Toward a Low-Carbon Society

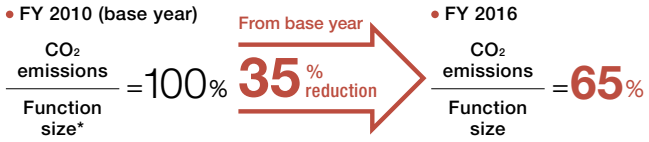
We seek to reduce CO_2 emissions by 80% compared to fiscal 2010 levels by fiscal 2050 to realize the drop in global anthropogenic GHG emissions that was deemed necessary in the IPCC's *Fifth Assessment Report*. We will attain this target throughout our value chain. First, this will be achieved by decreasing emissions during the *usage* stage of our products and solutions, which account for a substantial share of emissions in the value chain. We will contribute to our customers and to society by developing innovative technologies and solutions, as well as enhancing the efficiency of our products and supplying low-carbon energy. At the same time, we will also work to cut down on emissions at the *production* stage of our business activities.

Reduction of CO_2 Emissions During Use

Improved Environmental Performance in Products and Services

Hitachi is improving the environmental performance of its products and services with the hope of contributing to the resolution of environmental challenges through the development and popularization of products and services with high environmental value. We strike a balance between improving functionality and reducing the environmental burden by using, as our index, the reduction rate per product and service function of CO_2 emissions during usage and of the volume of resources used during the life cycle. The group of products that demonstrate a high level of potential in solving environmental issues are the targets of a plan to achieve a 40% reduction in CO_2 emissions by fiscal 2018 (compared to fiscal 2010 products). In fiscal 2016, we attained a 35% CO_2 emissions reduction rate by promoting environmentally conscious designs and expanding sales of products and services with high energy-saving functions.

Reduction in CO_2 Emissions



* Major functions of products correlated to CO_2 emissions.

Environmentally Conscious Design Assessments

We conduct Environmentally Conscious Design Assessments for all products and services involving a design process to ensure environmentally conscious design and development. Thirty environment-related areas are assessed for their impact on climate change, resource depletion, and environmental pollution (ecosystem degradation) at each stage of the product life cycle with a view to reducing the environmental burden. To meet the IEC 62430* criteria for environmentally conscious design, in addition to implementing these assessments, we are advancing environmentally conscious design and development by integrating this process into our existing management system, such as by keeping abreast of environmental regulations and ascertaining the environment-related needs of our stakeholders. We conduct life cycle assessments focusing on our main, priority products to quantitatively evaluate their burden on the global environment in such areas as the consumption of mineral resources, fossil fuels, and water resources, as well as their impact on global warming and air pollution. The results of such life cycle assessments are disclosed to our stakeholders and utilized in improving the design of next-generation products.

* The standard developed by the International Electrotechnical Commission concerning environmentally conscious design for electrical and electronic products.

Products and Solutions that Help Create a Low-Carbon Society

Reducing CO_2 Emissions Through Energy Savings

Amorphous Transformers

Transformers convert the high-voltage electricity produced at power plants into low-voltage electricity that can be used more safely. Since voltage is applied to the coil where electricity is flowing so that electricity can be used at any time, the occurrence of no-load loss (standby power) in which power is lost even when electricity is not being used cannot be avoided. Decreasing the no-load loss of transformers that operate 24 hours a day, 365 days a year, over a mean lifespan of about 25 years could lead to huge energy savings.

Hitachi Industrial Equipment Systems Co., Ltd. uses an amorphous alloy with outstanding magnetic properties in the iron cores around which coils are wound. This has resulted in an annual reduction of about one-fifth in no-load loss compared with previous silicon steel transformers* and an annual reduction of 26 MWh in total loss, including load loss, during use.

An oil-immersed transformer (left) and molded transformer.

* Comparison of loss between Hitachi's silicon steel transformer and amorphous transformer (3,000 kVA capacity, 22 kV/6.6 kV, 50 Hz models at 40% load factor).

