

» Environmental Management

Purpose of activities	Activities during fiscal 2018	Self-assessment	Targets/plans for activities from fiscal 2019 onwards
<ul style="list-style-type: none"> Complying with environmental legislation Continuing to reduce environmental impact 	<ul style="list-style-type: none"> Step up education on environmental legislation Strengthen measures to prevent environmental accidents 	A	<ul style="list-style-type: none"> Strengthen efforts to observe environmental legislation (introducing legal compliance check sheets, etc.) Step up education on environmental legislation

Self-assessment grades A: Target achieved B: Target mostly achieved C: Target not achieved

Environment Policy

Based on our Corporate Philosophy "For People, Society and the Earth," we recognize the importance of environmental preservation on a global scale and strive to contribute to the creation of a sustainable society through our business activities.

As a comprehensive materials manufacturer, with operations ranging from cement, metals and metalworking through to electronic materials and components, we supply many of the basic materials and products that are essential to our industrialized society. Indeed, our materials and products are widely used in many aspects of daily life.

Whereas operations within the materials industry inevitably have a high environmental impact at the manufacturing stages, they also present opportunities to effectively harness and recycle resources through initiatives at the waste processing and recycling stages.

We take the environment into consideration in everything that we do and are committed to environmental management, capitalizing on the nature of our operations to strike a balance between business and the environment. With that basic philosophy in mind, we are determined to do our bit to help create a recycling oriented society that has a low impact on the environment, through strict legal compliance and operations such as supplying and recycling essential everyday materials and products.

We are engaged in the following initiatives to achieve those objectives.

1. Promote environmental management

We will effectively harness environmental management systems, expand environmental education and take every possible opportunity to raise awareness of environmental management so as to ensure that it is put into practice by each and every employee.

2. Reduce environmental impact

We will make every effort to reduce greenhouse gases, waste, hazardous chemicals and other forms of environmental impact resulting from the consumption of energy and other resources at every stage of our business activities in an effort to preserve the environment. We will also focus on promoting green procurement and developing environmentally friendly materials, products and technologies and make every effort to minimize environmental risks through initiatives aimed at preventing environmental pollution and accidents.

3. Contribute to the creation of a recycling-oriented society

We will make the most of the technologies and facilities at our disposal, based on the nature of the Mitsubishi Materials Group's operations, in order to process and recycle resources from waste and promote other forms of recycling. We will also do our bit to promote a recycling-oriented society through initiatives such as increasing usage of renewable energy.

4. Preserve biodiversity

We recognize that biodiversity is one of the cornerstones of a sustainable society, not least in terms of natural resource development, and will ensure that our business activities remain in harmony with society and the natural environment, taking ecosystems into consideration every step of the way.

5. Help to create a low-carbon society

We will develop and get involved in materials, products and technologies that help to reduce energy consumption and prevent global warming in an effort to help create a sustainable low-carbon society. We will also proceed with forest development with the aim of making a greater contribution to CO₂ fixation (absorption) at forests owned by Mitsubishi Materials.

6. Coexist with local communities

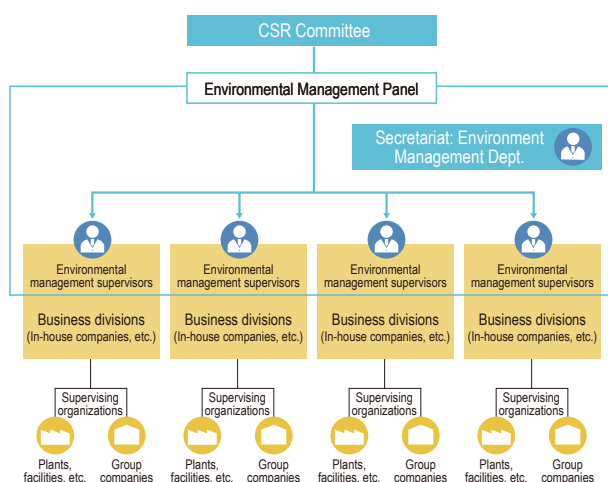
We will maintain close communication with local communities and work together to preserve the environment based on conditions in each area.

Framework

We have introduced environmental management systems throughout the group, including ISO 14001, and carry out environmental preservation activities based on specific factors such as the nature of our diverse business activities and the local area. When dealing with cross-sectional issues, we discuss options via the Environmental Management Panel, one of the dedicated subcommittees that form a part of our CSR Committee, then implement measures as necessary.

As a licensed waste treatment business, we recycle waste products generated domestically into raw materials and thermal energy for use in smelting and manufacturing cement in particular. We have positioned waste management as one of our top priorities, and make every effort to ensure legal compliance across the board, from head office to individual facilities. That includes using tools such as waste management manuals and self-check sheets, and operating a consultation desk at head office.

■ Environmental management system



Environmental Preservation

Full Compliance and Environmental Accident Prevention

Ensuring that environmental management is carried out appropriately requires full awareness among managers and staff of the importance of protecting the environment and a proper understanding of legislative requirements. The Group consequently shares information on legislative revisions, conducts capital investments and operations management in compliance with applicable laws and regulations and takes steps to prevent omissions in obtaining licenses and certifications. We provide ongoing staff education in pollution prevention and proper waste management, moreover, as well as training for ISO 14001 internal environmental auditors.

① Information-sharing Regarding Compliance with Environmental Legislation

We keep employees up to date on changes in legislation by providing information via intranet or email. In the event of major revisions, or revisions requiring measures such as equipment upgrades, we organize explanatory meetings to provide information on the requisite measures and ensure that all our facilities are prepared to take appropriate action.

② Compliance with Legislation on Pollution Prevention

We strictly observe all relevant laws and regulations in operations management at our business sites, with consideration for local residents and the environment as our highest priority.

In order to prevent failure to make notifications or obtain permits or licenses in accordance with legislation applicable to installing or upgrading equipment, we conduct investigations at individual facilities to determine what notifications the regulations require them to submit. We also confirm application of the legislation and the response status of the submissions by the relevant corporate departments. These activities pertain particularly to business startups that require investments exceeding prescribed amounts. In light of the importance of confirming with certainty that operations management is conducted in full compliance with laws and regulations at our business facilities, we introduced a checking system to confirm the status of legal compliance without fail and implemented it in July 2018.

With regard to our compliance with environment-related laws and regulations in fiscal 2018, we were not subject to any adverse dispositions (revoked permits, orders to cease operations, orders to stop use of equipment, fines, etc.) by regulatory authorities.

Moreover, we received 18 complaints relating to noise, vibrations, suspended dust, etc. For all of these, we immediately investigated the causes and implemented the necessary countermeasures.

③ Environmental Management Training

Management-level staff at our various facilities receive education designed to improve their understanding of pollution prevention management systems, and other basic management requirements from an environmental management perspective. Seminars are organized for environmental management supervisors at individual facilities to clarify legislation such as the Air Pollution Control Act and the Water Pollution Control Act. We have so far conducted seminars mainly at the Head Office but we will also begin holding them at manufacturing sites to reinforce employee awareness of environmental legislation, while also visiting environment-related facilities in order to reach more employees and contribute significantly to the seminar participants' knowledge of the issues and appropriate responses.

④ Waste Management Training

The Group participates extensively in various recycling businesses as a licensed waste treatment business. Fully aware that any violation of the Waste Management and Public Cleansing Law or related legislation could cause serious problems for the local residents or lead to revocation of our waste treatment business license, we position proper waste management as a vital factor for our business continuity and provide education and promote awareness among our employees accordingly.

⑤ Internal Environmental Auditor Training

We have introduced environmental management systems in accordance with ISO 14001, and organize seminars to train internal environmental auditors.

Training is focused on practical matters, including learning about ISO 14001 aspects and environmental legislation, identifying environmental concerns and applicable legislation, devising ways of reducing environmental impact, and checking for nonconformity.

■ Environmental education in FY2018

		Participants
Environmental management training	Managers	168
	Supervisors	17
Waste management training	Managers	17
	Supervisors	160
Training for internal environmental auditors		95

Dealing with Environmental Risks

If harmful substances leak, or waste products are treated in an inadequate manner, there is a risk that they could have a detrimental impact on the environment, as well as having a serious effect on our business activities as a group.

We carry out risk assessments in line with the nature of our business activities, the substances that we handle, and the location of individual facilities, and take action as necessary. As well as preventing inadequate waste treatment at our own facilities, we also take steps to ensure that we do not overlook inadequate treatment by contractors.

We recognize that freshwater is also an invaluable resource, and are taking steps to tighten wastewater management and save water, to minimize the risk that declining freshwater resources could impact on our business activities.

Environmental Accounting

In fiscal 2018, we invested approximately ¥3.5 billion in areas such as renewing Tohoku Power Service Station's Oyu Hydroelectric Plant and updating equipment at our cement plants to improve waste recycling.

Costs associated with environmental preservation came to ¥4.4 billion, including environmental measures, and maintenance and management of equipment to prevent pollution.

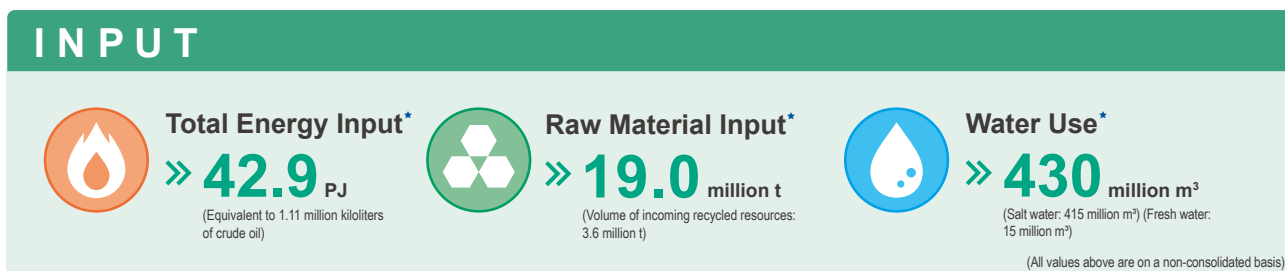
■ Spending on environmental preservation in FY2018

Category	[Million yen]	
	Investment Amount	Expense Amount
Business area costs	3,531	4,433
Pollution prevention costs	1,139	2,802
Global environmental conservation costs	1,455	187
Resource recycling costs	937	1,444
Upstream/downstream costs	0	0
Administration costs	63	333
R&D costs	27	12
Social activity costs	0	14
Environmental remediation costs	0	151

* Calculations are based on the 2005 version of the Environmental Accounting Guidelines published by the Ministry of the Environment.

