

Hitachi's Solutions for Environmentally Conscious Factory

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OVERVIEW: Calls to reduce emissions of greenhouse gases, particularly CO₂, to combat global warming have strengthened in recent years and companies are taking steps to cut their emissions. Hitachi has responded to these market conditions with solutions for improving environmental performance and reducing CO₂ emissions that it supplies globally.

INTRODUCTION

HITACHI operates its industrial business based around the following three key axes.

(1) Business axis

(a) Total solutions

Proposed solutions that draw on the overall strength of the Hitachi Group.

(b) Service

Proposed comprehensive solutions that include

maintenance, operation, and finance.

(c) Globalization

Proposed infrastructure solutions for emerging economies.

(2) Research axis

(a) The effective integration of utility plant functions, especially control

(b) Innovative product development

(c) Development of presentational tools

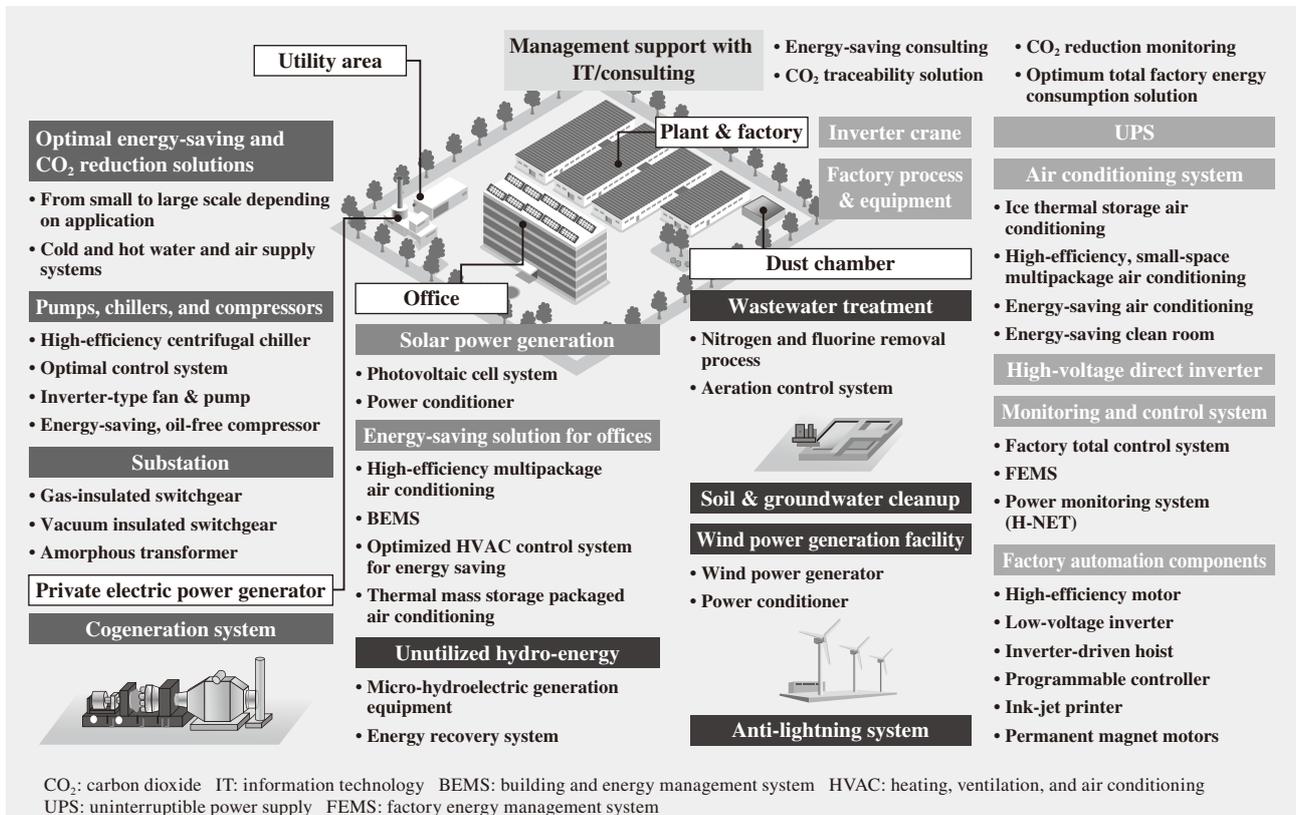


Fig. 1—Hitachi's Eco-Factory Solutions.

Wide-ranging solutions from consulting to products, systems, and services help reduce CO₂.

(3) Product axis

- (a) Strengthen price competitiveness.
- (b) Deliver products to market with high performance and advanced functions.
- (c) Short delivery times

In particular, Hitachi offers eco-factories for each type of manufacturing industry that bring together the combined strengths of the entire group (see Fig. 1).

Hitachi's concept of an eco-factory envisages a form of plant management that incorporates solutions for improved environmental performance and lower CO₂ (carbon dioxide) emissions that cover the entire factory, from utilities through to the production process, driven by Hitachi's know-how in the fields of information technology and monitoring and control such as its latest FEMS (factory energy management system). This is made possible by the fact that Hitachi manufactures process machinery for itself and because of the wide and comprehensive scope of its activities which extend from electricity distribution through to monitoring, control, maintenance, and management.

This article describes case studies of utility optimization solutions proposed for the automotive industry and petrochemical industry which are examples of Hitachi's work in the field of eco-factories, and an FEMS and the sensor network information system that makes energy use more visible which represent examples of product technology.

With reference to these successes, the article also

describes Hitachi's involvement in overseas CDM (clean development mechanism) projects which is an example of making an international contribution, and the development of a power supply solution involving the installation of a smart grid at an industrial park in India which is an example of Hitachi's consulting work.

SOLUTION FOR IMPROVED ENVIRONMENTAL PERFORMANCE AND LOWER CO₂ EMISSIONS IN AUTOMOTIVE INDUSTRY

The majority of the cooling and heat source equipment used at the Inabe Plant of Toyota Auto Body, Co., Ltd. were supplied by Hitachi, including the associated monitoring and control equipment. Now, Hitachi has received an order to upgrade the existing cooling and heat source systems to cope with an 11% increase in both the heating and cooling load and process steam requirements which are needed for a planned 10% increase in production at the company.

