Attachment

# Examples of Products and Technologies Developed and Deployed in the Course of Formulating, Implementing, Evaluating, and Improving the Keidanren Action Plan on the Environment

**Federation of Electric Power Companies of Japan**

| Product/Technology | Outline |
|---|---|
| Heat pumps | Heat pump technology can produce heat energy over input electricity by utilizing heat energy in the air, etc., and its energy efficiency is improving year by year through R&D efforts. Heat pumps are used in a wide range of applications, including air conditioning, hot water supply, and space heating.<br>• The energy efficiency of household air conditioners has roughly doubled in the past 10 years, halving electricity consumption.<br>• Heat pump technology is also used for commercial and residential water heaters, such as the Eco-Cute system which utilizes a natural refrigerant. Such systems have made a major contribution to reducing energy consumption and $CO_2$ emissions.<br>• In the industrial sector, higher heat temperature makes it possible to expand the areas of application, including replacing conventional boilers with heat pump technology. |
| USC (ultra supercritical) pressure thermal power generation | This is a conventional power generation system in which steam is generated by burning fuel using a boiler and electricity is generated using a steam turbine and generator. USC is designed to generate steam with higher conditions (temperature and pressure) in order to raise thermal efficiency, and conditions have now reached to 600°C-grade. Japanese utilities have been achieving higher thermal efficiency in coal-fired plants compared with those overseas. |
| LNG combined cycle power generation | This technology is the combination of a natural gas turbine system, which generates electricity by pressurized combustion gas in compressed air, and a conventional steam turbine system, which uses the steam generated through the heat exchange from the exhaust gas of the gas turbine. It is possible to raise thermal efficiency mainly by boosting the temperature of combustion gas, and Japanese utilities have been achieving world-leading efficiency levels. |
| Integrated gasification combined | This type of combined cycle system uses abundant coal resources as gasified fuel. This technology not |

| Product/Technology | Outline |
|---|---|
| cycle (IGCC) | only enables a high level of efficiency compared with conventional coal-fired generation but also is compatible with coal types that are not suitable for conventional coal-fired power generation due to their low ash-melting point. |
| Hydroelectricity | • Development of small hydroelectric power plants that make effective use of untapped energy sources, such as minimum flows required for dam operation.<br>• Improvement of generator output, etc., in conjunction with the replacement of obsolete facilities at existing power plants. |

**Japan Gas Association**

| Product/Technology | Outline |
|---|---|
| Gas cogeneration system | Gas cogeneration systems use city gas as fuel to generate electricity and heat, and achieve high total energy efficiency. |
| Natural gas conversions to meet industrial heat demand (high-efficiency burners) | Industrial combustion equipment such as furnaces and boilers that use fossil fuels are replaced or converted to run on natural gas, which produces low $CO_2$ emissions. Widespread use of highly efficient burners (regenerative burner systems, etc.) is encouraged to contribute to even greater reduction of $CO_2$ emissions. |
| Residential fuel cell system (“ENE-FARM”) | “ENE-FARM” generates electricity using city gas or LPG, while using the waste heat generated in the process to produce hot water (including hot water for heating applications) for household use. ENE-FARM achieves high total energy efficiency. |
| Latent heat recovery-type water heaters (“Eco-Jozu”) | “Eco-Jozu” is a highly efficient latent heat recovery-type water heater that captures and reuses latent heat that is exhausted through ventilation in conventional water heaters, achieving a high heat-efficiency rate |

| Product/Technology | Outline |
|---|---|
| | of around 95% (conventional water heaters have efficiency levels of around 80%). |
| Gas-fired solar hot water system utilizing solar heat for household use (“SOLAMO”) | “SOLAMO” uses a gas-fired instantaneous water heater as a supplementary heat source for solar heating devices (gas water heating system using forced circulation solar heat). |