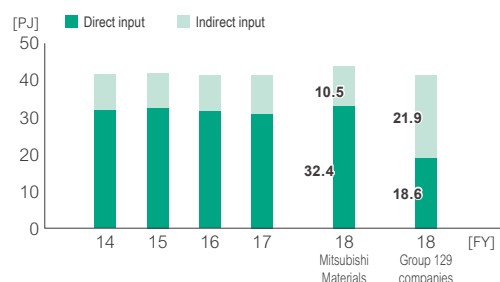
* Figures refer to Mitsubishi Materials on a non-consolidated basis.

» Overall Environmental Impact



Total Energy Input*

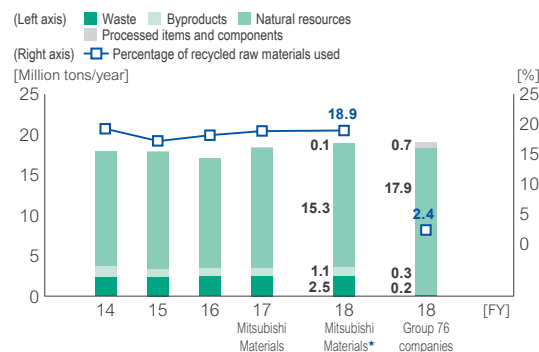
The fiscal 2018 total energy input (non-consolidated) had increased by about 4% (1.5 petajoules: crude oil equivalent of 40 megaliters) compared to fiscal 2017. This was due to increased production volume for cement, the demand for which has been increasing steadily. Energy unit consumption improved by 1.1% compared to fiscal 2017 as we sought to improve energy use efficiency by increasing production volume and improving energy-saving activities at all locations.



* 1 PJ (peta joules) = 10¹⁵ J = 1,000 TJ (tera joules)

Raw Material Input

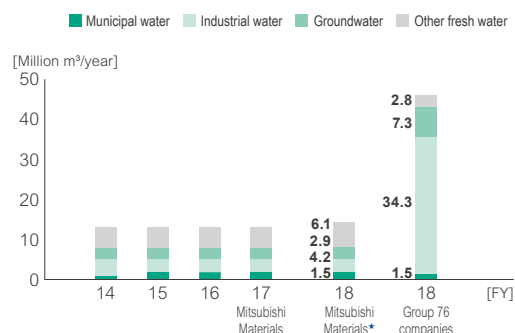
In fiscal 2018, we used a total of 3.6 million tons of waste and byproducts (similar to the previous year) at Mitsubishi Materials, which is roughly 19% of the total raw material input of 18.9 million tons.



* Natural resources include limestone procured from Group mines


Water Use

The vast majority of the water we consume is seawater used as cooling water thermal power generation facilities at our cement plants and copper plants. We used a total of 430 million m³ of water at Mitsubishi Materials during fiscal 2018. Of the total water consumption volume, only 14.7 million m³ (14% increase from the previous year) was fresh water.




* Excluding fresh water used in hydroelectric power generation
* Excluding seawater used for cooling

OUTPUT



Greenhouse Gas Emissions*


» **8,098** thousand t
(CO₂ equivalent)



Emissions into the Air and Bodies of Water*

» Airborne emissions
SOx: **1,046** t NOx: **11,771** t


» Water emissions
BOD: **47** t COD: **29** t Nitrogen: **112** t



Water discharged*


» **426** million m³

(Discharged into sea: 418 million m³
Discharged into other bodies of water: 8 million m³)



Volume of Industrial Waste*

» **12.6** thousand t
(7.5 thousand t of which was recycled)



Chemicals Released or Transferred*

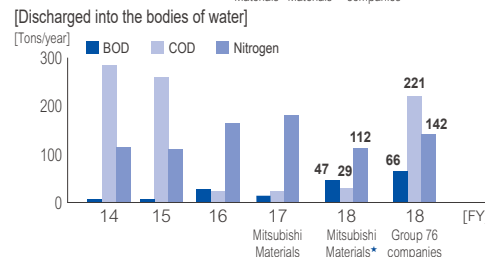
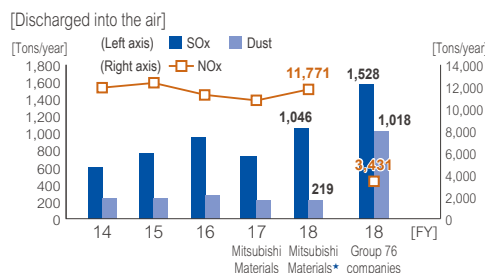
» Emitted: **59** t Transferred: **47** t

(All values above are on a non-consolidated basis)

Emissions into the Air and Bodies of Water

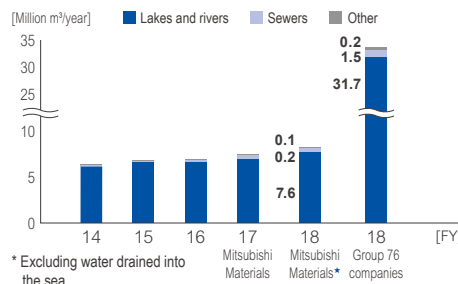
In fiscal 2018, the Company's non-consolidated SOx emissions had increased by about 48% on the previous year and NOx emissions by about 8%. The increase in SOx was due to the use of more fuel oil. The increase in NOx was due to the use of more petroleum coke.

* COD figures exclude COD contained in seawater used for cooling, due to changes to the scope of calculations from fiscal 2016 onwards.



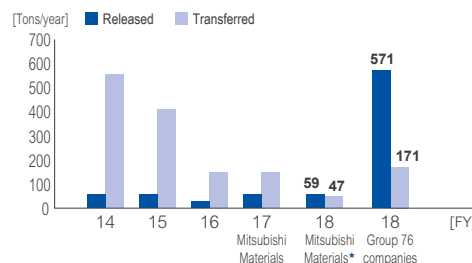
Water Discharged

The volume of water discharged by Mitsubishi Materials (excluding water drained into the sea) totaled approximately 8 million m³, roughly the same as the previous year. Of the 418 million m³ of water drained into the sea by Mitsubishi Materials, the vast majority was seawater that had been used as once-through cooling water.



Chemicals Released or Transferred

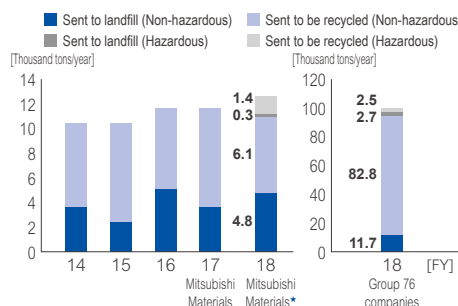
At about 59 tons, the Company's non-consolidated emissions were at a level similar to the previous year. The transferred amount was at about 47 tons, a 69% decrease on the previous year. This was because chemical substances emitted as waste at our plants could be recycled as materials at other in our Group plants.



Volume of Industrial Waste

The volume of waste sent to landfill by Mitsubishi Materials came to approximately 5.1 thousand tons in fiscal 2018, similar to the previous year. The total volume of waste for the Group as a whole, including Mitsubishi Materials, came to approximately 110 thousand tons, of which around 80% was recycled.

* We changed the method for calculating final waste disposal volumes and resource recovery volumes in fiscal 2018, now differentiating between hazardous and non-hazardous waste.



» Preventing Global Warming

Global Warming Prevention Policy and Framework

The large number of disastrous extreme weather events believed to have been caused by global warming in recent years (superstorms, floods, droughts, etc.) has engendered a growing sense of concern with respect to global economic risk. We have set clear targets based on our environmental policy for each of our plants for the purpose of achieving a steady reduction of CO₂ emissions while actively developing and supplying products and services that will contribute to realization of a low-carbon society.

Our cement business not only produce CO₂ through their use of energy sources, but they also produce CO₂ emissions through the thermal decomposition of limestone, the main raw material in cement production. Any tightening of regulations on greenhouse gas emissions (including emissions trading schemes) could therefore pose a considerable financial risk to the Group. At the same time, however, demand for technologies and products that contribute to saving energy and reducing CO₂ emissions is expected to grow, creating more future business opportunities as a result. We are also proactively developing damage prevention measures with respect to heavy rainfall and storm surges associated with extreme weather.

The Company's Global Environment and Energy Committee (comprising members of the Corporate Strategy Committee) takes the lead in formulating strategic initiatives in response to risks and business opportunities related to climate change from a comprehensive medium- to long-term perspective. In fiscal 2019, the Committee made the decision to begin considering ways of introducing an internal carbon pricing system.

Comprehensive Initiatives Aimed at Preventing Global Warming and Establishing a Recycling-Oriented Society

The Group's efforts to realize a sustainable society include establishing global warming prevention targets to be met by 2020 and acting on our total commitment to achieving higher energy efficiency through such means as actively pursuing energy saving at our facilities. We are monitoring progress toward achieving our targets at 13 facilities (with five plants counted as one in the cement business). Our performance in fiscal 2018 registered 100% or higher achievement of our targets at 3 facilities but under 50% at the remaining sites. In addition to pursuing CO₂ reduction initiatives, we are working to achieve clearly defined targets, such as effective use of recycled resources, aimed at contributing to a recycling-oriented society.

