

Green Socio-Automation to Realize a Comfortable Society

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ABSTRACT

Aiming to realize a “green society”, which can be defined as “a society that leads a comfortable lifestyle in harmony with the environment”, Fuji Electric uses sensors, wireless networks, wide area distributed systems and the like as core technology to provide environmental and energy-savings solutions as well as safety and security solutions. For the environment and energy-savings, Fuji Electric’s solutions enable the amounts of energy usage and waste to be visualized, and provide energy-saving solutions such as merchandise of “GreenUSE”. For safety and security, Fuji Electric’s solutions provide food safety proposals such as cultivation history management for agricultural products, production history management for food products, location management for emergency medical treatment, and so on, aiming to realize a green society.

1. Introduction

Governments are advancing “environmental and energy-savings” initiatives that aim to introduce new types of energy and prevent global warming, and to provide their citizens with a “safe and secure” lifestyle, and are actively advancing economic measures that will lead to the creation of new industries. The infrastructure for broadband communications, cell phones, wireless communications and terrestrial digital broadcasts has been established, and all industries are able to utilize this communication infrastructure⁽¹⁾. New business models to overcome the challenges involved in realizing “environmental conservation and energy savings” and “safety and security” with this communications infrastructure are being investigated. As a result of the “Kyoto Protocol” enacted in December 1997, global warming prevention measures with an awareness of the “global environment” have been watched closely⁽²⁾. In Japan, where approximately 90% of greenhouse gas emissions (a total of 1,370 million tons in 2007) is energy-derived CO₂ emissions, laws to limit the generation of energy have been enacted and the revised “Law Concerning the Rational Use of Energy” (i.e., the Revised Energy Law)⁽³⁾ will be enforced as of April 2010. As a governmental policy, the year 2020 goal of reducing CO₂ emissions by 15% based on 2005 levels is expected to have a significant effect on energy-saving measures and the introduction of new energy.

Defining green society (“green socio”) as “a society that provides a comfortable lifestyle in harmony with environment,” Fuji Electric aims to contribute to the construction of a comfortable and affluent society.

2. Fuji Electric’s Efforts

Previously, Fuji Electric has provided products, such as eco-friendly automated vending machines and energy-saving open showcases, for improving the comfort of daily life as well as other products, such as ETC-use vehicle sensors, for ensuring that the traffic flow at a highway entrance is safe, smooth and with minimal congestion. Now, Fuji is working to develop green socio-automation technology to provide solutions that are in harmony with the environment, comfortable and closely related to everyday life.

2.1 “Green socio” concept

The desired state of the societal and environmental sectors in 2020, as cited in the Third Phase of the Basic Program for Science and Technology⁽⁴⁾, matches Fuji Electric’s aim for a “green socio” policy.

- (a) To establish a route for overcoming global warming and energy problems
- (b) To realize a recycling-oriented society that is in harmony with its environment
- (c) To realize a ubiquitous network-connected society that will fascinate the rest of the world
- (d) To ensure the safety of the nation and society
- (e) To ensure the safety of daily life

To provide the market with solutions for realizing the “green socio” concept shown in Fig. 1, sensing, traceability, security, optimization technology and other previously acquired technology must be combined with technical know-how. “Green socio” aims to provide solutions that seamlessly combine technologies for “measuring objects with sensors,” “reducing work and labor,” “transmitting, distributing and preserving energy, objects and data,” “maintaining and managing equipment and systems,” and the like to solve environmental, energy-savings, safety and security-related

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problems as required by society. The target area is society at large, i.e., the fisheries industry, agroforestry industry, commerce, food industry, construction industry, transportation industry, distribution industry, warehousing industry, service industry, and public works.

2.2 Green socio-products

Fuji Electric has proposed many solutions for realizing a living environment that is human-friendly, comfortable and safe. To realize a comfortable and safe living environment, it is necessary to assess changes in the environment, people or objects with an intelligent system incorporating a network of sensors or ubiquitous computing, and to configure a structure that can be controlled with total optimization so as to always be in a favorable state. Fuji Electric is focused on technical development that will generate innovation for this purpose. Specifically, the relevant technologies and solutions involved in Fuji's work have the following three characteristics.