This section gives an overview of the energy-efficiency solution included in the investigation of the cooling and heat source equipment upgrade.

Issues at Inabe Plant of Toyota Auto Body, Co., Ltd.

The following five issues were identified in relation to optimizing the plant systems to cope with the

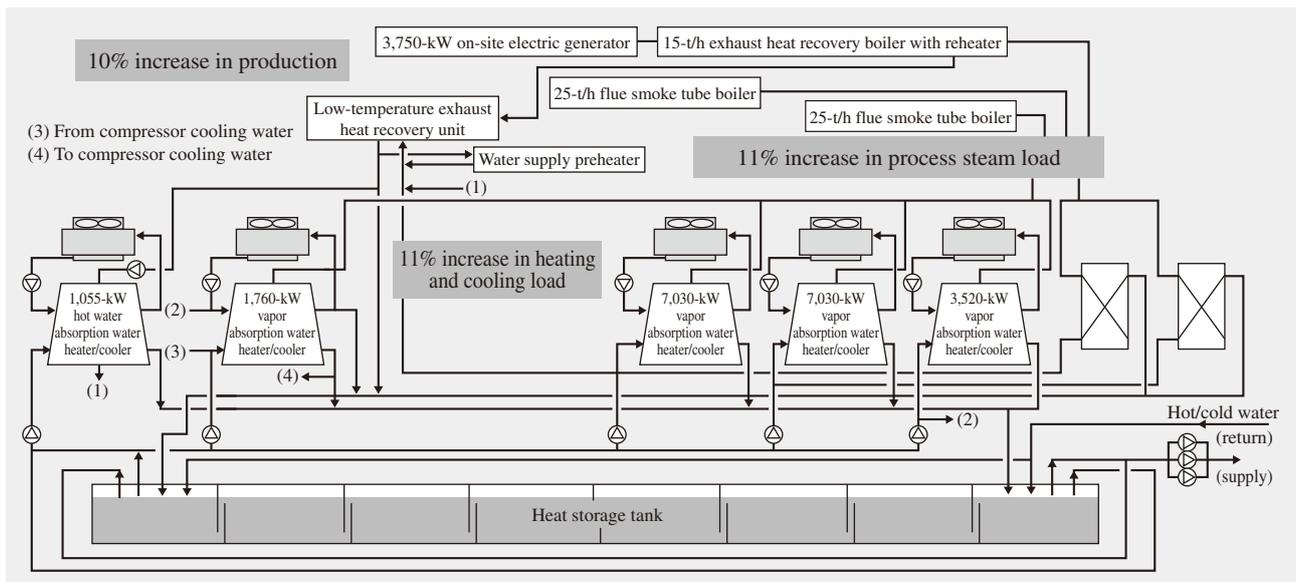


Fig. 2—Overview of Existing Cooling and Heat Source Flow and Load Increases for Cooling and Heat Sources and Process Steam.

A survey of the existing cooling and heat source flow indicated that a 10% increase in production would increase the heating and cooling load and process steam load by 11%.

planned increase in production.

(1) Energy equalization

- (a) Avoid increasing consumption of city gas.
- (b) Avoid increasing electricity demand.

(2) Improve energy efficiency.

- (a) Improve recovery of waste heat from compressors.
- (b) Improve efficiency of boiler operation.
- (c) Make effective use of heat storage tanks.

(3) Achieve energy-efficient operation.

- (a) Selection of optimum equipment and automatic operation control

(4) Reduce cost of investment.

(5) Reduce CO₂ emissions by 2,000 t per year (reduction in heat source equipment).

Proposed System Optimization

First a survey was carried out to determine the current energy usage and operating conditions. This included: (1) use of electricity, steam, cold water, hot water, and other resources; (2) the operating conditions for water heater/coolers, compressors, on-site electric generators, boilers, and other equipment; and (3) the design and specifications of the water heater/coolers, compressors, on-site electric generators, boilers, and other equipment (see Fig. 2).

Following on this survey, simulations were conducted based on the current equipment specifications

and the 11% increase in both the heating and cooling load and process steam requirements associated with the planned increase in production. From this simulation, the following proposals were devised with the aim of resolving the identified issues.

(1) Installation of a highly efficient centrifugal heat pump (to improve system efficiency)

One way of improving system efficiency is to operate the existing water heater/cooler which uses the vapor absorption method in a cascade configuration. This improves the efficiency of the centrifugal heat pump because it allows it to operate with a higher output temperature when producing cold water. For heating, it can also operate as a heat pump and produce hot water.

(2) Installation of small flow-through boiler (to improve efficiency of boiler operation)

This minimizes operation of the existing flue smoke tube boiler at low load where its efficiency is poor.

(3) Installation of ECS (energy control system) for demand forecasting and operation planning

This involves introducing operating practices that minimize CO₂ by performing overall control of the utilities equipment to improve the energy efficiency of the entire system operation.

(4) Reduction in CO₂ emissions

Proposals (1) and (2) would save approximately 1,500-t CO₂/year and proposal (3) would save