■ Targets for 2020 and results/progress in FY2018

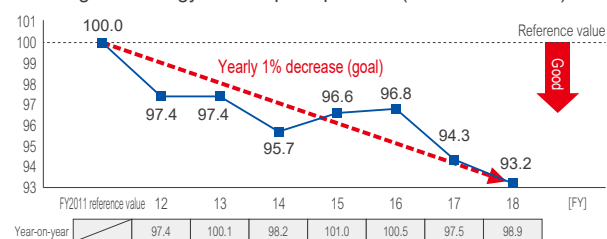
Sector	Applicability	Details	Preventing global warming		Creating a recycling-oriented society/contributing to the environment	
			Targets	Results/Progress	Targets	Results/Progress
Cement	All facilities (Aomori, Iwate, Yokoze, Kyushu, Higashitani)	Improve energy efficiency steadily through the installation of energy saving equipment. Promote the use of waste and byproducts from other industries as alternative materials for cement	• Energy consumption per unit Reduction of 1.2% (compared to FY2011)	1.9% increase compared to FY2011 (Milestone: 0.7% decrease) ☆☆	• Alternative waste/byproducts per unit 435 kg per ton (Baseline: 406 kg per ton)	436 kg/t (Milestone: 431 kg/t) ☆☆☆☆
					• Percentage of alternative thermal energy Increase of 2% (compared to FY2011)	1.8% decrease (Milestone: 1.3% increase) ☆
Metals	Naoshima Smelter & Refinery	Install high-efficiency equipment, and upgrade or install heat recovery and other such equipment at copper smelting facilities, in order to improve energy efficiency. Cater to growing volumes of E-Scrap overseas, reinforce pre-treatment facilities, and step up recycling operations.	• Energy consumption per unit Reduction of 1% per year (14% overall reduction compared to FY2006)	0.3% increase compared to FY2006 (Milestone: 11.4% decrease) ☆	• Volume of E-Scrap processed Over 100,000 tons per year	85,000 t/year (Milestone: 106,000 t/year) ☆
	Sakai Plant	Upgrade equipment to energy saving models as part of manufacturing processes for copper and brass materials, copper alloys and processed copper products.	• Energy consumption per unit Reduction of 1% per year (14% overall reduction compared to FY2006)	0.7% increase compared to FY2006 (Milestone: 11.4% decrease) ☆☆	• Waste oil/acid Reduction of 40% (compared to FY2006)	212% increase (Milestone: 32% decrease) ☆☆
Advanced Materials & Tools	Tsukuba Plant	Upgrade water chillers and heaters as part of air conditioning systems, and other equipment, to energy saving models in the manufacturing process for cemented carbide tools, and improve the overall efficiency of production equipment.	• Energy consumption per unit Reduction of 20% (compared to FY2006)	16.2% increase compared to FY2006 (Milestone: 16% decrease) ☆☆	• Scrap generated Reduction of 40% (compared to FY2010)	20.7% decrease (Milestone: 29.1% decrease) ☆☆
	Gifu Plant	Upgrade compressed air systems as part of the manufacturing process for cemented carbide tools, reduce liquid waste through measures to prevent leaks, and focus on development of environmentally friendly products.	• Energy consumption per unit Reduction of 15% (compared to FY2006)	30.2% decrease compared to FY2006 (Milestone: 12% decrease) ☆☆☆☆	• Incorporate industrial waste indicators (volume of industrial waste produced per production value) into each medium-term plan, and continue to achieve 100%. • Continue to achieve targets for the number of certified environmentally friendly products set out in each medium-term plan.	25.3% decrease compared to FY2013 reference value (Milestone: 24.2% decrease) ☆☆☆☆ Development theme completion (1 goal) → Drills for CFRP processing / MC series (1 case) ☆☆☆☆
	Akashi Plant	Reduce losses as part of the manufacturing process for cemented carbide products, through TPM activities, and improve wastewater processes.	• Energy consumption per unit Reduction of 10% (compared to FY2011)	1.0% decrease compared to FY2011 (Milestone: 8% decrease) ☆☆	• COD load No more than 1 ton per year	0.591 t/year (Milestone: 0.815 t/year) ☆☆☆☆
Electronic Materials & Components	Yokkaichi Plant	Upgrade refrigeration systems and other equipment to energy saving models as part of the manufacturing process for silicon products, and improve treatment processes for wastewater.	• Energy consumption per unit Reduction of 1% per year (14% overall reduction compared to FY2006)	1.6% increase compared to FY2006 (Milestone: 11.4% decrease) ☆☆	• Industrial waste generated per unit (tons per ton-products) Reduction of 56.3% (compared to FY2006)	50.0% decrease (Milestone: 47.8% decrease) ☆☆☆☆
	Ceramics Plant	Upgrade air conditioning systems and other equipment to energy saving models as part of the manufacturing process for electronic devices. Develop commercial temperature sensors for motorcycles.	• CO ₂ per unit Reduction of 30.8% (compared to FY2006)	45.6% decrease compared to FY2006 (Milestone: 28.7% decrease) ☆☆☆☆	• Number of environmentally friendly products At least one per year	1 or more cases/year → 4 cases/year (sensors: 2, surge absorbers: 1, antennas: 1) ☆☆☆☆
	Sanda Plant	Upgrade coolant water systems and other equipment to energy saving models as part of the manufacturing process for functional materials. Continue to develop next generation components for high efficiency inverters.	• Energy consumption per unit Reduction of 1% per year (15% overall reduction compared to FY2006) * Specific to this plant	30.4% decrease compared to FY2006 (Milestone: 16% decrease) ☆☆☆☆	• Develop next generation components for high efficiency inverters (Effect of reduction in CO ₂ emissions when using products: at least 3 times that in FY2009)	1.9 times (Milestone: 2.8 times) ☆☆

* We have set out the following scale to indicate progress.

☆☆☆☆: 100% or higher achievement of milestones at the end of fiscal 2018 for achieving the 2020 targets, ☆☆☆: Between 80% and 100% achievement,

☆☆: Between 50% and 80% achievement, ☆: Less than 50% achievement

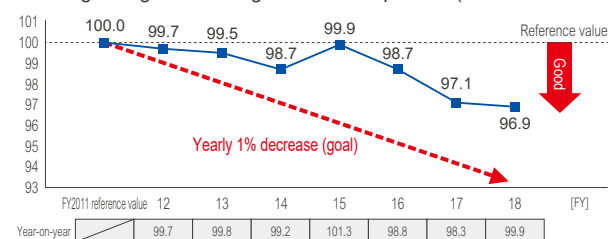
■ Changes in energy consumption per unit (non-consolidated)



[Decrease goal]
 ■ FY2011 reference value
 Year-on-year changes in consumption per unit for each fiscal year with FY2011 as the reference. The goal is to decrease consumption per unit by at least ▲1% yearly.

* Energy consumption per unit is calculated in accordance with the periodic report guidelines prescribed under Japan's Act on the Rational Use of Energy (Energy Conservation Act). As the Company's business is diverse, we identify a "value intimately related to energy use" for each business and use it as the denominator for calculations. We calculate each business's contribution by multiplying the year-on-year of each business's energy consumption per unit with that business's share of the Company's total energy use. The product is the Company's total consumption per unit (year-on-year). Greenhouse gas emissions per unit is calculated in the same way.

■ Changes in greenhouse gas emissions per unit (non-consolidated)



[Decrease goal]
 ■ FY2011 reference value
 Year-on-year changes in consumption per unit for each fiscal year with FY2011 as the reference. The goal is to decrease consumption per unit by at least ▲1% yearly.

Fiscal 2018 Reduction Activities

Progress towards Targets in FY2018

As for accomplishing our Global Warming Prevention goals, we achieved at least 100% of fiscal 2018 levels for 3 out of 9 units and less than 50% for the remaining units.

As for our Building a Recycling-Oriented Society / Environmental Contributions goals, we achieved at least 100% for 5 out of 11 items and less than 50% for the remaining 3 items.

The most common reason for achieving less than 50% was that "The external environment and other operation conditions had changed from what was expected when the goals were first set." Plants with low achievement rates are taking measures to achieve the goals.

Principal Initiatives at Each Business

We regard it as a top priority to save energy wherever possible at our manufacturing facilities and plants. That is why we are so committed to energy saving activities.

Specific activities include switching fuels, making effective use of untapped energy, upgrading processes and equipment, installing high-efficiency equipment, optimizing device specifications, and reviewing equipment controls and operating practices. We are constantly working to save energy at smaller facilities, too, including Head Office, branches, sales offices and research facilities, through measures such as installing LED lighting.

■ The Cement Business

We are working to reduce power consumption, through measures such as ensuring adequate mill maintenance, reviewing maintenance of exhaust heat power generation systems, increasing electrical equipment efficiency, and switching to LED lighting, as well as to improve energy efficiency through initiatives such as increasing the amount of alternative thermal energy sources that we use, and making energy-saving upgrades to burning equipment.

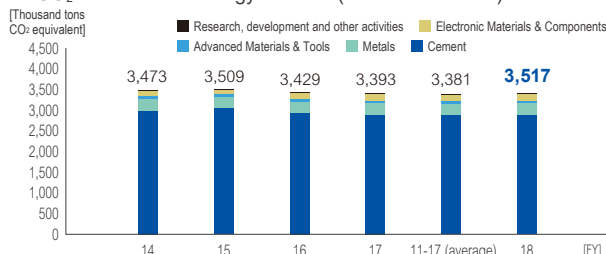
■ The Metals Business

We are working to increase energy use efficiency through measures such as saving energy from compressors and related equipment, increasing efficiency from transformers and motors, and switching to LED lighting, as well as to improve energy efficiency through initiatives such as reviewing operations for individual furnaces, in order to reduce fuel oil consumption.

