

Developing and Providing Recyclable Products

In Pursuit of a Recycling-oriented Business Model

Purpose of activities	Activities during fiscal 2023	Self-assessment	Targets/plans for activities from fiscal 2024 onwards
Expand processing of recyclables (Metals Business (Smelting sector))	Promoted the recovery of trace components in recycled raw materials	A	Strengthen and expand the scale of networks aimed at recycling resources
	Planned construction of a recycled raw material pre-processing facility at the Onahama Smelter of Onahama Smelting & Refining Co., Ltd.		Increase the recycling rate by expanding E-Scrap processing
			Create a recycling business for rare earth elements and rare metals
Aiming to be the driving force of resource-recycling systems Providing reliable recycling systems, such as by ensuring traceability (Metals Business (Resource-recycling sector))	Implemented automatic dismantlement robots	B	Expand the home appliance recycling business, promote automation of home appliance recycling, and improve the added value of collected items
	Introduced system for managing home appliance recycling operations (other site)		Demonstrate next-generation vehicle recycling technologies, LIB recycling technologies
	Implemented demonstration of LIB recycling system		Achieve commercial implementation of a solar panel recycling system
	Consideration of PV recycling system		Promote DX (recycling of home appliances)
Promoting the recycling of fluorine resources (Advanced Products (Electronic Materials & Components))	The amount recycled was 1,354 tons/year, 27% below the budget	C	Ensure the stable operation of recycling plants and achieve the plan of the amount recycled
	The raw material recycling rate was 14%		
Promoting the recycling of tungsten (Metalworking Solutions Business)	Recycling rate increased (by 188% from the fiscal 2018 level)	A	Increase the recycling rate (by 192% from the fiscal 2018 level)
	Increased recycling collections		Expand amount of materials recovered for recycling (expand overseas recovery area)

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

Recycling-oriented Business Model

Overview of our Recycling-oriented Business Model

The Mitsubishi Materials Group is a complex corporate entity encompassing a wide range of technologies and expertise, from resources upstream to materials midstream to processed products downstream. We have continued to make the most of those capabilities on a groupwide scale, in an effort to establish a Recycling-oriented business model based on recovering resources from a wide range of waste products.

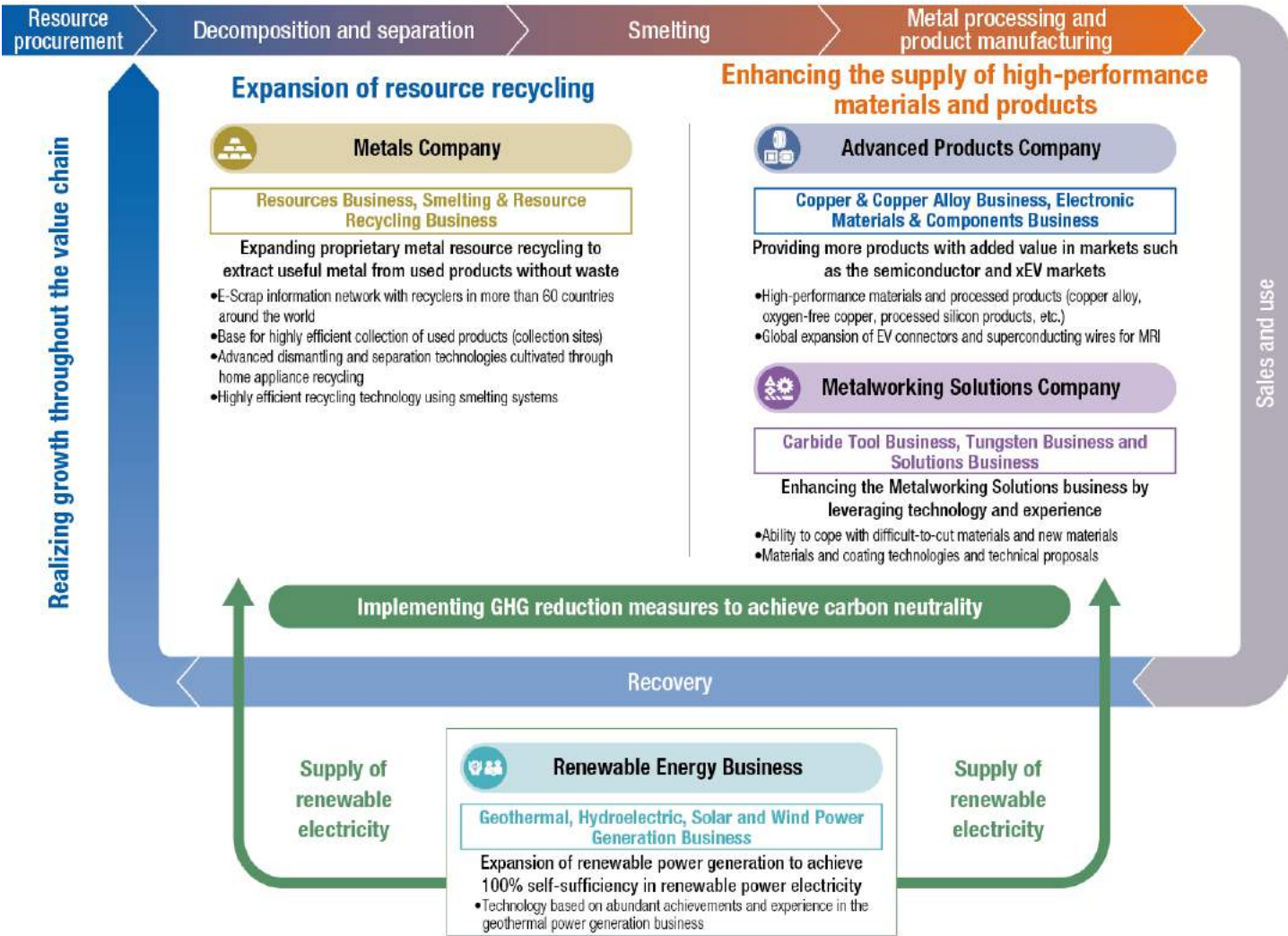
We strive to create cyclical value chains in each of our businesses, so that resources and materials are processed into products and then recycled back into materials. This also helps to promote Recycling-oriented social systems (Circular Economy). We will achieve growth throughout the value chain to expand resource recycling. We will achieve this by leveraging our strength in advanced disassembly and separation technologies in the home appliance recycling business, along with recycling technologies in the smelting business, expanding the range of items to which these technologies are applied, the regions in which we operate, and the scale of operations.

