

Development of Energy Supply & Demand Management System at the Core of Our Electric Power Supplier Solution

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Abstract

With full deregulation and liberalization of the electric power retail sales scheduled for April 2016, NEC has put together an Electric Power Supplier Solution which encompasses core systems crucial for power retailing such as the Customer Information Management System (CIS) for power utility companies and the Energy Supply & Demand Management System, plus solutions to attenuate imbalance fee including the Electric Power Demand Forecasting System and the Solar Power Prediction System. In this paper we will introduce the development concept and applications for the core Energy Supply & Demand Management System.



Energy Supply & Demand Management System, Customer Information Management System (CIS),
Electric Power Demand Forecasting System, Solar Power Prediction System

1. Introduction

The scheduled deregulation and liberalization of electric power retail sales beginning in April of 2016 will unleash a power market worth about JPY7.5 trillion, with an economic impact expected to surpass JPY20 trillion. Over 700 new Specific Scale Electric Utility Companies^{*1}, the so-called "New Power" companies, have filed business applications as of the end of July 2015, and it is expected that telecommunication carriers with their large customer base, as well as gas companies and trading companies that already own power generation facilities and sources of fuel, will become prominent players with a substantial market share. What's more, this new influx is expected to diversify how businesses enter the market, into which areas and the scale of business. Liberalization will bring about diversification in business models and the services that will be offered.

At NEC, we have lined up a broad array of assets

aimed at taking advantage of the enormous range of business opportunities that will open up following deregulation. This paper will examine one of these assets in particular — the newly developed Energy Supply & Demand Management System, which will play a key role in our Electric Power Supplier Solution.

2. Concept of the Energy Supply & Demand Management System

The biggest barrier to entry in the power retailing business is the low-profit commodity characteristic of electric power. In particular, the smaller the scale of the enterprise, the more likely an imbalance fee^{*2} will be charged. This creates a heavy load on operation costs, including forming teams with expertise and training of human resources. To provide a solution to this problem, NEC began developing the Energy Supply & Demand Management System in April 2015, which would stabilize

^{*1} Number of companies that have made submissions to the Agency for Natural Resources and Energy of the Ministry of Economy, Trade and Industry as of July 31, 2015.

^{*2} Pay-per-use fee applied to replenishment to a shortage of power that exceeds the variation range of 3% per 30 minutes in the balancing system.

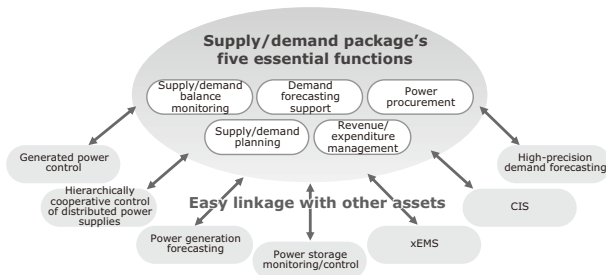


Fig. 1 Conceptual diagram of products.

an electric power business with limited investment while reducing its operation load.

Regardless of what the product is, our basic concept is always simplicity. No matter what the level of complexity or functionality, a system cannot be effective if its introduction adds to the operator's operational load. Consequently, we focused on a starter function that is the first thing a new entrant needs and a user interface that can be intuitively operated by inexperienced operators. For this reason, we concentrated on five major operations: supply/demand balance monitoring, demand forecasting support, power procurement, supply/demand planning, and revenue/expenditure management. Other operations will be custom developed to suit specific requirements by offering options and add-ons that can be introduced according to the business model of each enterprise (Fig. 1).

For example, an electric power demand forecasting solution supported with NEC's heterogeneous mixture learning technology^{*3} is offered to enterprises who require automation and high precision for their demand forecasting, while a customer portal is offered to enterprises who provide their customers with added value such as visualization that links with energy management systems including the Building Energy Management System (BEMS) and Home Energy Management System (HEMS). In other words, we enable our customers to take advantage of supply/demand data that maximizes the individual characteristics of each enterprise by delivering functional extensibility that matches specific business models in addition to suppression of imbalance fees.

In collaboration with the Customer Information System (CIS), it is also possible to manage and analyze the

load curve of every customer, each area or each plan. Our products are designed with an emphasis on the flexibility of the external interface, assuming a certain degree of system linkage.

Further, we focus on building the system as a service platform on a cloud computing, utilizing Open Source Software (OSS). We plan to offer this solution as both a cloud service and on-premises type. In other words, we will go beyond the sales of operation packages to "New Power" companies; the use of this solution will make it possible to build a platform for new services such as shared services and supply/demand management agent services.

3. Key Elements of NEC's Energy Supply & Demand Management System

Fig. 2 shows the development roadmap for our Energy Supply & Demand Management System. Of the various elements shown in the diagram, we consider the following three especially important.