■ The Advanced Materials & Tools Business and the Electronic Materials and Components Business

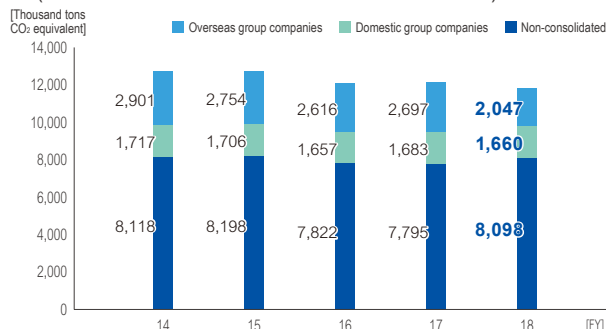
We are working to reduce power consumption through measures such as improving water pump controls, saving energy from air conditioning, refrigeration, compressors and related equipment, installing higher efficiency electrical equipment, switching to LED lighting, and upgrading various other processes, as well as to improve energy efficiency through initiatives such as optimizing controls on boilers and heat recovery equipment.

■ CO₂ derived from energy sources (non-consolidated)*



* CO₂ derived from non-energy sources comes mainly from limestone, which is used as a raw material. As it is difficult to substitute or reduce volumes of limestone, however, our emissions target covers CO₂ emissions derived from energy sources, which can be reduced by energy saving initiatives.

■ Total greenhouse gas emissions (non-consolidated + main consolidated subsidiaries)*



■ Breakdown of total emissions for Fiscal 2018*

Category		[Thousand tons CO ₂ equivalent]				
		Non-consolidated	Domestic group companies	Overseas group companies	Total companies	
SCOPE1 (direct)	From energy sources (fuel, etc.)	2,924	563	768	4,255	
	From non-energy sources	From processes	4,143	194	692	5,029
		From waste	418	267	30	716
		Greenhouse gases other than CO ₂	20	35	5	60
	(Reference) Total from non-energy sources	4,581	496	727	5,805	
Subtotal		7,505	1,059	1,495	10,060	
SCOPE2 (indirect)*	From energy sources (power, etc.)	593	600	552	1,745	
(Reference) Total from energy sources		3,517	1,163	1,320	6,000	
Total		8,098	1,660	2,047	11,805	

* "Group companies" includes 129 consolidated subsidiaries (66 domestic, 63 overseas).
 * The above data has been calculated in accordance with Version 4.3.2 of the Manual for Calculating and Reporting Greenhouse Gas Emissions.
 * SCOPE2 (Indirect) shows market base emissions. It is 1,750 [thousand t-CO₂e] for location base.

Eighth Eco Contest

We have been running an award scheme to promote activities at facilities throughout the Mitsubishi Materials Group since fiscal 2011, aimed at preventing global warming, preserving resources, and protecting the environment. The results of our fiscal 2018 contest are outlined as follows.

■ Best location award: Fuji Oyama Plant, Universal Can Corporation

They are actively engaged in activities on the environmental priority themes of “promoting energy-saving,” “preventing environmental pollution” and “managing waste” as they strive to reduce their environmental impact. Specifically, they actively promote activities for reducing waste, including switching to LED lighting and other energy-saving activities as well as turning metal scrap into valuable resources. They achieved the goals for each activity, successfully reducing the plant’s overall energy and waste unit consumption.

■ Best activities award: Sanpo Plant, Mitsubishi Shindoh Co., Ltd.

Centering on an Energy-Saving Committee (at the plant) comprising expert and local staff, they have developed energy-saving themes and are conducting activities based on a thorough discussion of return on investment. They conducted plant energy-saving contests and other energy-saving activities (adopting fan and pump inverters, renewing worn-out gas equipment, collecting and using equipment waste heat as well as air-cooling in the annealing process instead of water-cooling), reaching the goals for each activity. Through such participative activities supported by all members, they also seek to raise the staff’s energy-saving and cost awareness.

Logistic Initiatives

Our CO₂ emissions from logistics for fiscal 2018 totaled 43,910 tons for Mitsubishi Materials (up 482 tons from the previous year), and 77,320 tons on a consolidated basis*1 (down 358 tons). Energy consumption per unit*2 meanwhile came to 15.95 kiloliters per million ton-kilometers for Mitsubishi Materials (0.5% worse than the previous year), and 19.87 kiloliters per million ton-kilometers for the group as a whole (0.2% worse than the previous year).

We are working on initiatives such as promoting a modal shift and improving shipping efficiency by road, as we continue to optimize logistics throughout the group and minimize the resulting impact on the environment.

*1 Consolidated figures refer to six companies classified as “Designed shippers,” accounting for over 90% of emissions among domestic group companies.

*2 Refers to the amount of energy consumed in kiloliters crude oil equivalent (kl) divided by transportation in ton-kiloliters (million ton-kilometers)

■ CO₂ emissions according to mode of transport

(Unit: Tons CO₂)

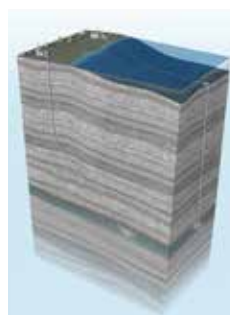
	FY2017		FY2018	
	Mitsubishi Materials	Group companies*1	Mitsubishi Materials	Group companies*1
Total	43,428	34,257	43,910	33,410
Road	8,224	26,459	8,694	26,246
Rail	1	32	35,154	7,137
Ocean	35,143	7,766	1	28
Air	59	0	61	0

Recovery and Underground Storage of CO₂

We have been keeping a close eye on carbon dioxide capture and storage (CCS) technology, capable of isolating and recovering CO₂ from production activities and storing it underground, rather than releasing it into the air. We are putting to good use the outstanding technologies and human resources that we have built up since the Company’s founding to assess the relevant underground structures.

In May 2008, we invested in Japan CCS Co., Ltd., which was established under the leadership of the Ministry of Economy, Trade and Industry. Through Japan CCS, we are participating in large-scale CCS demonstration testing in Tomakomai and studies into suitable locations for CO₂ storage.

We are also contributing to assessment studies for CO₂ storage in an environmentally friendly CCS testing project headed by the Ministry of the Environment, which started in fiscal 2017.



Outline of CCS as part of demonstration testing in Tomakomai (courtesy of Japan CCS Co., Ltd.)



CO₂ recovery plant (courtesy of Japan CCS Co., Ltd.)

Images and photos provided by Japan CCS Co., Ltd.

Towards Commercialization of Bioplastic Materials Derived from CO₂-sequestering Algae

This R&D has been adopted by the Ministry of the Environment as a “Development and Demonstration Project for Reduction of CO₂ Emission” performed by University of Tsukuba as a representative organization. We aim to realize to put “highly functional algae-derived plastic” into practice within fiscal 2022.

If cement manufacturing process as CO₂ source and algae culturing process as efficient CO₂ fixation are combined and highly functional bioplastic can be produced from emitted CO₂, it is possible to produce a substitute for petroleum-based synthetic plastics and contribute to a low-carbon, recycling society.

In collaboration with University of Tsukuba, Sobio technologies Inc. and NEC Corporation, we started joint development for practical application of this technology.



Algae culture (photosynthesis) using sunlight and CO₂ released from a cement factory



Prototype algae bioplastic

(Courtesy of the University of Tsukuba)

Producing Renewable Energy

Geothermal Power Generation Business

We stably generate environmental loading-reducing electric power through our Ohnuma Geothermal Plant and Sumikawa Geothermal Plant (steam supply only, power generated by Tohoku Electric Power Co., Inc.), both in the Hachimantai area of Kazuno, Akita prefecture. In fiscal 2018, we generated a total of 325 GWh of power, which is equivalent to a 240,000-ton reduction in CO₂ emissions compared to oil-fired power.

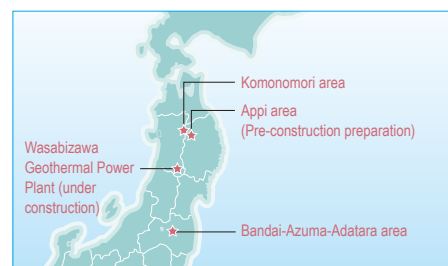
In conducting the geothermal power generation business, we have to confirm the geothermal systems of Sumikawa area, in order to maintain continual and stable supplies of steam. We are working to maintain a geothermal reservoir at the Sumikawa Geothermal Area, with the aim of increasing the amount of power generated in the future. We have been examining data, and reanalyzing geothermal systems since we started operations at the site, as we continue to focus on maintaining stable operations.

Activities for New Geothermal Development

In addition to operating existing power plants, we are currently working on new projects too. Yuzawa Geothermal Power Corporation, established jointly with Electric Power Development Co., Ltd. and Mitsubishi Gas Chemical Co., Ltd., started construction of Wasabizawa Geothermal Power Plant in May 2015. In October 2015, we established Appi Geothermal Energy Corporation in conjunction with Mitsubishi Gas Chemical Company, Inc., and went ahead with a feasibility study, including an environmental impact assessment, for the construction of a geothermal power plant in the Appi area of Hachimantai, Iwate prefecture.

We are also in the process of conducting joint surveys with other companies and in the Bandai-Azuma-Adatarata area of Fukushima prefecture. We are hoping to carry out further studies in the Komonomori area of Kazuno, Akita prefecture, providing that we can secure support from the local community.