**Japan Chemical Industry Association**

| Product/Technology | Outline |
|---|---|
| Energy conservation through maximum use of LNG cryogenic energy in industrial complexes | Maximum use of the cryogenic properties of LNG, the raw material for city gas supply. |
| Cooperative energy-saving schemes for multiple companies through installation of large-scale natural gas fired cogeneration facilities using the ESCO model | Installation of state-of-the-art, highly efficient large-scale natural gas fired cogeneration facilities to supply electricity and steam to neighboring operators while establishing wide-area fuel partnerships with operators in distant places. |
| Energy conservation at ethylene plants through raw material diversification | Reduction of energy use per production volume by partial switching of raw material from naphtha to butane. |

**Japan Paper Association**

| Product/Technology | Outline |
|---|---|
| Biomass boilers | Boilers using fuel derived from biomass and waste materials. |
| High-temperature, high-pressure recovery boilers | Highly efficient high-temperature, high-pressure recovery boilers. |
| Energy-saving pulpers | Energy saving in the pulp manufacturing process, including introduction of pulpers with superior disaggregation capabilities. |

**Four Electrical and Electronic Industry Associations**

| Product/Technology | Outline |
|---|---|
| Energy-saving appliances for household and office use | Improved energy efficiency and reduced standby power consumption through development and introduction of the following products (all percentages are approximate, and take 2011 as the base year except LED light bulbs):<br>• LCD TVs (32V type): 55% energy saving compared to 2006<br>• PCs: 80% energy saving compared to 2007<br>• Electric refrigerators (401–450 liters): 65% energy saving compared to 2001<br>• Air conditioners (2.8 kW class): 14% energy saving compared to 2001<br>• LED light bulbs (typical bulb of around 10 W): 80% energy saving compared to regular 60 W type bulb (54 W)<br>• Heated toilet seats (instantaneous type): 15–60% energy saving compared to 2001 |

| Product/Technology | Outline |
|---|---|
| Widespread use of renewable energy (new energy sources) | Achieved world-leading mass production and cost reduction in photovoltaic power generation and world's top level of cell conversion efficiency. Promoted widespread use of mega-solar generating systems by reducing overall system costs through development of high-efficiency, high-capacity power conditioners, etc. Launched world's first fuel cell cogeneration system in 2005 and started selling to consumers in 2009. Mass production and cost reductions have since been encouraging widespread use of such systems, while technological advances have been increasing efficiency and system life. |
| IT-solution-based energy conservation measures | Achieved energy savings for IT devices, data centers, and networks, and supplied systems utilizing IT to save energy in applications including videoconferencing, cloud computing, air conditioner monitoring, and digital tachometers. |

**Japan Automobile Manufacturers Association**

| Product/Technology | Outline |
|---|---|
| Next-generation vehicles, etc. | Achieved major reductions in $CO_2$ emissions during the product usage phase by increasing the adoption of fuel efficiency improvement technologies, such as variable valve timing and continuously variable transmission (CVT), and developing and wider diffusion of next-generation vehicles, including hybrid vehicles and electric vehicles. |

**Japan Rubber Manufacturers Association**

| Product/Technology | Outline |
|---|---|
| Fuel-efficient tyres | Improved vehicle fuel economy by lowering the rolling resistance of tyres (thus reducing both gasoline consumption and $CO_2$ emissions). For the further promotion of fuel-efficient tyres, a world-leading "Tyre Labeling System" was launched in 2010 and steadily promoted. This system provides consumers with a clear understanding of tyre performance (rolling resistance and wet grip).<br>Note: Conventional tyre design entailed a trade-off between rolling resistance and wet grip (safety), but technological innovation has now enabled both attributes to be improved simultaneously. |
| Run-flat tyres | Run-flat tyres enable vehicles to safely keep running for a certain distance at limited speed even if air pressure is lost. Since this eliminates the need to carry a spare tyre, they also help to make vehicles lighter and reduce fuel consumption. Moreover, by reducing the production of spare tyres they contribute to resource savings, reduction of energy use for manufacturing, and lower $CO_2$ emissions in the disposal phase. |
| Retread tyres | Extending tyre life through the use of retreads (recycled tyres) contributes to reductions in the use of raw materials and energy in manufacturing and lower $CO_2$ emissions in the disposal phase. |
| Tyres using renewable materials | These tyres help to save diminishing resources and encourage the use of recycled materials in the manufacturing phase and lower $CO_2$ emissions in the disposal phase. |
| Smaller, lighter parts | Smaller and lighter automotive components improve vehicle fuel efficiency, rubber parts reduce motive energy requirements, and plastic palettes reuse resources and improve fuel economy in the transportation phase. |
| Energy-saving belts | Rubber belts with high transmission efficiency reduce energy loss during equipment operation (by reducing motive energy requirements). |