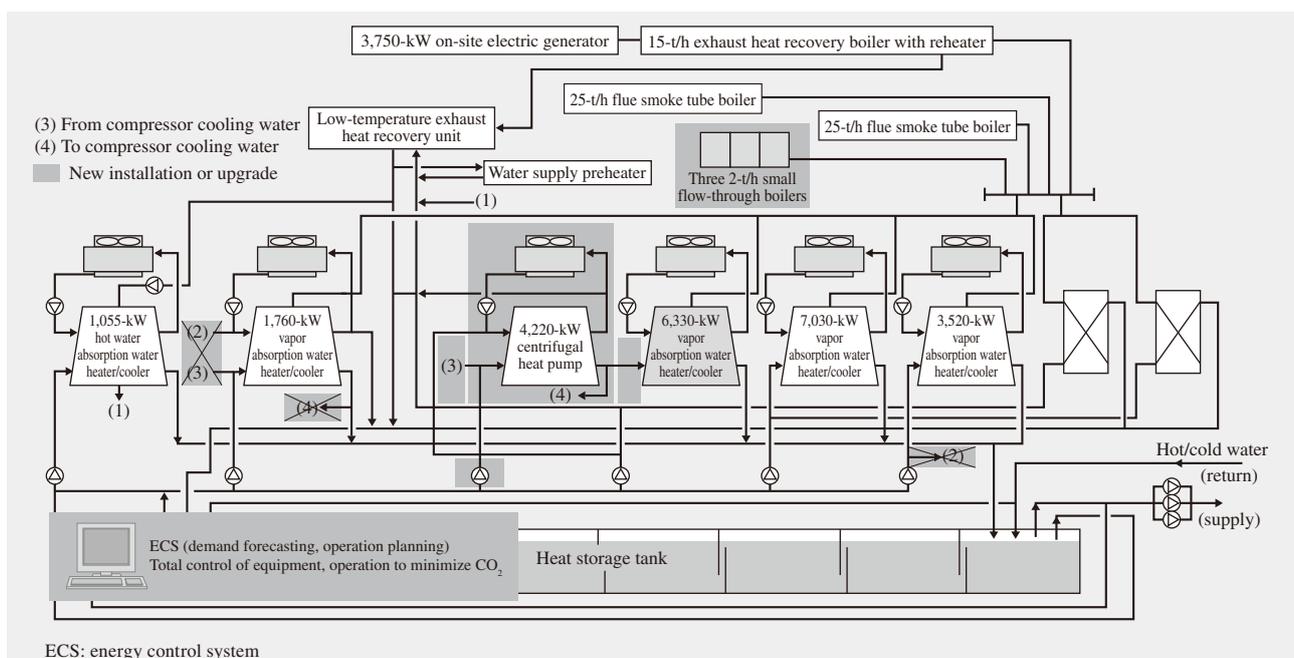


Fig. 3—Overview of Cooling and Heat Source Flow after Installation of Energy-efficiency Equipment.

The system flow after installing a new centrifugal heat pump, upgrading the existing vapor absorption water heater/cooler, and introducing an ECS is shown.

approximately 700-t CO₂/year, giving a total saving of approximately 2,200-t CO₂/year.

Details of Energy Saving Proposals

Although an increase in energy consumption may be unavoidable when increasing production, it became necessary to minimize energy consumption through the installation of a centrifugal heat pump and small flow-through boiler and by upgrading the existing cooling and heat source equipment.

The new ECS uses past energy demand data and other information such as the air temperature and humidity to forecast the process steam and heating and cooling load based on each day's production. Based on this forecast load, the mix of cooling and heat source equipment that will result in the lowest CO₂ emissions is selected to produce an optimum plan for energy-efficient operation. Once operation starts, the system compares the forecast with actual data at periodic intervals and, if any variation is found, revises the equipment selection to minimize CO₂ emissions and maintain optimum energy-efficient operation.

Trials of the above installation of new equipment, upgrades of existing equipment, and introduction of an ECS in an actual plant showed that the demand forecasting errors which indicate the difference between the uncorrected model-based estimate and actual output value were 9.0% for cooling and 10.6% for heating. This is sufficiently accurate for practical applications (see Fig. 3).

Also, the objectives of energy equalization, energy-efficiency improvement, and energy-efficient

operation identified as issues were achieved with a 2,095-t CO₂/year reduction in CO₂ emissions by heat source equipment, adequately meeting the target set for the Inabe Plant of Toyota Auto Body, Co., Ltd. (see Fig. 4).

SOLUTION FOR IMPROVED ENVIRONMENTAL PERFORMANCE AND LOWER CO₂ EMISSIONS IN PETROCHEMICAL INDUSTRY

Traditionally, the petrochemical industry has used large boilers and steam turbine systems to supply utility services. However, shifts in the balance between electric power and heat (steam) due to factors such as changes to their product mix and plant consolidation, together with the rapid increase in the price of fuel in recent years, have created a demand to review how utilities are supplied.

Electrification Activities

Hitachi has focused its attention on the use of pumps, compressors, and other equipment driven by steam turbines in the petroleum product and chemical industries.

Hitachi has used changes such as improvements to the efficiency of existing compressors, upgrades to steam turbines, and shifts in the electricity/heat balance as an opportunity to propose a switch from steam turbine drive to electric motor drive.

Based on past installations, converting a compressor driven by a steam turbine with a capacity in the 2,000-kW class to electric drive can be expected to

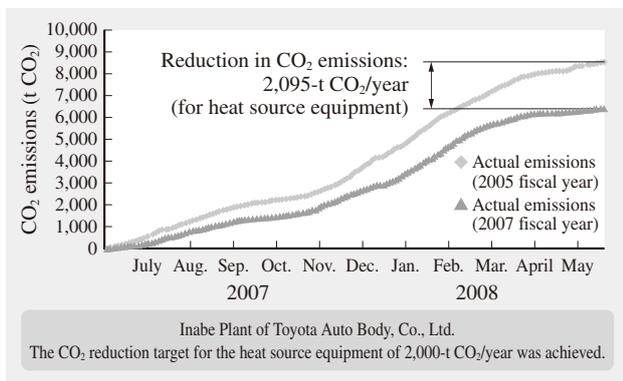


Fig. 4—Comparison of CO₂ Emissions before and after Introducing ECS. A comparison of actual CO₂ emissions in the 2005 fiscal year before introducing an ECS and in the 2007 fiscal year after introducing an ECS showed a more than 2,000-t CO₂/year reduction in CO₂ emissions from the heat source equipment that was the issue of concern.