(1) Compatibility with the new system

The existing Electricity Business Act requires simultaneous equal amount control on actual load. However, as part of the liberalization of electrical power retail sales beginning in April of 2016, retailers will be required to balance loads based on a one-hour advance plan.

While NEC's Energy Supply & Demand Management System has been designed to manage load balancing according to planned values, it is also capable of managing bidding in the one-hour advance

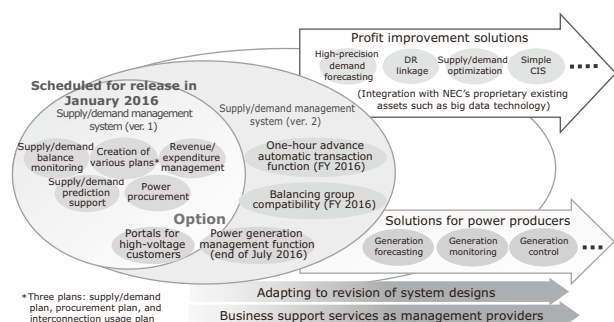


Fig. 2 Product Roadmap.

^{*3} Technology developed by NEC Central Laboratories that automatically discovers the numbers of regularity using the correlations among data that coexist in big data, and then automatically switches reference rules depending on the data being analyzed. This makes it possible to achieve high-precision prediction and abnormality detection even with data that changes its regularity according to the situation — a kind of data which is difficult to analyze using conventional machine learning that discovers and refers to only a single regularity. This type of data is utilized for applications such as automated ordering of the system and energy demand predictions for buildings and ships.

^{*4} A type of short-term energy transaction market handled by Japan Electric Power Exchange (JPEX) planned to go into effect in 2016 in which transactions will be possible up to one hour in advance of the actual supply and demand.

market^{*4}. When combined with the high-precision demand prediction generated by the electric power demand forecasting solution discussed earlier, the system will be able to monitor fluctuating demands in real time and implement power procurement accordingly, enabling it to effectively minimize load imbalances even under the new regulations.

(2) Compatibility with the balancing group

Generally, it is considered that the smaller the demand scale of power, the more difficult it is to predict demand and achieve balancing. The balancing group is a mechanism created to solve this problem. It is a union-like system in which one wheeling contract is concluded between multiple "New Power" companies and transmission/distribution companies, and the representative company of the group will control the balancing. Taking advantage of the benefits of scale, this makes it possible for group members to reduce their imbalance fees, as well as enabling them to standardize and outsource supply/demand management operations to reduce operation costs.

While making possible centralized control of supply/demand management operations by representative contractors, NEC's Energy Supply & Demand Management System also offers multi-tenant functionality, allowing group members to manage data on an individual company basis. This facilitates secure enterprise-level information management, while at the same time leveraging the advantages of scale to help suppress imbalances, thereby contributing to the expansion of profits for all members of the enterprise group.

(3) Systems that can also be used by power producers and customers

The biggest advantage of the supply/demand monitoring function provided by NEC's Energy Supply & Demand Management System is that it can be even used by power producers and utilized for creation of power generation plans. When linked with a solar power prediction system, it will facilitate effective command and control of reserve margins and spinning reserves even with an unstable power supply.

There are also benefits for customers. For instance, if manufacturers use these systems, they will be able to optimize intra-corporate group and

inter-plant balances between the external power supply and in-house power generation by using self-wheeling or becoming as customer PPS (Power Producer and Supplier) which has its own power load while managing overall energy use in accordance with product manufacturing plans and facility operation plans. When energy management of the overall supply chain is finally optimized, it can enhance the competitiveness of products released by companies using these systems.

4. Applications for Every Energy Business

Electric power supply/demand data is valuable not just for manufacturers, but potentially in just about any business. Not only does it help retailers suppress imbalances, it also addresses the expectations of both providers and customers, such as companies that wish to optimize their own energy consumption by self-wheeling, local governments aiming for local production and consumption, and providers of renewable energy. With this system, we will support revitalization of markets through creation of new businesses, such as business process outsourcing (BPO) services, negawatt transactions^{*5}, ancillary services^{*6}, and resource aggregators^{*7}.

To achieve these goals, it will be necessary to leverage not only the energy assets of each company, but also all of the various energy management systems, as well as to integrate the backbone systems of providers and customers.

NEC's Energy Supply & Demand Management System evolved as an energy management platform (**Fig. 3**) that links with these systems to make it possible to achieve advanced energy management.

5. Conclusion

NEC's Energy Supply & Demand Management System uses power supply/demand balance monitoring to optimize the balance between production and consumption of power. However, this is only one of the energy management functions this system is designed to achieve. NEC's energy management system encompasses three cycles: collection and visualization, analysis and prediction, and control and optimization (**Fig. 4**). Our goal

^{*5} The reduced portions of the required amounts that consumers have achieved by saving electricity and using in-house power generation are considered deemed power generation and are then bought and transacted on the market by providers.