■ New geothermal development projects



Hydroelectric Power Generation Businesses

We have a long history of generating hydroelectric power, dating back to 1898, when we built seven hydroelectric power plants in Akita prefecture, for the purpose of supplying enough power to run Osarizawa Mine (opened as a gold mine, later operated as a copper mine, closed in 1978) and homes in the local area. We were compensated for one of those power plants when a dam was built and the plant was submerged in 2000. The remaining six however are still operating today, selling on all of the power that they generate to a power company. Since 2014, we have successfully completed upgrades at three hydroelectric power plants, in an effort to deal with aging facilities. We successfully completed equipment updates at three hydroelectric power plants that were part of aging countermeasures started in 2014. We also completed updates at Oyu Hydroelectric Power Plant (Kazuno) in March 2018. We are determined to keep on securing both stable operations and stable revenue in the future.

In fiscal 2018, the combined power generated by all six hydroelectric plants was 93 GWh, which is equivalent to a 67,000-ton reduction in CO₂ emissions compared to oil-fired power. We are currently planning a new hydroelectric plant on the Komatagawa water system, in an effort to generate even more renewable energy.



Oyu Hydroelectric Power Plant

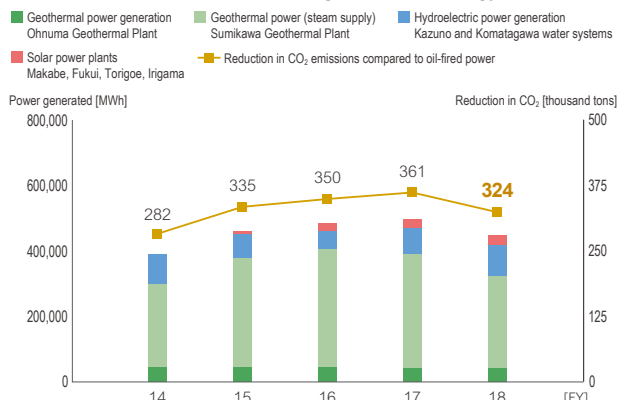
Solar Power Businesses

Having entered the solar power business in 2013, making effective use of idle group land, by 2017 we had built power plants in five locations as part of a joint venture with Mitsubishi UFJ Lease & Finance Company Limited. We are currently operating plants in Makabe (Ibaraki prefecture), Fukui, Torigoe (Fukuoka prefecture), Irigama (Miyagi prefecture), and Yabuki (Fukushima prefecture). In fiscal 2018, the combined total of power generated by all five solar power plants was 29 GWh, which is equivalent to a 21,000-ton reduction in CO₂ emissions compared to oil-fired power.



Yabuki Solar Power Plant

Reduction in CO₂ emissions using renewable energy



* The above figures have been recalculated based on the latest data published by the Central Research Institute of the Electric Power Industry (2010).

Ground Source Heat Pump Systems (GSHP)

Helping to Save Energy and Reduce CO₂ through Optimized Infrastructure and Rooftop Snow-Melting Systems

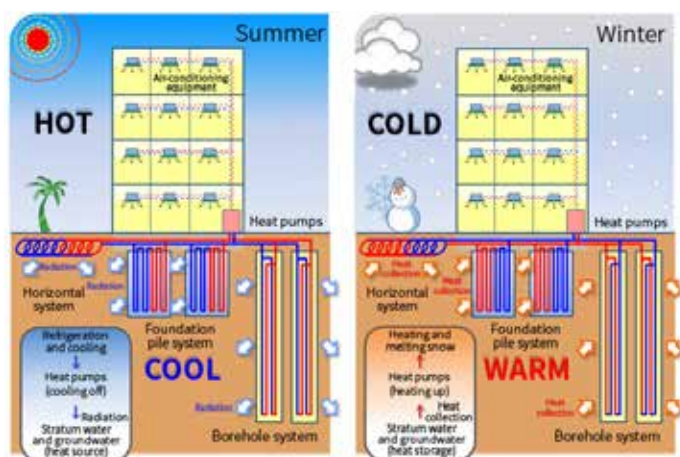
Mitsubishi Materials Techno Corporation is actively working on research and development of systems capable of harnessing “ground-source heat” as a form of renewable energy. It has successfully developed commercial systems using the borehole, foundation pile and horizontal methods, with over 100 systems installed nationwide since 2003.

We are working to develop systems to harness ground source heat using urban infrastructure. Having been included in a project spearheaded by the New Energy and Industrial Technology Development Organization (NEDO), aimed at developing technology to harness heat from renewable energies, in February 2016, Mitsubishi Materials Techno is now conducting research into low-cost GSHP systems that combine the SMW* system, which is commonly used in urban construction, with ground source heat. The end results will be compiled by the end of fiscal 2019.

From December 2015 to March 2018, the Company was commissioned by the Ministry of the Environment and conducted assessments based on empirical field trials and monitoring as to what impact the use of ground source heat has on underground ecosystems (especially microorganisms). Our report from the empirical trials concluded that we could not observe any impact on underground ecosystems by the use of ground source heat. This result is reflected in the Ministry of the Environment’s *Guidelines for the Use of Ground Source Heat (Revised and Enlarged Edition)* (March 2018).

* SMW system: Method of construction that involves taking soil (S) and mixing (M) it together with cement slurry onsite, to form a connected wall (W) in the ground.

Overview of the geothermal heat pump (GeoHP) system



Examples of systems in use

	Facility	Location	Started operations
Bore hole systems	Kazuno Wide-Area Administrative Union Fire Department (air conditioning)	Kazuno, Akita prefecture	2015
	Tokyo Metro Co., Ltd. Nakano Depot (air conditioning)	Tokyo (Nakano ward)	2015
	Ishinomaki Port Government Building (air conditioning)	Ishinomaki, Miyagi prefecture	2014
	Tokyo Skytree (district heating system)	Tokyo (Sumida ward)	2012
Foundation pile systems	Akita City Hall (air conditioning, snow-melting system)	Akita, Akita prefecture	2016
	Hachimantai City Hall (air conditioning)	Hachimantai, Iwate prefecture	2014
Horizontal systems	Iyo City Office (air conditioning)	Iyo, Ehime prefecture	2017
	Setagaya-Daita Station and Higashi-Kitazawa Station (Odakyu Line) (air conditioning)	Tokyo (Setagaya ward)	2014
Open loop systems	Mitsubishi Materials Techno Corporation Kazuno office (air conditioning)	Kazuno, Akita prefecture	2015

» Preventing Environmental Pollution

Preventing Air Pollution

We use manufacturing processes that emit air pollutants such as dust, sulfur oxides (SOx) and nitrogen oxides (NOx), as a result of burning fuel for instance. In particular, our cement and copper manufacturing operations account for the majority of those emissions. We ensure stable operations at each of our facilities, and adequately maintain the performance of electrostatic precipitator and other such emission treatment equipment, in an effort to minimize emissions of air pollutants.

Preventing Water Pollution

As well as seawater, which we use as once-through cooling water for thermal power generation at our cement plants and at our copper plants, we also use industrial water, groundwater and river water, which we discharge into the sea, rivers and sewers after use.

We install effluent treatment systems at all of our facilities, and make every effort to prevent water pollution through steps such as imposing management targets that are even stricter than wastewater standards. In addition to measures such as installing dikes to prevent chemical or oil leaks, and inspecting equipment on a daily basis, we also conduct training aimed at preventing the spread of substances in the event of a leak.

Chemical Management

The Group's manufacturing plants for non-ferrous metals, processing tools, and electronic materials handle a diverse range of chemical substances. Each plant is taking steps to reduce usage and switch to less hazardous substances by developing processes and introducing new equipment in accordance with the characteristics of each chemical substance. Through this, we are preventing hazardous chemical substances from leaking into the environment and reducing environmental risks by decreasing loads.

The Sanda Plant Shizuoka DBA Center, which manufactures DBA substrates, produces industrial waste in the form of ferric chlorides. Meanwhile, our Naoshima Smelter & Refinery purchases and uses ferric chlorides for its wastewater treatment process, thus Naoshima started using ferric chlorides from the DBA Center in fiscal 2016 after resolving quality, stable supply and other issues. As a result of continuously working on this initiative, almost all the ferric chlorides produced as industrial waste from the Sanda Plant Shizuoka DBA Center (annual maximum of approximately 1,000 tons) is reused at the Naoshima Smelter & Refinery.

Waste Management

Here at the Mitsubishi Materials Group, we make every effort to reduce the volume of waste that we generate, and to recycle resources from waste.

The plants of the Advanced Materials & Tools Company, where cemented carbide products and ultra-precision processing tools are manufactured, are working to recycle waste by keeping down amounts of waste produced, thoroughly separating the waste, and selling it. The Narita and Yasu Plants of Mitsubishi Hitachi Tool Engineering, Ltd. have been acknowledged for such continuous initiatives and were awarded by the Environment Special Award for fiscal 2018 by the Japan Cutting & Wear-Resistant Tool Association (JTA).

Further, starting in fiscal 2018, we revised our calculation methods for the amounts of waste for final disposal and recycling, dividing them into hazardous and non-hazardous waste.

Managing Abandoned Mine

Purpose of activities	Activities during fiscal 2018	Self-assessment	Targets/plans for activities from fiscal 2019 onwards
<ul style="list-style-type: none"> Managing abandoned mines 	<ul style="list-style-type: none"> Provided management training for abandoned mines Upgrading aging facilities 	A	<ul style="list-style-type: none"> Enhancement of management training for abandoned mines Upgrading aging facilities Tailings dam reinforcement work

Self-assessment grades A: Target achieved B: Target mostly achieved C: Target not achieved

Managing Abandoned Mines

We are a company with its origins in the mining industry. The Mitsubishi Materials Group owns a wide range of mines around Japan, including limestone, coal and nonferrous metal mines, such as copper, lead and zinc mines. Operations at all of our nonferrous metal mines have now been suspended or discontinued. The following controls and management programs are currently in place at 21 abandoned mines in 14 locations.

- Management of tailings dam (sites used to store rubble from mining minerals, slag and sediment from mine drainage treatment).
- Maintenance of excavated mine drift and drainage routes; implementation of safety measures at disused mine mouths and subsidence sites.
- Treatment of acidic drainage containing heavy metals from the above sites.