- Miniaturization and energy-savings achieved through application of MEMS (Micro Electrical Mechanical Systems) to measurement devices, radiation sensors, gas analysis sensors and the like
- Provision of intelligence to field equipment by providing wireless network functionality⁽⁶⁾ to sensors, and field visualization enabled by seamlessly linking the field equipment to the system
- Measurement by sensors, data collection via a wireless network, and construction of an efficient business system through application of a wide area distributed system platform

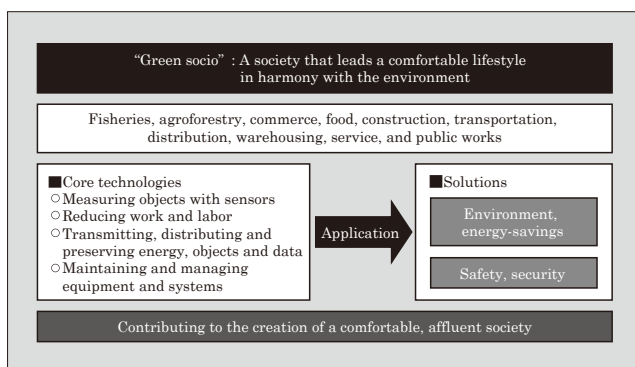
Figure 2 shows green socio-solution products that utilize these related technologies.

2.3 Supporting technology for green socio-products

In support of green socio-products, development efforts are focused on sensor technology, wireless network technology and a platform for wide area distributed systems, and an overview of each of these technologies is presented below.

(1) Sensor technology

Fig.1 The "green socio" concept



Typical sensors include pressure sensors for transmitters, thin-film gas sensors for gas alarms, vibration sensors, analysis chips for environmental chemicals, RI sensors for personal dosimeters, flow sensors for detecting the airflow in a clean room and for infrared gas analyzers, etc. These sensor elements incorporate MEMS technology to achieve small size, light weight and low power consumption. A circuit board attached to the sensor element is composed so as to reduce the size and weight of the entire sensor assembly using high density mounting technology. The sensors are equipped with wireless network functionality powered by coin cells to realize wire savings, and to support the frequent rearrangement of devices on the line, status monitoring of mobile devices, etc.

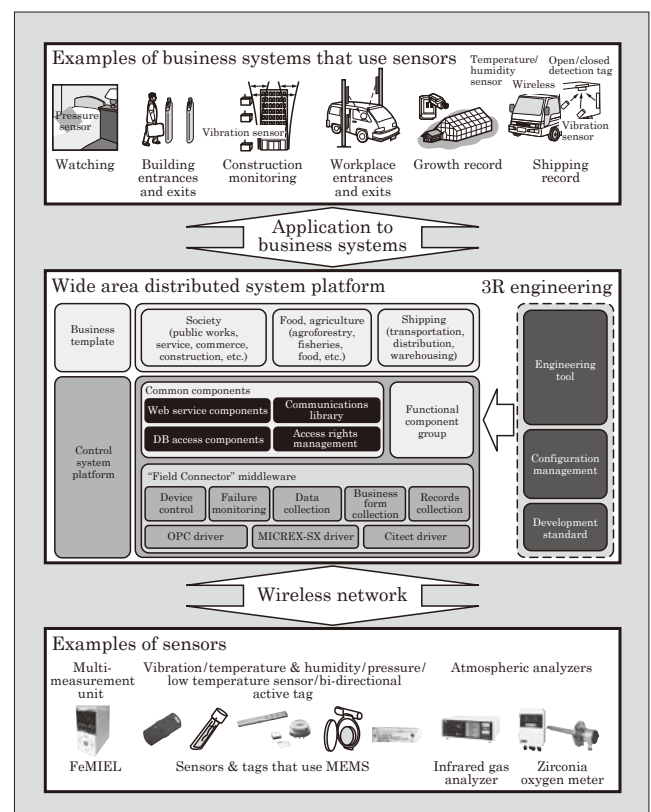
(2) Wireless network technology

Fuji Electric was early to commercialize RFID tags and use them for controlling distribution and the like. As wireless technology, low-power mesh network technology has been used for the automatic reading of electric power, gas and water meters, and for continuous energy measurements. Additionally, wireless technology for low-power acceleration sensors for motor vibration diagnosis and wireless technology for tire pressure sensors in a tire pressure monitoring system (TPMS) that continuously monitors and measures the tire air pressure of trucks and other vehicles in a metallic structure environment have been realized.

