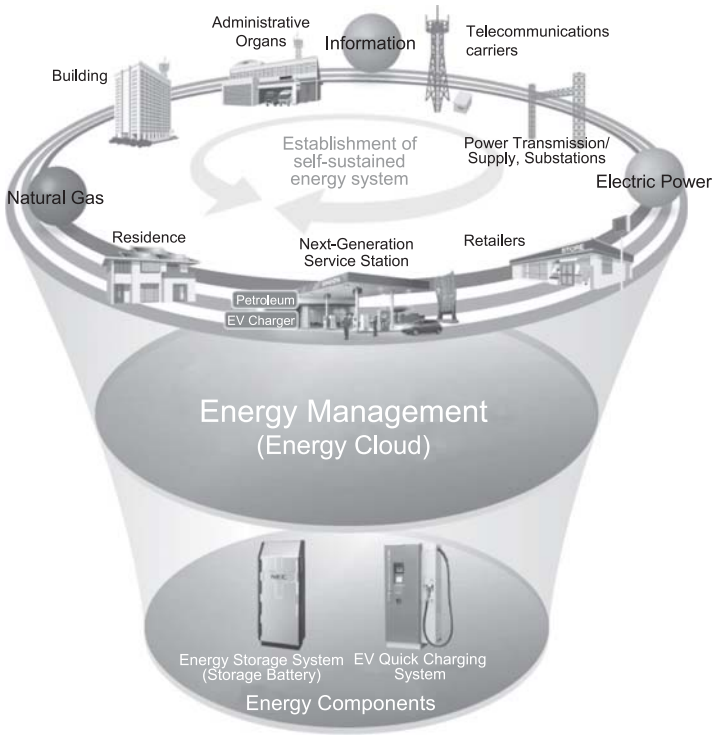


Fig. 4 Next-generation energy society & NEC's business vision.

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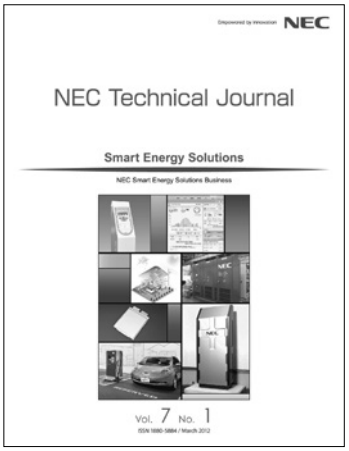

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