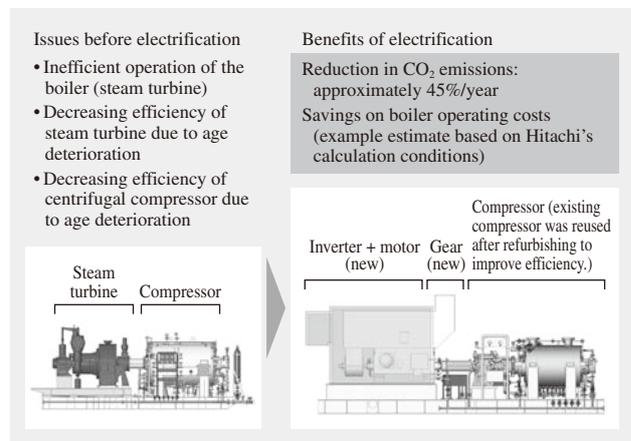


Fig. 5—Electrification of Compressor Driven by Steam Turbine. Converting a compressor driven by a steam turbine in the 2,000-kW class to electric drive can be expected to provide CO₂ emissions savings of 45%/year.

reduce CO₂ emissions by about 45%/year determined by calculating the amount of CO₂ that corresponds to the difference between the reduction in fuel use by the boiler that produces the steam for the steam turbine and the additional electricity purchased from the power company (see Fig. 5).

Proposed Changes to New Heat and Electricity System

When it is necessary to convert a boiler to low load, it is also possible to reduce the electricity consumption of the ancillary boiler equipment by converting the fans and pumps used by the boiler to inverter drive at the same time. If a 300-t/h class boiler has an operating load ratio of 60%, the benefits of converting the IDF (induced draft fan) to inverter drive can be expected to reduce CO₂ emissions by about 60%.

Also, so that the plant can reduce to some extent the additional power consumption resulting from conversion from steam turbine to electric drive, the conversion of existing electric motors to inverter operation is also considered as a way to reduce power consumption.

Hitachi is also investigating measures for dealing with the case when a reduction in fuel use by the boiler results in surplus by-product fuel. Examples of such measures are upgrading the steam turbine to increase the proportion of fuel used to generate electricity and installing a gas turbine to revise the relative proportions of heat and electric power. These propose changes to the system to match the new heat/electricity balance.

FEMS

The equipment used in factories includes production machinery which is used in large numbers and for a wide range of applications. How to make this equipment “visible” and translate energy efficiency into real terms are very difficult problems. However, it is important to undertake energy management by analyzing factors such as the size and operating times of machinery, establishing targets such as for energy use when equipment is idle and usage per unit of output, and following the PDCA (plan, do, check, act) cycle for improving production practices.

Energy management by making performance “visible” can be expected to become a system that has progressed to the level of company-based activities under the revised Act on the Rational Use of Energy by linking together the different scopes of management, from the equipment to the overall factory level and from the factory to the company-wide level (see Fig. 6).

Points to Note for Energy Efficiency

Improvements are being made in the efficiency of utilities such as the lighting, air conditioning, and other ancillary equipment used in buildings as part of the adoption of energy efficiency. Although progress in this field is slowing and there is a feeling that there is little left to be done, genuine benefits are possible and therefore it is important to continue to pursue this approach. The measures that need to be undertaken for energy efficiency include establishing management standards based on judgment criteria and performing

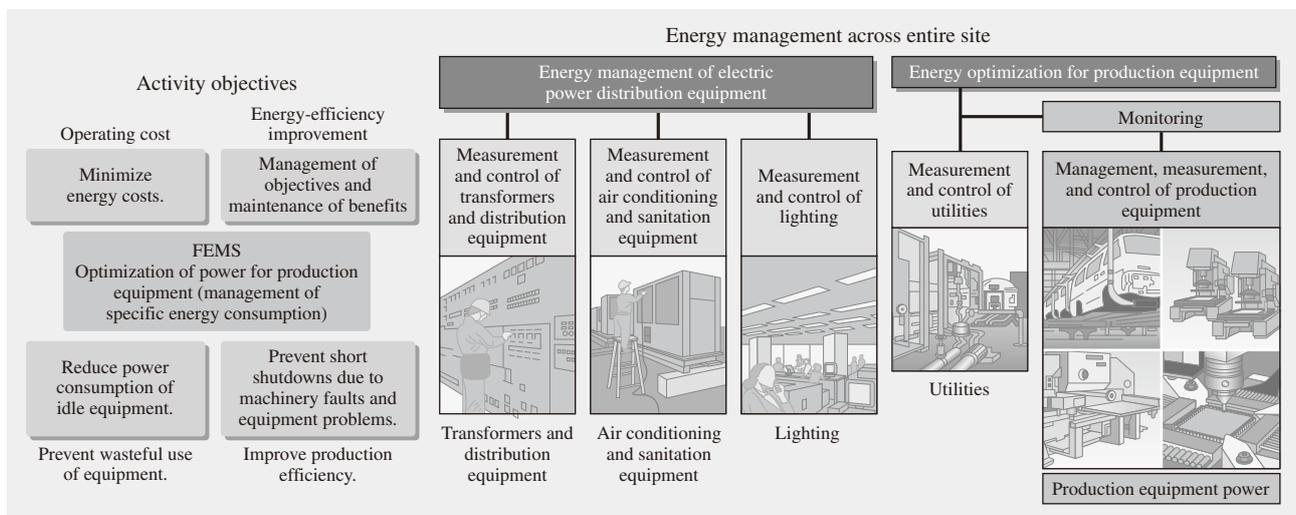


Fig. 6—Factory Energy Management System.

Hitachi constructs energy management systems through ongoing activities that seek to optimize energy use by individual items of equipment by making energy use throughout the site more visible.

LCAs (life cycle assessments).

An important factor to consider when improving energy efficiency is the ability to assess energy usage. Energy-efficiency improvements often avoid making changes to the motive power used in production equipment, but because the proportion of power accounted for by production equipment is high at 60 to 70%, making energy use visible and complementing this with energy management are important issues.

Need for Energy Management

Improvements to energy efficiency need to be undertaken in a way that involves all staff in making a wide range of efforts to reduce consumption in buildings, equipment, and other locations. Also, actions need to be ongoing rather than just providing temporary results. To achieve this, management and the deployment of an energy management system directed at performing optimization with clearly defined activity objectives are important. This requires working with targets such as energy costs and the promotion of sustainability as well as clarifying the establishment of targets such as for energy use by idle equipment and usage per unit of output.