Reducing CO_2 Emissions with Renewable Energy

Down-wind Turbine System

Hitachi has installed 162 wind turbines in Japan (as of February 28, 2017) and is actively developing this business to contribute to the growth of the renewable energy sector. In Hitachi's original down-wind system, the rotor is on the downwind side of the tower. The system's weather vane effect enables turbines to switch to the free-yaw operation mode in blackout conditions, such as during storms, preventing the dangers posed by cross wind. The characteristic makes the down-wind system very safe. Down-wind turbines also generate energy efficiently by capturing upward blowing winds in mountainous and hilly areas.

At a new wind power plant of the Aoyama-Kogen Wind Farm Corporation, located on the Aoyama plateau in Mie Prefecture, Hitachi supplied 40 down-wind turbines. The output is 80 MW, the largest in Japan.*1 Hitachi is also taking part in research for the Fukushima Floating Offshore Wind Farm Demonstration Project of the Agency for Natural Resources and Energy, Ministry of Economy, Trade, and Industry.

A 5 MW floating wind turbine
(courtesy of the Fukushima Offshore Wind Consortium).

CO_2 emissions reduction amount → **330 kt-CO_2/year*2**
(amount for the 162 wind power turbines installed by Hitachi)

*1 According to a list of wind power generation facilities installed in Japan (as of March 31, 2016), compiled by the New Energy and Industrial Technology Development Organization (NEDO).

*2 Comparison with LNG thermal power generation. Calculated from the life cycle CO_2 emissions for each type of power generation listed in the Evaluation of Life Cycle CO_2 Emissions of Power Generation Technologies, published by the Central Research Institute of Electric Power Industry (July 2010).

Reducing CO_2 Emissions During Transport

Railway Systems

Among the various modes of transportation, railways have among the lowest CO_2 emissions. As a comprehensive railway systems integrator, Hitachi is a global provider of railcar and transport systems, including signaling and train management systems, and will continue to deliver total railway systems for greater efficiency and environmental consciousness.

Hitachi's aluminum A-train rolling stock is lighter than stainless steel rolling stock, for example, enabling trains to run at high speeds with less energy. Outside of Japan, A-train production has also begun in a UK plant and additional orders have been received for 63 AT-300 cars for a railway in southwest England. Together with an order received in July 2015, the total is for 236 cars (36 trains).

The use of silicon carbide (SiC) in carriage inverters reduces energy loss during operation and cuts mass and volume by 40%. Energy savings are achieved through both lower electrical energy use and the contribution of these inverters to lighter rolling stock.

An AT-300 train for a UK railway company.

CO_2 emissions per transport unit (passenger) → **Railway emissions are about 1/7 those of automobiles***

* From Ministry of Land, Infrastructure, Transport, and Tourism data on CO_2 emissions in the transportation sector.

Reducing CO_2 Emissions by Improving Automobile Fuel Efficiency

Lithium-Ion Battery Packs

Automobile CO_2 emissions are a major environmental issue, and fuel efficiency is being improved through various technologies.

Hitachi Automotive Systems, Ltd. has developed a 48V lithium-ion battery pack for mild hybrid vehicles. An output density 1.5 times existing levels has been achieved by improving the material composition of the positive and negative electrodes and increasing the amount of lithium that can be stored per unit of weight. This not only enhances the motor's torque performance for assisting acceleration but also enables the recovery of substantial regenerative energy when decelerating and reduces energy loss.

Hitachi contributes to reduced CO_2 emissions through improved automobile fuel efficiency by providing storage batteries and other energy-saving automobile parts.

A 48V lithium-ion battery pack for mild hybrid vehicles.

48V lithium-ion battery pack energy density → **1.5 times previous product**

Reducing CO_2 Emissions Through Greater Efficiency with IoT

Building Eco-Factories with Lumada

Hitachi Construction Machinery Co., Ltd. uses a network of Japanese and international affiliates centered on four main plants in Japan to produce construction machinery and its principal components. Together with energy reductions during use as these products switch to electric or hybrid power, efforts throughout the network are also being made to reduce energy consumption in the manufacturing stage.