^{*6} A new technical mechanism to maintain the quality of power supply, the ancillary service is now attracting attention as a new subject for market transactions thanks to its ability to monitor supply and demand balances, adjust voltages and frequencies, and provide reserve margins.

^{*7} Provides centralized control of energy equipment such as storage batteries distributed through the system, resource aggregation is a mechanism that allows both power generators and customer aggregators to take advantage of its benefits and ensures the aggregators receive equivalent value.

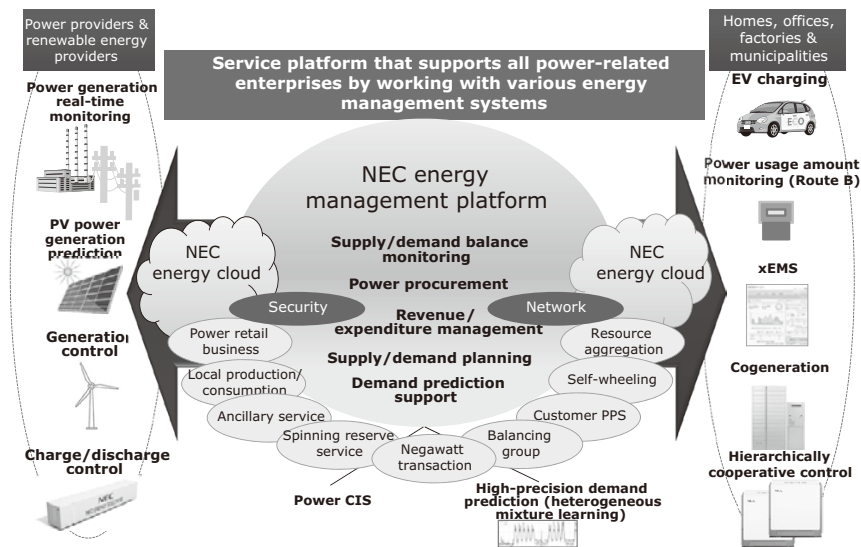


Fig. 3 The concept of NEC's energy management platform.

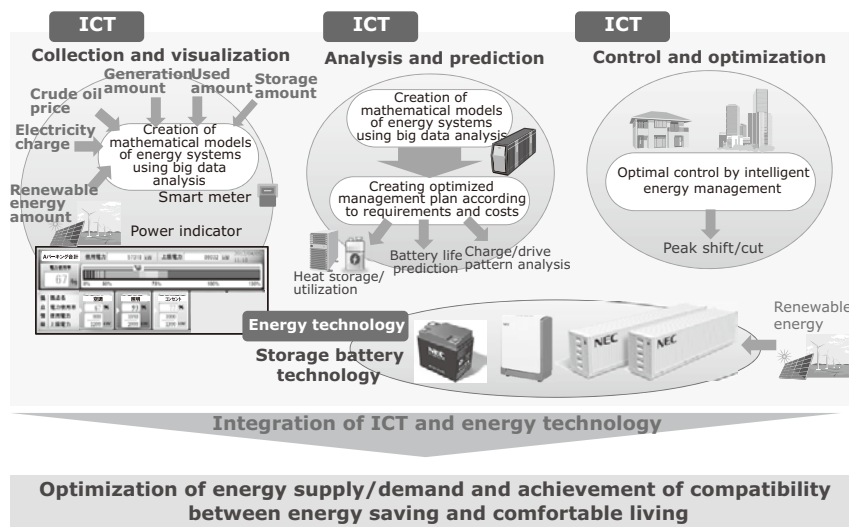


Fig. 4 NEC's energy management cycle.

is to contribute to the stabilization and optimization of the overall energy system, focusing on three main objectives: 1) automatic collection and visualization of diverse and uncertain real-world data in addition to the amount of power generated and the amount of power consumed; 2) create a plan for optimum energy management according to costs and requirements, while using big data analysis to predict the future; and 3) implementation of an intelligent energy control system based on NEC's power storage technology.

We are confident that we can also create the virtual energy grid that can be freely interchanged when we integrate our proprietary ICT base technologies for net-

works, security, and cloud platforms with our energy assets such as power storage technology. We are committed to contributing to the achievement of compatibility between waste-free energy consumption and comfortable living by building energy life cycles and supply chains according to seasons and situations.

Authors' Profiles

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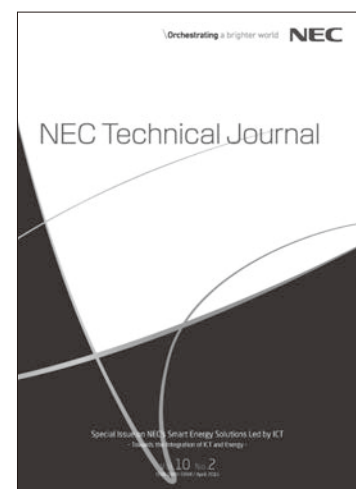
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