| Product/Technology | Outline |
|---|---|
| Thermal insulation building materials, etc. | Development and supply of thermal insulation building materials and other green products (including rigid urethane materials, highly transparent heat-reflective film for windows, and thermal insulation roof coatings) reduce power consumption for air conditioning, etc. |
| Parts for energy-saving products | Development and deployment of film for solar cells, and development, improvement, and supply of products compatible with energy-saving functions. |
| Energy-saving technologies for manufacturing | Development and introduction of highly efficient production facilities and application of manufacturing expertise. |

**Brewers Association of Japan**

| Product/Technology | Outline |
|---|---|
| Energy fuel conversion and upgrading to small through-flow boilers | Fuel for boilers used to produce steam was switched from fuel oil to low-$CO_2$-emission gas in breweries where city gas supplies are available. Further major reductions in $CO_2$ emissions were made by upgrading from large boilers to highly efficient small through-flow boilers. |
| Installation of anaerobic wastewater treatment facilities | Major reduction in electricity required for aeration was achieved by installing anaerobic facilities to pretreat wastewater emitted by the production process prior to aerobic treatment. |
| Installation of biogas cogeneration systems | Using biogas generated during anaerobic wastewater treatment as a fuel has sharply reduced indirect $CO_2$ emissions associated with electricity purchase. |

**Federation of Pharmaceutical Manufacturers' Associations of Japan**

| Product/Technology | Outline |
|---|---|
| Reduction of fluorocarbons in aerosols | Improved manufacturing technologies and development and deployment of non-fluorocarbon formulations, such as powder inhalants, have reduced emissions of hydrochlorofluorocarbon for inhalation aerosols during the usage phase. |

**Japan Sugar Refiners' Association**

| Product/Technology | Outline |
|---|---|
| Installation of auto-vapor recompression concentrators | Steam emitted during production is adiabatically compressed in a steam compressor and the heated pressurized steam is reused as a heat source. |
| Boiler downsizing | Installation of multiple small boilers enables producers to operate only the number of boilers required to produce the necessary amount of steam, avoiding wasteful steam production. |
| Inverter-drive motors | Inverters adjust motor speed as required, reducing wasteful electricity consumption. |

**Real Estate Companies Association of Japan**

| Product/Technology | Outline |
|---|---|
| Energy-saving, low-emission apartment buildings | Introduction of energy-saving equipment and devices such as those listed below is promoting apartment buildings with comprehensive energy-saving and emission-reduction functions.<br>• Thermal load reduction: High-insulation exterior cladding, high-insulation window glass and sashes<br>• Lighting: LED lighting, motion sensors, light sensors |

| Product/Technology | Outline |
|---|---|
| | • Water heating: Eco-Jozu latent heat recovery-type gas-fired instantaneous water heaters, Eco-Cute natural refrigerant heat pump water heaters<br>• Water saving: Low-flow shower heads, water-saving toilets, water-saving faucets<br>• Renewable energy: Photovoltaic power generation systems, gas-fired water heating systems using solar heat |
| Energy-saving, low-emission office buildings | Encouraged the design of buildings achieving energy-savings more than 10% greater than standards set by government through introduction of energy-saving equipment and devices such as the following:<br>• Thermal load reduction: Enhanced building insulation, installation of louvers and sunshades, high-insulation glass, double-skin exteriors, airflow windows, solar radiation control blinds<br>• Air conditioning: Highly efficient heat sources and air conditioning equipment, cogeneration systems, thermal storage systems, radiant air conditioning<br>• Lighting: LED lighting, motion sensors, control systems compensating for daylight and reducing initial illumination levels, task-ambient lighting<br>• Ventilation: Automated ventilation control based on $CO_2$ levels, natural ventilation<br>• Water heating: Highly efficient water heaters, cogeneration systems utilizing waste heat<br>• Elevators: Inverter control, group control systems<br>• Renewable energy: Photovoltaic power generation systems, geothermal-powered systems<br>• Introduction of highly efficient building energy management systems (BEMS) |
| Energy-saving, low-emission initiatives in wide-area/district development projects | Introduction of measures such as those listed below when undertaking wide-area or district development projects encourages energy conservation and lower $CO_2$ emissions that also spread to surrounding areas.<br>• Wide-area energy interchange schemes and utilization of unused and renewable energy<br>• Promotion of greening of development sites |