The entire Hitachi Construction Machinery Group continues to implement energy-saving measures and promote greater efficiency in plant and office lighting and air-conditioning. Several locations have also introduced IoT technology to further reduce energy consumption and raise productivity. Specifically, by adopting the Energy and Equipment Management Service, a key solution concept under Hitachi's Lumada IoT platform to comprehensively control energy data and equipment across multiple business facilities, they are able to efficiently analyze and manage electric power data gathered from equipment at each plant. Energy usage by the machine tools, robots, and other production equipment used in plants is finely controlled, reducing standby power and increasing energy efficiency.

With these efforts the energy use per unit has been decreased 32% compared with fiscal 2010 at the company's main plants in Ibaraki Prefecture, contributing to a significant reduction in electric power costs.

Tsuchiura Works East Building and the Hitachi UH03 hydraulic excavator, which is included in the list of Japan's Mechanical Engineering Heritage.

Energy use per unit **32** % reduction compared with fiscal 2010

Reduction of CO_2 Emissions During the Production Stage

We are working to reduce energy use per unit—an indicator of energy efficiency—by systematically improving efficiency, such as by installing high-efficiency equipment and devices, from LED lighting to inverter air conditioners, at each facility. In fiscal 2016, we achieved an improvement of 12% (from a base year of fiscal 2005), against a target of 15%. Part of the reason for not hitting the target was because of a decline in sales in energy intensive business divisions, which contracted the denominator in calculating energy use per unit.

The increase in the total volume of CO_2 emissions was due to the fact that a materials company in the Americas newly became a member of the consolidated Hitachi Group in fiscal 2016. There was a general decline in regions other than the Americas.

We will continue to harness our expertise in control and IT technologies to actively pursue energy conservation measures at our factories and offices and promote the efficient use of energy.

Reduction in Energy Use per Unit

• FY 2005 (base year)

$$\frac{\text{Energy used } 1.75\ \text{GL}^{*1}}{\text{Activity amount}^{*2}} = 100\%$$

From base year **12** % reduction

• FY 2016

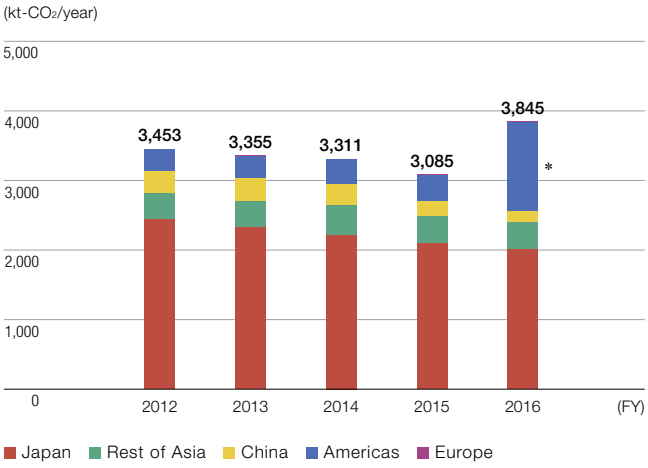
$$\frac{\text{Energy used } 1.95\ \text{GL}}{\text{Activity amount}} = 88\%$$

*1 Energy volume used both in and outside the organization (SCOPE 1 and 2).
*2 A value closely related to the emission factor numerators (environmental burden) of energy use from business activities (for example, production quantity, output, building floor space, and number of employees).

Introducing Renewable Energy

We are promoting the use of solar, wind, and other forms of renewable energy. During the 2016 fiscal year, Hitachi produced 2,925 MWh of renewable energy for its own use. Hitachi Computer Products (America), Inc. proactively uses renewable energy to power its factory, purchasing 8,769 MWh during fiscal 2016. In Japan, we contracted for 1,000 MWh/year of Green Power through Japan Natural Energy Co., Ltd. to provide power for offices, showrooms, and exhibitions.

CO_2 Emissions



* Includes 958 kt-CO_2/year emitted by a materials company that became a consolidated member of the Hitachi Group in fiscal 2016.

Notes:
- The CO_2 electrical power conversion factor uses the 2005 emission coefficients for individual countries published by the International Energy Agency (IEA) in the 2010 edition of *CO_2 Emissions from Fuel Combustion*.
- Energy-related CO_2 emissions were 1,296 kt-CO_2 (SCOPE 1) and 2,549 kt-CO_2 (SCOPE 2).