(3) Wide area distributed system platform

Fuji Electric has completed development of "Field

Fig.2 Green socio-solution products



Connector” middleware for collecting field data measured by sensors distributed over a wide area, and has successfully devised a structure for collecting and controlling in real-time the measurement values from sensors distributed over a wide area. The Field Connector middleware is configured from the following four components, as shown in Fig. 3, so as to facilitate field visualization.

- (a) I/O servers that collect field data from sensors and component devices
- (b) Broadcast servers for sharing field data among distributed sites
- (c) Agents for accessing field data from the business system
- (d) An intelligent viewer for the screen display and setting

The use of Field Connector middleware enables the real-time monitoring and control of up to 100,000 points, 64 locations, and 4,096 stations for the entire system.

A business system for processing, editing, displaying, setting and controlling field data can be developed with a common procedure shown in the wide area distributed network platform of Fig. 2. The platform is configured from shared components such as the Field

Connector middleware, a Web service, and a communications library; functional components groups classified according to screen, control, data collecting and monitoring functions; engineering tools, including tools for automatically generating source programs and test automation tools; and business templates for tasks

Fig.3 Configuration of wide area distributed system that uses Field Connector

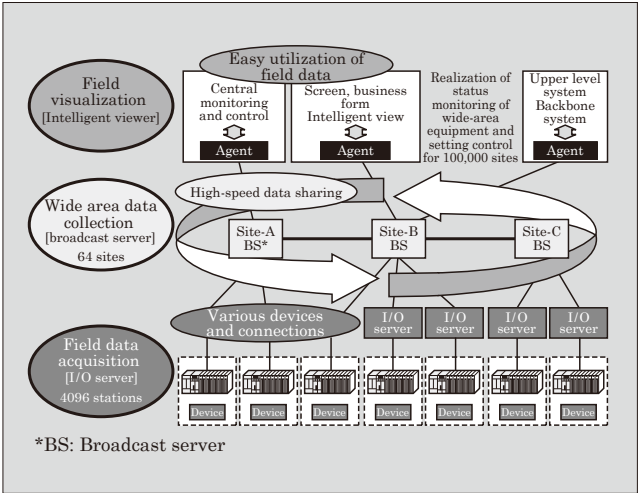


Table 1 Examples of green socio-product solutions

Green socio (environmental harmony, comfortable lifestyle)	Society (public works, service, commerce, construction, etc.)	Food & agriculture (agroforestry, fisheries, food, etc.)	Shipping (transportation, distribu- tion, warehousing)
Environment, energy-savings	Environmental monitoring Energy measurement New energy Energy-saving diagnosis and counter- measures Store energy management GreenUSE Green Cabinet Environmental reports	Energy conservation Diagnosis and countermeasures New energy Water purification processing Local production for local consumption	Modal shift Cooperative distribution
Safety, security	Remote monitoring of buildings Remote monitoring of gas equipment Motor vibration diagnosis Tire air pressure diagnosis ETC-related Watching over infants and the elderly Location management, contamination detection Building & workplace entrances and exits Control to prevent removal of important items Customs clearance inspection, facility monitoring Safety reports	Pest control guidance Production records, disclosure Traceability Growth monitoring	Traceability Measurement of shipping status Container distribution

Fig.4 Comprehensive view of solutions for environment conservation and energy savings