We continue to preserve and maintain sections of mine drift in some abandoned mines as cultural heritage sites or tourist facilities to exhibit their former conditions and preserve historical mining technologies for future generations.

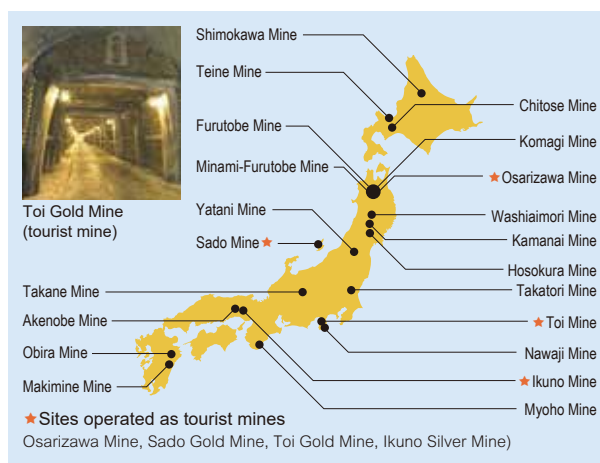
Facility Upgrading and Environmental Countermeasures for Abandoned Mines

Since 2015, all our Group companies have been implementing responses to deteriorating natural disasters and other risks by conducting protective construction to guard against pollution and other threats, reinforcing tailing dams to prevent uncontrolled release of slag and sediment in the event of major earthquakes, reducing wastewater at the source and upgrading aging facilities.

Construction costs are recorded on a regular basis as provisions for the environment. Funding for tailing dam reinforcement work at six of the 10 sites in need of reinforcement had been recorded as of fiscal 2018 along with the costs of mine pollution countermeasures, including the costs involved in reducing wastewater at its source.

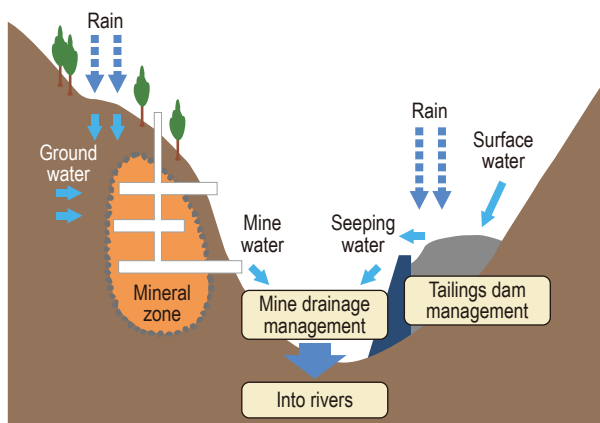
In addition to introducing these construction-based solutions, we are directing efforts toward R&D of new technologies for reducing the volume and improving the quality/treating the drainage water in mines and training human resources to handle future operations. We intend to continue our efforts to enhance efficiency and reduce the environmental burden in our management of abandoned mines.

Abandoned Mitsubishi Materials (non-ferrous) Mines



Overview of Acid Mine Drainage Treatment at Abandoned Mines

Broadly speaking, acid mine drainage can be generated in two ways. There is the acidic water in the pits (mine water) containing heavy metals, generated through contact between oxidized minerals and rainwater and groundwater, which can fill the underground pits and mining cavities formed in mineralized belts due to mining operations. Then there is the permeated water (wastewater) generated when small amounts of heavy metals in the tailings dams come into contact with rainwater and surface water. Heavy metals are removed from the acid mine drainage at processing plants and the water is then discharged into rivers according to wastewater standards after undergoing neutralization.



Major Management Tasks for Abandoned Mines

The Group controls acid mine drainage treatment, tailings dams, mine drifts and entrance drifts at the abandoned mines under our management. Acid mine drainage treatment control involves the appropriate processing of acid mine drainage. Tailings dam control involves preventing stored slag and sediment from leaking out in case of dam body collapse. Mine drift and entrance drift control involves inspections to maintain waterways for acid mine drainage and sealing entrances to prevent injuries due to third-party trespassing and mine drift collapse. In particular, acid mine drainage control is carried out around the clock every day of the year.



Mine wastewater treatment management (Teine Mine)



Tailings dam management (Ikuno Mine)



Mine drift & mine mouth management (Sado Mine)

Human Resources Development

All the Group's non-ferrous metal mines are abandoned and some time has passed since the mines were closed down. As such, we have seen a decrease in relevant human resources as engineers with skills in non-ferrous metal mining have either retired or reached advanced age. For the sake of our continuous management of abandoned mines in the future, we are actively training young engineers with little mining experience, helping them to inherit and learn techniques from experienced engineers in a variety of programs.



Group training (training for abandoned mine managers)



Emergency training



Field training (mine drift management training)

Tailings Dam Reinforcement

Drawing on lessons learned from the leakage of slag and sediment from tailings dams during the Great East Japan Earthquake, the Ministry of Economy, Trade, and Industry revised its relevant technical policies in November 2012. Based on this, we evaluated the stability of the tailings dams at abandoned mines managed by the Group, which revealed that measures needed to be implemented at 10 locations. Thus, we started construction work to design and implement stability measures at the locations in fiscal 2016.



Reinforcement work on the Yatani Mine Tailings Dam No. 1.



Reinforcement work on the Washiainori Mine Ketakura Tailings Dam.

Wastewater Reduction at the Source

In an effort to decrease the burden and risks of acid mine drainage due to environmental change (large-scale typhoons and guerrilla rainstorms) in recent years, we are conducting construction work to separate clear and waste waters as a way to preempt potential accidents. One way of doing this is to cover exposed surfaces of mineralized belts on a large scale, using the latest technology (chipcrete). This prevents rainwater from coming into direct contact with the mineralized belts, which is expected to reduce the amount of water to be processed as well as the burden of contamination.



Contamination containment work at Komagi Mine: membrane section waterproofing



Contamination containment work at Komagi Mine: chipcrete section

» Preserving the Natural Environment

Purpose of activities	Activities during fiscal 2018	Self-assessment	Targets/plans for activities from fiscal 2019 onwards
<ul style="list-style-type: none"> Promoting biodiversity-oriented activities 	<ul style="list-style-type: none"> Undertook activities to protect endangered species of plants in nature conservation areas Carried out tree-planting activities at mines 	A	<ul style="list-style-type: none"> Continue with current activities for the time being
<ul style="list-style-type: none"> Ensuring sustainable management of company-owned forests 	<ul style="list-style-type: none"> Maintained forest certification based on documentary screening and site inspections (Otaru Forest, Shiraoi Forest) Provided placements for seven overseas trainees as part of JICA issue-specific training, and organized training workshops Tree-planting ceremony with local participants in Teine Forest (44 participants) 	A	<ul style="list-style-type: none"> High added-value use of broadleaf-tree resources (use for office furniture, etc.) Measure forest resources using drones Continue tree-planting and raising ceremonies and activities

Self-assessment grades A: Target achieved B: Target mostly achieved C: Target not achieved

Preserving Biodiversity

Monitoring Water Quality at Copper Mines (Copper Mountain Mine)

We invest in Copper Mountain Mine, located in British Columbia, Canada, where we engage in corporate management with an emphasis on biodiversity. We continually monitor the quality of water in local rivers, in accordance with quality guidelines issued by the provincial government, and also carry out ongoing surveys into fish populations, in order to gauge the impact of our activities on the ecosystem.



Surveying fish populations

Environmental Impact Assessment as part of Copper and Gold Deposit Development Project

We are carrying out a basic environmental study geared towards conducting EIA* as part of a development project in Zafranal, in southern Peru. At the same time, we are studying and analyzing the potential impact on the environment by the development, and are looking into ways to secure new habitats for species of flora and fauna if there is a risk of any impact on the ecosystem.

* Environmental Impact Assessment



Exploration drilling



River water quality survey

Initiatives at Limestone Mines (Cushenberry Mine)

At Cushenberry Mine in California, Mitsubishi Cement Corporation extracts limestone and also manufactures cement at the foot of the mine. Having worked with local experts to develop and plant trees across a mining area covering 25,000 square meters. Around 90% for the trees we have planted to date have grown. We also carry out activities to protect precious wild animals in the area, in conjunction with the local preservation authorities, and have maintained watering stations ever since the area was operational, in an effort to protect bighorn sheep and other wildlife living in the hills behind the mine.



Bighorn sheep
(taken with an automatic camera)

Initiatives at Limestone Mines (Mount Buko)

The Une Mine of Ryoko Lime Industry Co., Ltd. extracts limestone from Mount Buko, which is the symbol of the Chichibu area in Saitama Prefecture. In the area in which limestone is extracted, we have planted more than 20,000 trees, the majority being Euptelea and willows native to the area. Despite the harsh environment with a slope facing north and an altitude over 1,000 meters, 35 years have passed since we planted the first trees and they are now more than 5 meters tall. Wild larch, beech and other trees have also found their way in from the adjacent forest and the mining site is slowly but steadily returning to its original state. In recent years, the fresh verdure can be seen from the city in May, allowing local residents to observe the achievements of our greening activities as well.



Greening at Une Mine

Sustainable Management and Operation of Company-Owned Forests

Basic Approach to Sustainable Forest Management

We currently own around 14,000 hectares of forestland in Japan, mainly in Hokkaido, making us one of the largest owners of forestland in the country. We originally began acquiring forests for the purpose of supplying wooden supports for our own mines and coal mining activities. As we no longer operate domestic mines or engage in coal mining however, our forests now fulfill different roles and are subject to different expectations.