MAKING ENERGY VISIBLE

Use of Sensor Network Information System to Make Energy More Visible

The connection of instruments as well as various sensors and other devices is needed to make energy,

temperature, and other information visible, and two ways of doing this are wired and wireless connections. The sensor network information system developed by Hitachi uses wireless communications to collect data, reduces costs such as cabling work by using wireless connections between the sensors and base stations, and provides a trouble-free way of achieving better “visibility” at a plant. Because the system uses wireless communications, adding, removing, relocating, and making other changes to sensors are easy (see Fig. 7).

Sensor Network Information System Functions

Sensor network information system consists of wireless base stations that control the wireless network, sensor nodes that transmit sensor measurements wirelessly, and wireless repeaters that provide multi-hop wireless communications between the wireless base stations and sensor nodes. A major feature of the system is that the wireless network can be extended simply by adding wireless repeaters.

(1) Sensor nodes

The two types of sensor node are nodes with built-in sensors (temperature and humidity, illumination intensity, etc.) and nodes that connect to commercially available sensors. General-purpose interfaces for connecting commercially available sensors include pulse input, 4-20 mA, and RS-485 (Recommended Standard 485), and these interfaces can be used to connect power meters, calorimeters, CO₂ sensors, and other instruments. Better plant “visibility” can be achieved efficiently by using sensor nodes in different ways such as installing large numbers of temperature and humidity sensors to provide detailed measurements of the temperature and humidity on a floor or using sensor nodes with general-purpose interfaces to collect sensor data from operating production lines.

(2) Integrated management software for sensor-net

The sensor network management software for sensor-nets manages the wireless network, data measured by sensor nodes, and similar. The main functions are as follows.

- (a) Wireless network management
- (b) Data measurement, management of measurement data, graph display, browser display, and daily report output
- (c) Fault detection and automatic recovery of missing data caused by problems such as wireless communication faults
- (d) API (application program interface) for interfacing with higher level applications

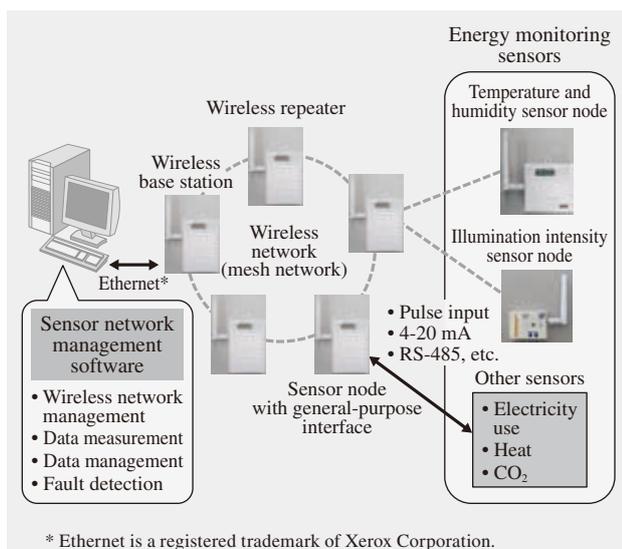


Fig. 7—Explanation of Sensor Network Information System Functions.

System for making energy more “visible” using wireless communications is shown.

(3) Interoperation with FEMS

In large energy management systems for factories or other facilities, the sensor network information system can operate as part of an overall system. In this case, it is possible to connect the wireless devices directly to the control equipment in the energy management system on their own without using sensor network management software. Because the wireless base stations store the measurement data sent from sensor nodes, all the higher level control equipment needs to do is read this measurement data. The three interfaces available for communications between the wireless base stations and higher level control equipment are Ethernet, RS-232C (Recommended Standard 232C), and RS-485.

HITACHI'S TOTAL SOLUTION FOR IMPROVED ENVIRONMENTAL PERFORMANCE AND LOWER CO₂ EMISSIONS

Hitachi's solutions for improving environmental performance and reducing CO₂ emissions for users in the manufacturing industry provide systems that deliver value over the long term in the form of total solutions that draw on the strengths of the overall Hitachi Group who participate from establishing the concept with the customer and from pre-engineering through to production (see Fig. 8).

By participating from the earliest planning stages such as the confirmation of operational data, Hitachi can support the study of optimum systems. Hitachi offers a broad range of services which include its

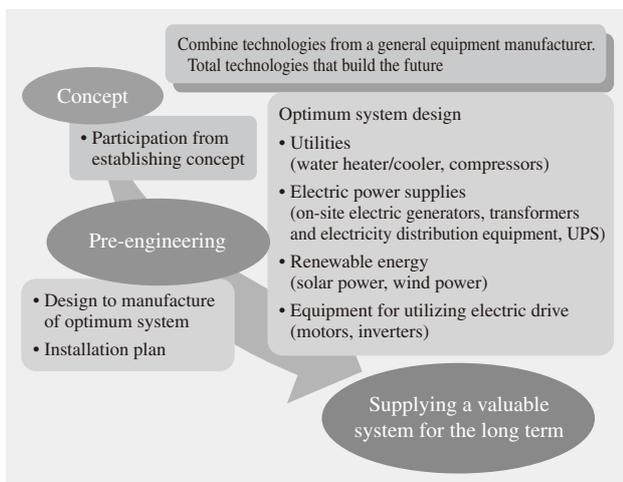


Fig. 8—Hitachi's Solutions for Improved Environmental Performance and Lower CO₂ Emissions. Hitachi supports value creation over the long term from establishing concepts through to maintenance.

ESCO (Energy Service Company) business that provides planning services that also cover financing and its O&M (operation and maintenance) business that provides planning services for operation and maintenance.

Hitachi's CDM Activities

The 15th Conference of the Parties (COP 15) to the United Nations Framework Convention on Climate Change was held in Copenhagen in December 2009 where delegates from different countries debated topics including targets for reducing emissions of greenhouse gases and the form that the next framework convention should take.

Against this background, Hitachi is working to achieve a sustainable society not only by developing technology and encouraging its wider adoption but also by making a contribution to the global environment through the utilization of emission credits.

This section describes some of these activities.

Case Study of Overseas CDM Activities

The CDM is a means for developed economies to acquire emission rights by utilizing their technological, financial, and other resources to run projects for reducing greenhouse gas emissions in emerging economies and to use these rights to meet their own targets for reducing greenhouse gas emissions (see Fig. 9).