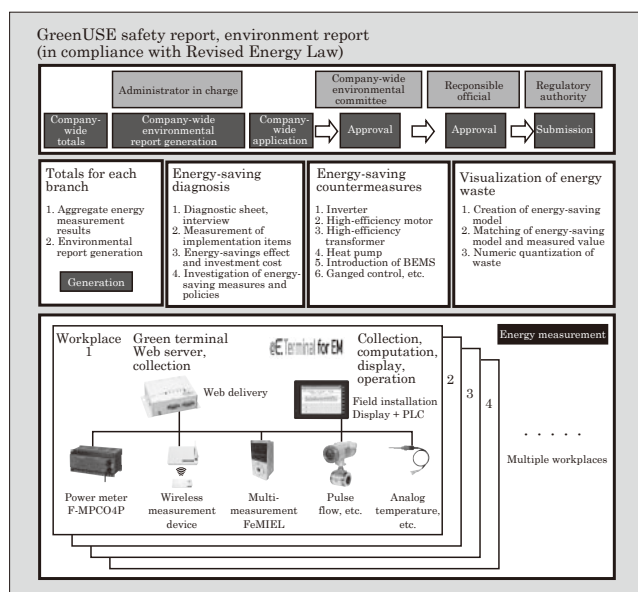
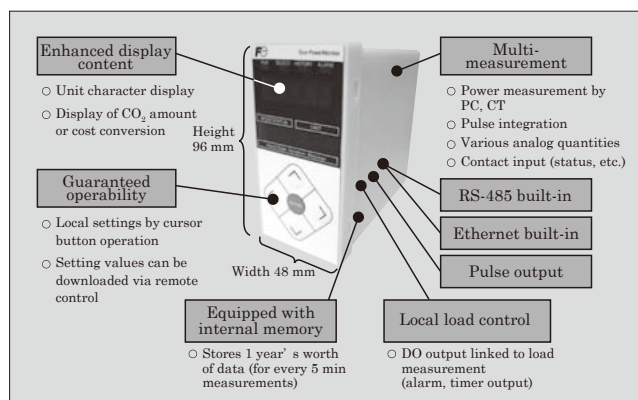


Fig.5 FeMIEL compact, multi-measurement unit



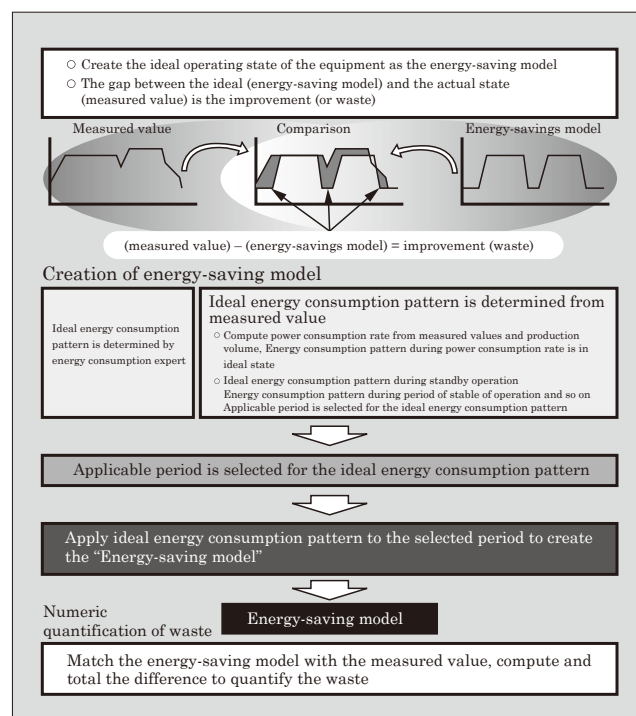
previously encountered. When creating the screen program, the required screen specifications are defined with XML (Extensible Markup Language) according to screen definition rules. The definition and program components for each screen component are extracted and combined by an automated generation engine to generate a screen program automatically with the required specifications. In this manner, reusability is enhanced, new program generation is minimized, and a high quality business system can be provided in response to a customer's requirements.

Green socio-products for realizing “environmental conservation and energy-savings” and “safety and security” are being provided to the societal sector, food agriculture sector and shipping sector, and examples of these product solutions are listed in Table 1.