At present, we are managing forests for the purpose of harnessing their diverse public interest functions, including the production of lumber as a renewable resource, the provision of public recreational spaces, the prevention of global warming by fixing CO₂, and the conservation of biodiversity. Not all company-owned forests are the same as their location and environmental conditions vary by area, as do the functions they are hoped to fulfill. As such, we divide the forests we manage into four categories (zoning): water and ecosystem conservation zones, health and cultural usage zones, selective natural forest cutting zones, and timber resource recycling zones. We specify what functions need to be developed and what management methods apply for each zone type. All the while steadily conducting this kind of meticulous forest management, we will make continuous efforts to preserve the rich forests now and in the future under the slogan “Mitsubishi Materials’ forests will lead the way for forests throughout Japan.”

By way of outside recognition for sustainable forest management initiatives such as these, on 1st October, 2012, we obtained certification from the Sustainable Green Ecosystem Council (SGEC) at Hayakita Forest in Hokkaido. Since then, the SGEC has revised and introduced certification standards outlining transitional procedures for mutual certification with the Programme for the Endorsement of Forest Certification (PEFC), an international forest certification scheme. With that in mind, we simultaneously obtained forest certification under the SGEC’s new standards for a total of nine forests in Hokkaido in 1st September, 2015, including Hayakita Forest.

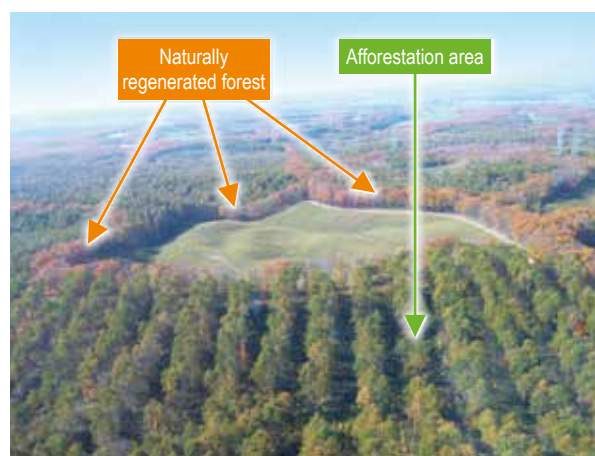
■ The zoning of company forests and management policies

Zone	Activity
Water and ecosystem conservation zones	Maintain the natural forest by the water and convert it into a natural forest if artificial
Health and cultural usage zones	Create a model forest and facilities for walking and other forms of forest recreation
Selective natural forest cutting zones	Produce useful broad-leaved trees in a sustainable manner by felling trees in naturally regenerated forests within a range not exceeding their growth
Timber resource recycling zones	Sustainably produce lumber from artificial needle-leaved forests



■ Data on Company-owned forests

- 31 locations nationwide
- Total area: 14,513 hectares
- SGEC certified area: 11,541 hectares * 9 forests in Hokkaido
- Natural forest: 6,976 hectares
Manmade forest: 7,467 hectares

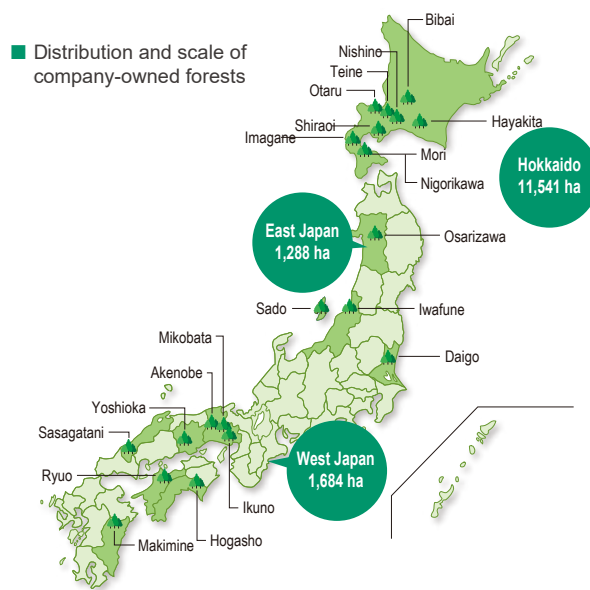


Hayakita Forest

The forest is laid out in a mosaic pattern, based on appropriate zoning between naturally regenerated forest (trees that have grown naturally) where felling is prohibited, and afforestation areas (trees grown from seedlings planted manually), planted with larch to be used for recycled resources.

Role of Individual Forests

The role played by each of our forests depends on factors such as the forest's terrain and location. Hayakita Forest, for example, is located on a gentle incline, which makes it easier to maintain the forest efficiently. It also benefits from an excellent location from the standpoint of logistics, situated close to paper factories that use a great deal of wood, and to the Port of Tomakomai, which is heavily used for shipping outside Hokkaido. That is why Hayakita Forest is positioned as a "resource forest," geared primarily towards sustainable timber production. In contrast, Teine Forest is located within the city limits of Sapporo. It is positioned as an "environmental forest," somewhere for local people to cherish, as a rare slice of rich forestland on the outskirts of their city. As well as providing space to City of Sapporo, for purposes such as camp grounds, public access and nature walks, we also give local NPOs access to fields to carry out natural activities, and even offer up part of our company-owned forest for local elementary school children to practice skiing. Our aim is to create a forest environment that is embraced by the local community.



The Extensive Value and Potential of Company-Owned Forests

The Value of Company-Owned Forests



1. Contributing to a recycling-oriented society –Supplying society with sustainable timber resources–

Timber is an outstanding sustainable resource. We produce timber primarily through our "resource forests," and provide society with a steady supply, which in turn contributes to the establishment of a recycling-oriented society.

In our "resource forests," toward the sustainable forest management, we maintain an even spread of trees of different ages, and continue to fell and replant a certain portion of each forest, to ensure that we can supply timber consistently over the long term. We have also formulated our very own management standards for each species of tree that we plant, and have set out long-term management plans running up to 80 years into the future, so that we can continue produce high quality timber at a reasonable cost. As the natural world is constantly changing, reality frequently deviates from our initial plans. That is why we carry out onsite surveys across all of our forests every five years, when formulating forest management plans. This enables us to revise plans flexibly, and take remedial measures along the way, to bring us closer to achieving our goals for each forest.



Survey in progress

2. Contributing to the local community –Forests where local people can relax and interact with the wonders of nature–

As well as being company's assets, our company-owned forests are also an important element of the environment, in terms of shaping the local area. Adequate forest management enhances functions that benefit the public as a whole, including watershed protection and prevention of soil loss, all of which helps to prevent disasters in the local area.

Company-owned forests located on the outskirts of urban areas meanwhile are positioned as "environmental forests," parts of which are open to local people to enjoy the natural environment up close. Located in the Teine area of Sapporo, Teine Forest offers a slice of rich forestland that also has excellent transport access from the city center. We open up part of the forest to the people of Sapporo as a public forest, for purposes such as nature walks and camping ground. We also provide access to fields for nature activities organized by local NPO Teine Sato-gawa Tankentai, as a practice slope for local elementary school children to improve their skiing, and for research by universities and other institutions. That is why it is important to maintain an environment that is suitable for each of these purposes, so that everyone in the local community is able to use our company-owned forests in a meaningful way. We bring in light to the interior of our forests, by thinning out trees in dark areas where overcrowding is blocking the sunlight, and quickly remove dead or damaged trees that are at risk of falling, in order to make the forest a safe place. If paths become difficult to use, due to mud caused by melting snow or heavy rains for instance, we lay down timber and take steps to maintain surfaces, so that visitors can walk along the paths with confidence.

As a way to let local residents know about the value and fun that forests provide, we hold tree planting festivals in our forests. In the future, we will be creating more opportunities for local residents to interact with the forests through these kind of active initiatives, and increase our efforts to make the forests of Mitsubishi Materials into valuable features of their local areas.



Experiencing taking sap from a painted maple (Teine Forest)



Tobogganing (Teine Forest)



Maintaining muddy paths (Teine Forest)



Tree growing festival (Teine Forest)

3. Contributing to a low-carbon society –CO₂ fixation–

One of the important ways in which forests benefit all of us is through the function they perform in terms of CO₂ fixation. As one of the largest owners of forestland in Japan, we dedicate ourselves to sustainable forest management, and do our level best to enhance the CO₂ fixation capabilities of the trees in our forests, so that we can do our bit to prevent global warming. The CO₂ fixation capabilities of our forests is estimated* to be 54,000 tons per year (corresponding to amount for approx. 26,000 people).

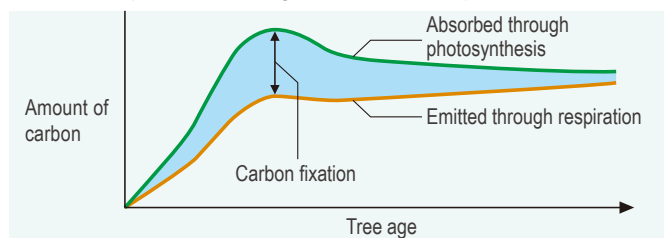
The ability of forests to fix CO₂ peaks during the period when trees are young or middle-aged. When they age beyond that point, their fixation capabilities start to decline. That is why we make every effort to regenerate our forests, by felling and planting new trees at the right time, in an order to maintain CO₂ fixation capabilities over the long term.

When trees are cut down, the CO₂ remains inside the timber. In particular, CO₂ remains fixed over a longer period of time if timber is used on a long term basis, as a building material for instance. We therefore contribute to effective CO₂ fixation by maintaining stable production of quality timber that can be used for purposes such as building materials, focusing particularly on major commercial species such as Japanese larch and cedar.

* Method of calculation

Growth (m³) x material volume weight (t/m³) x carbon conversion efficiency x tree/trunk ratio x CO₂ molecular weight / carbon molecular weight

Relationship between tree age and carbon absorption/emissions



Japanese larch

* Edited from documents published by the Forestry and Forest Products Research Institute (FFPRI)

4. Conserving biodiversity –Maintaining an environment suitable for a wider range of wildlife–

As our company-owned forests also provide a habitat for a diverse range of wildlife, we take the utmost care to ensure that our various activities, including timber production, do not have a detrimental impact on living organisms.