With its numerous technologies for helping prevent global warming, Hitachi is in a position to undertake CDM projects.

Hitachi has already proceeded with many such projects, particularly those that earn a large number of emission credits from a single site such as hydro and wind power plants or plants for recovering methane gas

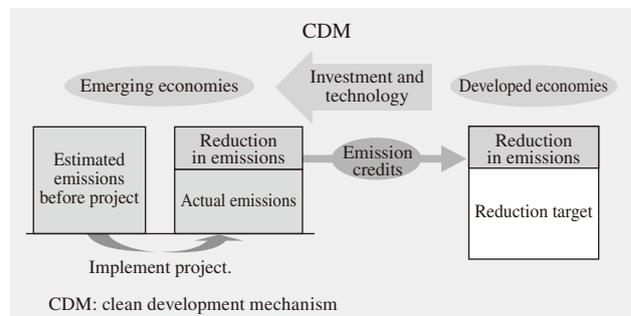


Fig. 9—CDM Concept. A mechanism established under the Kyoto Protocol that allows emissions of greenhouse gases in developed economies to be offset by reductions achieved by greenhouse gas emission reduction projects in emerging economies.

and using it to generate electricity which is effective because methane has a high global warming potential (21 times that of CO₂).

Little progress has been made, however, on CDM projects that utilize energy-saving technologies such as inverters or highly efficient transformers because the emissions reductions per site are small.

In response, Hitachi is promoting initiatives that combine a number of sites to create a project that is viable under the CDM despite being based on the use of energy-saving products with only small per-site emission reductions. The following sections describe case studies of the utilization of amorphous transformers and high-voltage inverters which are being implemented as CDM projects.

CDM Projects in Electricity Distribution Using Amorphous Transformers

The Super Amorphous brand of amorphous transformers produced by Hitachi Industrial Equipment Systems Co., Ltd. have excellent energy efficiency and use an amorphous alloy core to reduce standby power (losses under no-load conditions) to between one-third and one-fifth that of conventional transformers with cores made of silicon steel sheet (based on a comparison of Hitachi single-phase, 30-kVA, 50-Hz transformers).

However, because the emissions reductions achieved by single amorphous transformers are too small to justify the costs associated with the CDM, they were not considered to be basis of a potential CDM business.

In response, Hitachi has investigated ways of combining a large number of transformers so that they could be collectively treated as a CDM project.

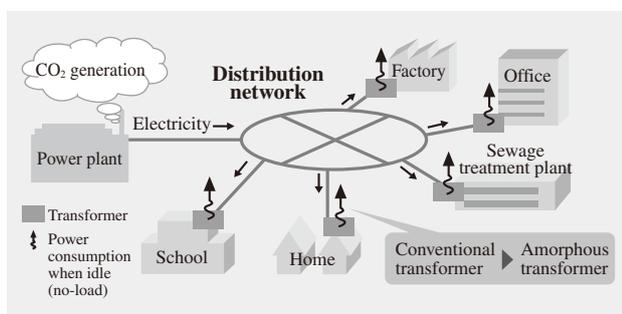


Fig. 10—Electric Power Savings in the Distribution Network Achieved by Switching to Amorphous Transformers. A methodology was developed that sums the emission reductions from a large number of transformers in the distribution network using a monitoring method that manages the quantity and timing of transformer installation.

Determining the quantity of emissions requires an accurate calculation of the reduction in CO₂ emissions and, if the scope of the project includes the times when the transformers are operating under load, this requires realtime monitoring to determine the operating status of the transformers.

Accordingly, a methodology was devised that only considers the standby power and calculates the size of the reduction based on the number of transformers and their time in use (a “methodology” stipulates the technologies used to reduce greenhouse gases and how to calculate the reductions that these technologies achieve). The methodology was approved by the United Nations in March 2008 making it the first approved methodology in the field of electricity distribution (see Fig. 10).

CDM Project Using High-voltage Inverters to Improve Energy Efficiency

High-voltage inverters are found mainly in manufacturing where they are used to save energy by controlling the operation of fans, pumps, and other hydraulic or pneumatic machinery. The installation of high-voltage inverters (500 to 2,000 kVA) can reduce CO₂ emissions. Fig. 11 shows an overview of “Program CDM” which uses high-voltage inverters.

A feature of this model is that it makes use of the new “Program CDM” system introduced in 2007. “Program CDM” allows a number of greenhouse gas reduction activities to be amalgamated so that the emission reductions achieved by high-voltage inverters in different companies and districts that were installed after the program started can be combined into a single project. This makes the program suitable for energy-saving equipment with small per-site

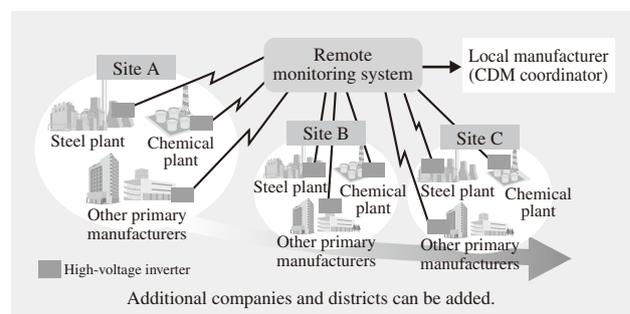


Fig. 11—Overview of Program CDM Utilizing High-voltage Inverters. A monitoring function is used to collect data on the emission reductions from a number of inverters. The intention is to apply to the United Nations to be allowed to sum the emission reductions from a number of sites by utilizing Program CDM.

emission reductions and it is expected to become the predominant CDM model for such equipment in the future.

For this model, Hitachi is also investigating the application of a monitoring system, which has already been used successfully in Japan, to perform monitoring of emissions at multiple sites at low cost.

The design document (which defines the business plan, how emission savings are calculated, and other aspects based on the project's methodology for reducing greenhouse gas emissions) for the project is now complete and a study aimed at undertaking a project is underway with Dongfang Hitachi (Chengdu) Electric Control Equipments Co., Ltd. (a joint venture between Dongfang Electric Corporation and Hitachi) which manufactures and sells inverters in China.