| Product/Technology | Outline |
|---|---|
| | • Use of district heating and cooling systems<br>• Load averaging through mixed-use development<br>• Introduction of area energy management systems (AEMS) |
| Technologies to make everyday energy consumption more visible at home | Development of display systems that further increase consumer interest in energy usage and desire to conserve energy, such as technologies enabling residents to monitor energy consumption by clearly displaying amounts of gas and electricity used and systems displaying household energy use rankings in apartment blocks. |

**NTT Group**

| Product/Technology | Outline |
|---|---|
| Greening of machine rooms and data centers | Energy conservation and reduction of electricity use in machine rooms,[*1] data centers, and wireless base stations, which use large volumes of electricity in the course of providing ICT services. The following air conditioning, electricity supply, and energy management technologies have been developed and introduced.<br><u>Air conditioning</u><br>• Development of automated airflow control systems for optimal temperature and humidity adjustment in machine rooms and data centers<br>• Development of external air induction technology enabling servers to be supplied with airflow at the required temperature, humidity, and quantity, according to external environmental conditions<br>• Introduction of highly efficient water-cooled air conditioners |

| Product/Technology | Outline |
|---|---|
| | Electricity supply<br>• Development and introduction of high-voltage direct current power source technology that improves electricity supply efficiency and eliminates power loss due to AC/DC conversion by supplying DC electricity directly to ICT devices<br>• Use of renewable energy including solar and wind power<br>• Installation of lithium-ion batteries to store surplus electricity generated by fuel cells, etc.<br>Energy management<br>• Development and introduction of BEMS that optimize energy supply and demand in machine rooms and data centers through unified management and highly coordinated control of air conditioner operation and loads on servers and other ICT devices<br>*1. Machine rooms: Spaces where ICT devices are managed and operated |
| Reduction of electricity consumption by networks | Research and development to achieve dramatic reductions in electricity consumption by ICT services.<br>Recent research results<br>• Development of laser technology enabling data transmission with ultralow power consumption of one-tenth the energy of the conventional approach<br>• Power consumption of nanoscale circuits reduced using plasmons, which are collective charge oscillations, and graphene, a new carbon-based material<br>• Power-saving technology developed for LSI chips[*2] compatible with the next generation of high-speed broadband access systems<br>*2. LSI chip: A large-scale integrated circuit chip containing around 1,000–100,000 circuit elements |
| Creation of smart communities | Development of technology that creates smart communities by applying technologies for making energy supply and demand visible and optimizing control to entire districts, not just individual houses and |

| Product/Technology | Outline |
|---|---|
| | buildings.<br>Specific examples<br>• Conducted R&D on smart community platforms that use automated demand response to enable wide-area coordination of electricity supply and demand.<br>• Developed service platforms enabling electric utilities and aggregators to provide automated demand response services without owning facilities, by locating smart community platforms in the cloud. (First company in Japan to be certified as compliant with OpenADR 2.0, the international standard for automated demand response. Used in government agency/university trial.) |

**Association of Japanese Private Railways**

| Product/Technology | Outline |
|---|---|
| Variable voltage variable frequency (VVVF) inverters | VVVF inverters convert DC power from rail lines to three-phase AC power and control voltage and frequency to drive AC motors. This technology helps reduce electricity consumption through efficient control of motors. |