3. Examples of Green Socio-Solutions

Examples of green socio-solutions for “environmental conservation and energy savings” and “safety and

Fig.6 Waste visualization based on energy-saving model and measured value



security” are presented below.

3.1 Solution for environmental conservation and energy savings

Figure 4 shows a comprehensive view of a solution for environment conservation and energy savings. This solution consists of visualizing the amount of energy usage based on energy measurement, performing an energy-savings diagnosis and proposing energy-saving measures, visualizing wasted energy based on an energy-saving model, and using a GreenUSE function that supports energy-saving activities and the generation of reports.

(1) Visualization of amount of energy usage

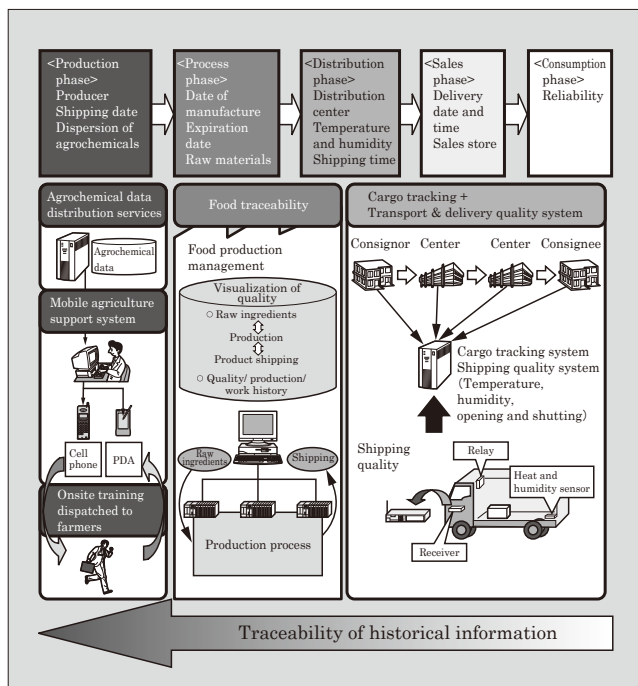
The amount of energy usage can be visualized by using the compact FeMIEL multi-measurement unit shown in Fig. 5. FeMIEL has the following characteristics.

- In addition to power circuit measurements, various energy measurements can also be taken
- Measured amount of power can be converted into the corresponding CO₂ emissions or cost
- Main unit is capable of storing one year's worth of data recorded in 5 minute intervals
- Equipped with network function (Ethernet, RS-485 selectable)

(2) Visualization of energy waste

For customers who already have the capability to visualize their amount of energy usage or who have already implemented energy-saving measures using inverter driving, Fuji Electric also provides energy-saving diagnostic consulting known as “waste

Fig.7 Food safety solution

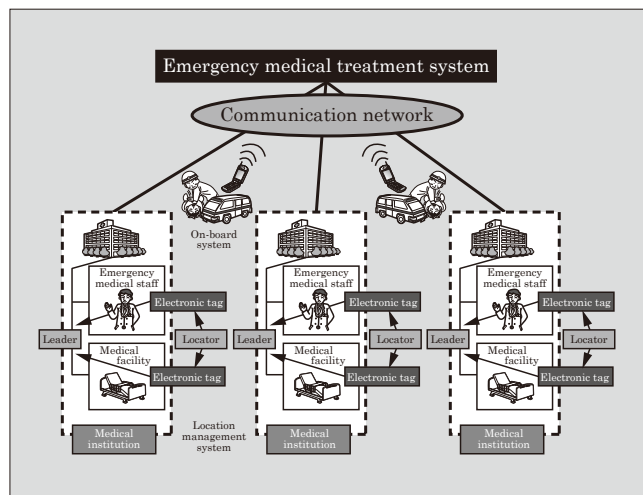


visualization” as a simple energy-saving measure. The amount of energy used by equipment in an ideal operating state (the energy-saving model) is compared with the measured amount of energy usage, and the difference is presented as wasted energy. This procedure is shown in Fig. 6. For example, an energy savings of 5 to 10% was achieved at a parts factory by referencing the visualized waste to correct the operating status of equipment. This method is applicable not only to the industrial sector, but also to the consumer sector for use in rental buildings and the like, and is an effective measure for realizing energy savings in manufacturing equipment and business facilities.