CASE STUDY OF POWER SUPPLY SOLUTION INCORPORATING SMART GRID FOR JAPANESE INDUSTRIAL PARK IN INDIA

The DMIC (Delhi-Mumbai Industrial Corridor) scheme promoted by the Japanese government is an industrial infrastructure development project for India that involves linking industrial parks, ports, and other sites in the six states between Delhi and Mumbai (Uttar Pradesh, Haryana, Rajasthan, Gujarat, Madhya Pradesh, and Maharashtra) by dedicated freight rail and road links to turn it into a single large industrial

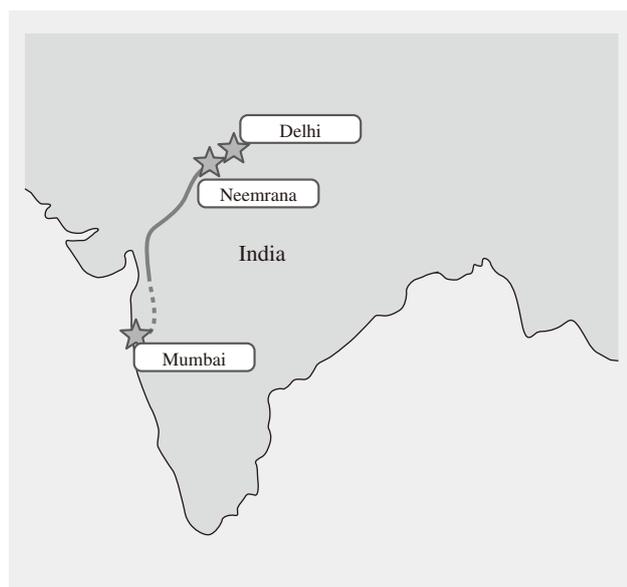


Fig. 12—Map of India Showing National Highway 8. The 1,500-km long NH8 national highway from Delhi to Mumbai has attracted the most attention as the main axis of the DMIC (Delhi-Mumbai Industrial Corridor).

region (see Fig. 12).

Hitachi is working with the Hitachi India Business Support Centre (IBSC) on a system for ensuring a reliable supply of power to the Neemrana Industrial Park in the DMIC by applying the concepts of micro grid and smart grid technology and has established a shared energy center with the aim of building up the site's industrial infrastructure.

This section describes the development of a power solution based on the installation of micro grid and smart grid systems at Neemrana Industrial Park.

Power Supply Issues at Neemrana Industrial Park and Concept behind Shared Energy Center

Industrial parks in India suffer chronic electricity shortages caused by the poor reliability of the commercial electricity supply. This has led companies to install DEGs (diesel engine generators) to provide their own power and avoid having to rely on the commercial electricity grid. However, in Japan these DEGs would only be used as an emergency backup and they suffer from their own problems which include (1) the high cost of power generation and (2) the difficulty of interconnection with other power supply networks. It was this situation that led to the idea of establishing a shared energy center that could link together DEGs from different companies to provide a cheap and reliable electricity supply.

Formulation of Basic Plan for Shared Energy Center Using Gas Turbine Generators

To implement this idea, Hitachi started work in 2008 on formulating a basic plan for establishing a shared energy center that could use a gas turbine generator to provide a cheap and reliable electricity supply to the companies at the Neemrana Industrial Park. The plan was approved as an Early Bird Project by the Japanese and Indian governments in October 2008 which meant it could proceed with cooperation from Japanese government agencies including the Japanese Embassy in India and the Ministry of Economy, Trade and Industry as well as from the Indian and Rajasthan governments. Next, a business establishment study committee for the shared energy center was set up in February 2009 led by the companies with operations in the industrial park and with Hitachi in the role of technical advisor.

Unfortunately, the impact of the global economic recession that hit from late 2008 led to a decision to allow more time for establishing the energy center.

Instead, it was decided to commence preparations for establishing the energy center in a phased manner. Phase 1 would involve supplying power by linking together differently rated DEGs with excess capacity that were installed by companies in anticipation of rapid growth. Phase 2 would consist of installing a gas turbine to provide a reliable power supply.

NEDO Investigation of Reliable Power Supply System

The energy center plan also included an investigation into the use of a micro grid. Because linking together DEGs from different companies in Phase 1 meant that each company could be both a supplier and consumer of electricity, the following five issues needed to be resolved.

- (1) How to control the DEGs to minimize the overall cost and environmental impact while still providing the companies with highly reliable electric power
- (2) How to coordinate the control of DEGs with different capacities
- (3) How to control both demand and supply in the event of a fault in the grid
- (4) What functions will be required in the equipment for monitoring and controlling demand and supply
- (5) What protection mechanisms will be needed at the point of connection to the grid. (See Fig. 13.)

In addition to the use of a micro grid, the plan for resolving these issues involved utilizing smart grid technology capable of coordinated control of both

power supply and load. To carry out the associated study, an application was made to the New Energy and Industrial Technology Development Organization (NEDO) for funding as a cooperative research project which was approved in June 2009 (with the project to run from fiscal year 2009 to fiscal year 2010). The Indian Institute of Technology Hyderabad was also selected as a joint research partner for this work. Hitachi is also intending to use the research project as an opportunity to help further improve the level of education in India. The NEDO project for the 2009 fiscal year involved conducting simulation testing for issue (3) and work on specifying the equipment for the hardware-related issues (4) and (5).

Investigation into Coordinated Control of DEGs at Industrial Park

The monitoring and control system for the grid at the Neemrana Industrial Park has an important role in ensuring efficient operation, reliability, and the coordinated control of distributed power sources. The plan also considers the case when the system operates with the local grid connected to the commercial grid and provides the means to control the power flows through the line connecting the two systems in such a way that they do not interfere with each other. To achieve this, an investigation was conducted into the monitoring and control system intended to resolve issues (1) to (3) described in the previous section (see Fig. 14).