In addition to prohibiting the felling of trees in key locations where creatures live and move around, including forest ridge and riverside areas, we also refrain from clearing large areas of land even in timber production areas. Ensuring that we never clear connecting areas and that we disperse the areas for the felling of trees enables us to maintain biodiversity within the forest environment. We are also introducing trial forest management schemes in selected areas, aimed at conserving biodiversity. These include managing felling so that we leave underlayer trees after cutting down upper layer trees, rather than bare earth, and actively mixing coniferous and broad leaf trees in certain areas, in order to give the forest a more diverse structure.

We carry out wildlife monitoring on a daily basis too. As well as recording wildlife sightings while on patrol around our forests, we have positioned plant survey sites where we keep track of any changes in plant life, and fixed camera traps to monitor populations of wildlife living in the area. When felling trees or engaging in other such activities, we carry out monitoring surveys before and after, to ensure that wildlife has not been affected. If we find that there are any rare species in the area, we look into ways to minimize impact from our activities, such as felling trees at more suitable times of year.

Rare species that have been confirmed to be living in the area (most endangered species included on red lists published by the Ministry of the Environment and Hokkaido Government) are included in our own red list of rare species living in Mitsubishi Materials company-owned forests. Warnings are also issued to all concerned parties with access to the relevant forests.



Daily monitoring



Wildlife camera trap

Confirmed rare species (As of August 2017)

Mammals 1 species	Aquatic 4 species	Plants 13 species
Birds 12 species	Insects 1 species	



Japanese sable



Black woodpecker



Masu salmon



Japanese primrose



Dogtooth violet

Policies for maintaining and improving biodiversity

1. In order to maintain and improve the biodiversity of individual forest, we conduct flora and fauna surveys, either by ourselves or by hiring someone. Based on the results, we prescribe a biodiversity conservation program in each company forest's management and administration plan.
2. The abovementioned flora and fauna surveys prioritize resource recycling forests for clearcutting.
3. The results of the abovementioned flora and fauna surveys are of highest priority for the zoning in the individual company forest's management and administration plans.
4. We stipulate preservation plans for animals and plants listed in the red data book.
5. All waterside forests in fens or marshes should be zoned as biodiversity preservation zones in the individual company forest's management and administration plan, and forest operations should not be conducted as a principle. The extent of the waterside forests' preservation zones are individually determined based on the terrain, but they should generally cover about 10 meters on each side.
6. Natural forests are as a rule zoned as either water and ecosystem preservation zones or selective cutting zones. Taking into consideration the continuity of natural forests, only suitable places will be made timber resource recycling zones for needle-leaved artificial forests.
7. Natural forests along ridges are maintained as water and ecosystem preservation zones.
8. With the exception of larches, no non-native species are to be planted.
9. Hunting is prohibited in company forests as a principle. Moreover, non-forestry activities that hinder the maintenance of biodiversity should also not be conducted as a rule.
10. The picking of wild animals and plants should not exceed sustainable levels and efforts should be made to prevent inappropriate activities.

(Excerpt from a company forest management and administration plan)

» Developing Environmental Technologies and Products

Basic Policy on R&D

Developing New Products and Technologies to Anticipate Changes in the World Around Us

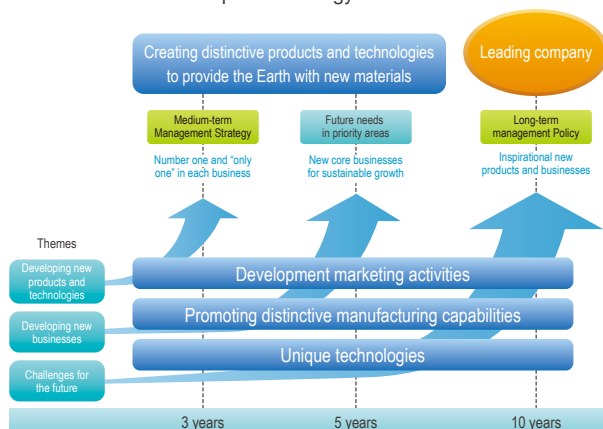
Our basic policy when it comes to development is to precisely identify customers' needs and future technology trends, and to develop and provide products and technologies that anticipate changes in the world around us. With this policy in mind, we aim to provide the Earth with new materials that make the most of the group's unique technologies. This means creating distinctive products and technologies that will be competitive in the global market, and upholding our strategy of becoming a world's leading company.

We also engage in a development strategy with the aim of creating timely new products and technologies that will help us to become the number one, and "only one," in each of our lines of business in the short term. Over the medium term, we intend to focus on developing new core businesses that will underpin the sustainable growth of the entire group, particularly in next-generation vehicles, IoT and AI-related products and areas where we can contribute to a realization of fulfilling sustainable society. On a longer-term basis, we intend to boldly take on the challenge of creating inspirational new technologies for the future. Combining technology, human resources and passion, our aim is to continually achieve innovation, with an emphasis on the customer's perspective and speed.

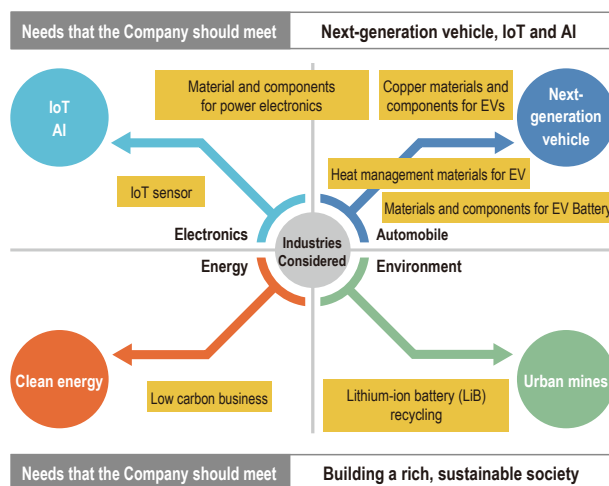
Examples of Environmentally Friendly Development

We are also committed to improving manufacturing processes, and reducing environmental impact from our materials and components. We use computer analysis technologies to optimize operating conditions at our cement plants, to achieve further reductions in CO₂ emissions due to thermal energy sources. We have rolled out the same technology to manufacturing processes for copper smelting and polycrystalline silicon, to enable us to improve quality and increase efficiency. We are also working on technologies capable of harnessing alternatives to fossil fuels, including waste plastic and shredder dust, as well as using recycled raw materials in the smelting process and recovering rare metals from urban mines. In an effort to save energy and extend the life span of our materials and components meanwhile, we are working on development in areas such as coating films for cemented carbide products, battery materials, connector terminals, insulated circuit substrates and temperature sensors.

■ Research and development strategy



■ Creation of new products and businesses



Developing Environmental Technologies and Products

Developing a high-precision temperature measuring system to enhance the energy saving effect for cement production

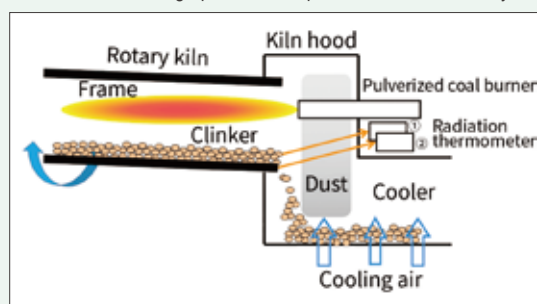
As we seek to alleviate climate change, there is a need to develop new energy-saving technology for cement production. The temperature of the clinker*¹ fired inside rotary kilns,*² which is a type of cement production equipment, is measured using radiation thermometers,*³ but there was a problem that the precision is low due to dust composed of clinker particles dispersing, absorbing, and radiating luminous energy.

Wanting to ensure that the clinker firing does not waste energy, the Company and CHINO Corporation used a technique called the Dust Canceling Method to develop a high-precision temperature measuring system that can be used in a cement rotary kiln under high concentration of dust. Having tested it in a real kiln, it was successfully shown to be able to measure temperatures within a range of $\pm 25^{\circ}\text{C}$, which represents a huge increase in precision when compared to the -150 to -60°C error range of conventional radiation thermometers.

This system not only contributes to decreasing thermal energy consumption in the clinker firing process, which is the most energy-consuming in the cement production process, but we believe that it will be indispensable for realizing low-temperature clinker firing technology that uses mineralizers,*⁴ whose commercialization is expected to become a reality soon. Moreover, we also expect that it can be applied to temperature measurement in other industrial furnaces where dust is a problem, outside of the cement production process. Mitsubishi Materials Corporation and CHINO Corporation will be increasing the system's measurement precision, reliability, and durability, and plan to productize it in fiscal 2021.

Moreover, this research was implemented as part of a project promoted by the New Energy and Industrial Technology Development Organization (NEDO).

■ Overview of the high-precision temperature measurement system



*1 Lumps of limestone, clay, silica stone, iron, and other materials a few centimeters in size resulting from kiln firing. It is pulverized together with gypsum to produce cement.
 *2 Rotating continuous high temperature firing device. The raw ingredients are entered above into the slightly tilted "steel tube lined with fire brick" and the burner flame is applied from beneath. The ingredients are fired while slowly moving downward due to their own weight and the rotation.
 *3 A measuring instrument that takes in luminous energy corresponding to the temperature radiated from an object of measurement and converts this into a temperature value.
 *4 A technology that lowers the firing temperature of clinker by about 100°C by adding mineralizers (fluorine and sulfur trioxide). It is expected to save around 2.6% of energy. It was developed as part of Developing Basic Technologies for Innovative Cement Production Processes, a 2010–2014 project subsidized by the Ministry of Economy, Trade, and Technology. Clinker particles tend to become smaller during low-temperature firing, which generates more dust and so may reduce measurement precision.