(3) GreenUSE for supporting energy-saving activities and report generation

With the Revised Energy Law which will take effect in 2010, a company whose energy usage exceeds the oil-equivalent of 1,500 kl is obligated to perform energy management. GreenUSE is provided to support the energy-saving activities and reporting work for these types of companies. GreenUSE utilizes a workflow function for obtaining department totals or for processing inter-department applications or approvals, and enables visualization of the corporate environment and safety. Specifically, the energy usage and safety inspection results for individual stores are to be reported from the store manager to the regional manager, and environmental and safety reports for the entire business are to be submitted to the regulatory authority and stored. With GreenUSE, energy measurement, totals within a branch office, company-wide totals, approval and reporting to the regulatory authority are integrated seamlessly, increasing the efficiency of reporting work and supporting environmental

Fig.8 Location management solution for emergency medical treatment



business practices.

3.2 Solutions for safety and security

As solutions for safety and security, a food safety solution provided to the agriculture, fisheries, food, distribution and commerce sectors, and a location management solution for emergency medical treatment provided to the service sector are introduced below.

(1) Food safety solution

The food safety solution, as shown in Fig. 7, supports the provision of safe agricultural products and processed food to consumers by centrally managing historical information ranging from the growth record of agricultural products to food production and shipping quality.

(a) Management of growth record of agricultural products

A system that uses a mobile terminal in the field to display and collect production information of the agricultural product growth process has been developed. The production information consists of pest control guidance and the growth status record. A database of necessary agrochemicals for growing the products is transmitted to the producer's mobile terminal, and guidance regarding the type, concentration and dispersion period of agrochemicals appropriate for the product being grown and pest control is provided to the producer. The name of the grower, the record of agrochemical dispersion, and the record of fertilization are collected from the mobile terminal. As a result, the use of ineffective agrochemicals and violations of agrochemical usage standards will be prevented, and safe production processes are supported.

(b) Management of food production history

History management for food production processes has been realized by installing a food production management system, and assigning material procurement numbers, serial numbers, ship-

ping numbers and the like corresponding to each subsystem, i.e., material procurement, production planning, production history and distribution. From the serial number stamped on a product, the production history information (the production factory, production line and distribution warehouse) and the distribution history information (when and where shipped), and from the material procurement number, raw material history information (the shipping destination of products that use the procured material), can be referenced instantaneously.

In the case of a defect such as contamination with a foreign substance, this mechanism for historical management can be utilized in collecting the product from consumers or to issue a sales cessation order quickly.

(2) Location management solution for emergency medical treatment

Figure 8 shows a location management solution for emergency medical treatment. In a medical institution distributed over a wide area, electronic tags are attached to the medical staff and medical devices, and when used in combination with a locator (an apparatus for transmitting location numbers, such as room numbers, to an electronic tag) inside the medical institution, the location of medical staff and the working condition of medical devices can be assessed accurately (as a specific location) in real-time. The notification to an emergency vehicle of the working condition of a medical device enables the determination of the appropriate type of medical conveyance in an emergency. Electronic tags were developed based on NTT Network Innovation Laboratories' specifications and are non-contact bi-directional active tags that permit both reading and writing. The electronic tags have the following three features.

- (a) The tags place the equivalent of 32 bytes of data on the same HF radio wave band utilized by the IC cards used at a railway ticket gate, and the tags can be written to or read from at a distance of 10 m.

- (b) Using UHF band radio waves, written data and the identifying code of a tag can be read at a distance of 100 m.
- (c) According to the application, the tags may also capture sensor measurement values.

4. Postscript

The challenges to “environmental conservation and energy savings” and “safety and security” are not limited to manufacturers or certain businesses, and in many instances are closely related to our everyday life. Having previously provided many solutions for overcoming these challenges, Fuji Electric intends to continue to develop green socio-solutions and to contribute to the construction of a society in which the lifestyle is comfortable and in harmony with the environment

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