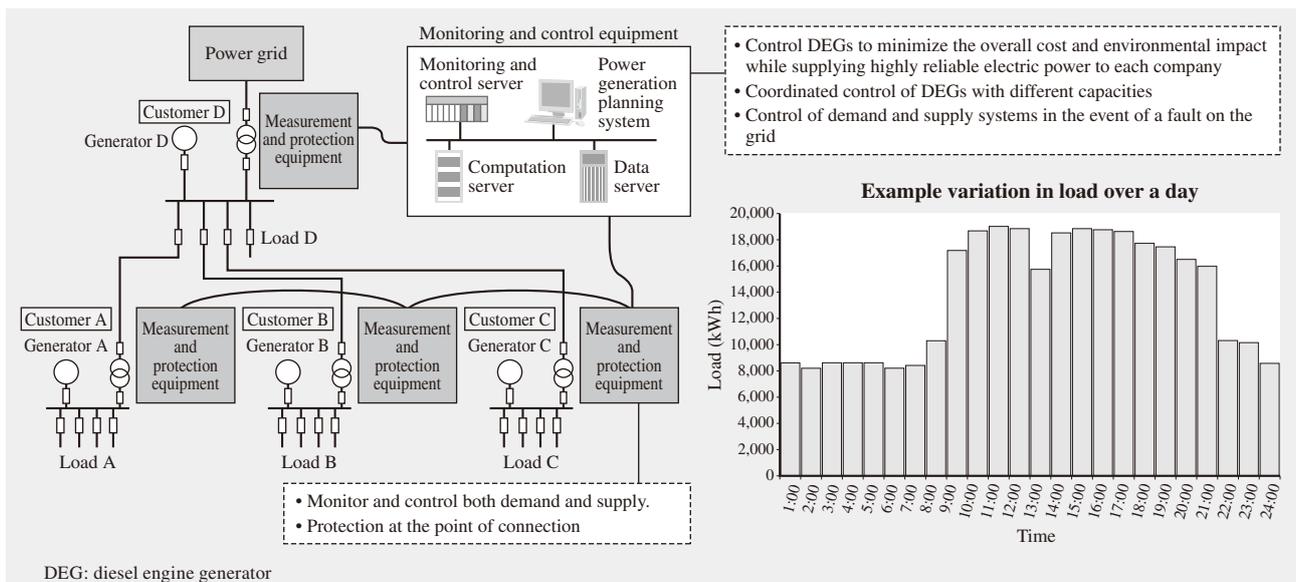


Fig. 13—Configuration of Smart Grid Monitoring and Control Equipment. The monitoring and control equipment that manages the entire grid are linked by communication lines via the generation equipment and substations to collect the required grid data and transfer control signals.

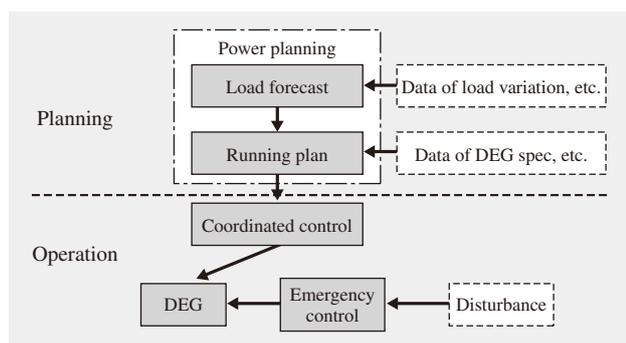


Fig. 14—Overview of Control Functions.

The system performs load forecasting and coordinated control of the DEGs based on the operation plan. The system also performs emergency control if a disturbance is detected on the grid.

Investigation of Measurement and Protection Equipment

This section describes the results of the investigation carried out into the hardware-related issues (4) and (5). To interlink different companies that can act as both suppliers and consumers of power, the measurement and protection systems need to function as data collection terminals capable of transmitting power flow, equipment status, and other information in either direction. The equipment also requires protection functions that can operate circuit breakers immediately in the event of a fault to minimize the flow-on effects.

Development of Future Power Supply Solution

In the 2009 fiscal year, a simulation-based study into the potential problems that could occur when the DEGs from the different companies were linked together was conducted to determine the specifications required for the measurement and protection equipment. The research will continue in the 2010 fiscal year to finish development of the control technology for interlinking the power supplies using a smart grid.

An aim for the future is to help establish through this research a platform for Indian micro grids and smart grids including, for example, the connection of renewable energy sources such as solar power to the grid. It is also believed that establishing this technology will create opportunities for similar power supply solution technology to be deployed at other industrial parks in the DMIC.

CONCLUSIONS

This article has described some of what Hitachi is doing in the field of eco-factory solutions.

As the problem of global warming becomes progressively more severe, manufacturers and other companies have an obligation to set limits on their total emissions of greenhouse gases and emissions per unit of production as well as to adopt energy efficiency and reduce CO₂ emissions.

Meanwhile, the standardization of energy management systems by the ISO (International Organization for Standardization) international standards body and others is being debated as a global movement.

In this environment, it becomes important to offer solutions that maximize CO₂ reduction benefits based on an accurate appreciation of the changes in production volumes in the industrial sector, fluctuations in the price of fuel, and other changes to the circumstances in which companies operate. Hitachi intends to continue operating its businesses based around the three axes of business, research, and products, and contributing to society by offering solutions for improving environmental performance and reducing CO₂ emissions.

REFERENCES

- (1) "Energy Conservation Control System," Hitachi Technology 2008-2009, p. 28 (July 2008).
- (2) Y. Imamura et al., "Captive Power Plant at Neemrana Industrial Park," Hitachi Review 58, pp. 292-294 (Dec. 2009).
- (3) New Energy and Industrial Technology Development Organization, <http://www.nedo.go.jp>
- (4) H. Matsumoto et al., "Inverter Drive Solutions Enhancing Plant Facilities' Energy Efficiency," Hitachi Review 57, pp. 192-197 (Sep. 2008).
- (5) National Institute for Environmental Studies, "Greenhouse Gas Inventory," <http://www-gio.nies.go.jp/aboutghg/nir/nir-e.html>
- (6) The Japan Electrical Manufacturers' Association, "FEMS Installation Guidebook," (Oct. 2009) in Japanese.

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