In the recycling of metal resources, we will recover used or discarded products, disassemble or separate them, input the materials into smelting or other processes to extract useful metal elements, then process or fabricate those elements into high-performance materials and products that will be supplied to the market.

In this way, we will design and build a circulatory system for resources through “veins” that circulate resources, “arteries” that supply high-performance materials and products, and once again through “veins” via the market. At the same time, the renewable energy business will supply the renewable energy-based power it has generated to the entire business, contributing to progress in reducing greenhouse gases on the way to achieving carbon neutrality.

■ Recycling-oriented Business Model of the Group

Build a recycling system for metal resources based on our strengths and realize growth throughout the value chain by expanding the scope, regions and scale of our operations



Advanced Technology-based Waste Recycling

Recycling in Individual Businesses

Metals

■ Recycling Rare Metals

PGM* are rare metals that are found in E-Scrap, etc. Group company Materials Eco-Refining Co., Ltd. refines PGM intermediate materials obtained from our Naoshima Smelter & Refinery, to create products such as metals and chemical compounds. Platinum and palladium in particular are key materials in the automotive, electric and electronic sectors. With that in mind, we applied to register our brand with the London Platinum and Palladium Market (LPPM), as a means of ensuring credibility in the market, and successfully obtained certification in September 2012. We are determined to keep on improving the quality of our products, and make every effort to ensure stable supplies of rare metals.

* Platinum Group Metals

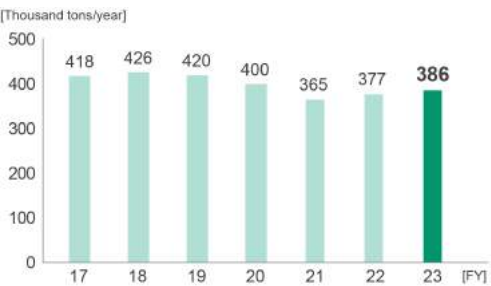
■ Recycling Scrap

We use smelting technology for the purpose of recycling at our smelters and refineries. We take in a wide variety of scrap, including shredder dust and used batteries from sources such as used home appliances or scrap vehicles, and E-Scrap from sources such as used substrates and connectors. We then recycle scrap, by using it for raw materials or thermal energy, and recover valuable metals.

The rare metal recycling process



Volume of scrap processed

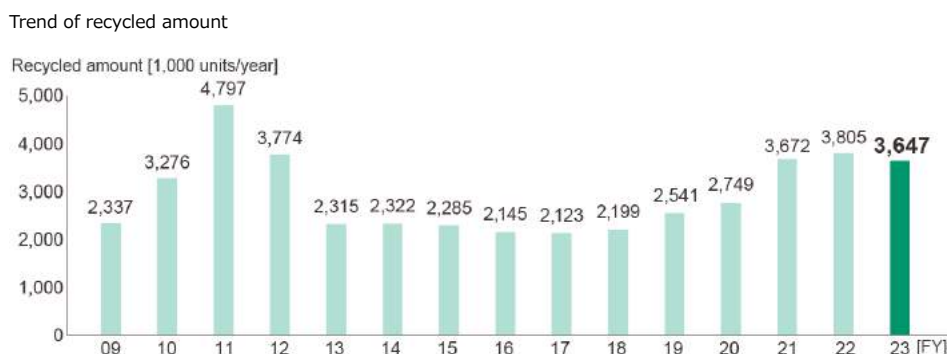


■ Home Appliances Recycling

Home appliances are made by combinations of various materials such as glass, plastic and rubber as well as metals such as steel, aluminum, and copper. Home appliances are first of all disassembled manually, then crushed and sorted at our home appliances recycling plants*¹, which are operated in partnership with home appliance manufacturers. We have adopted several advanced sorting processes for components and materials, and are always trying to create more value from recovered materials and to improve recycling efficiency. We recover copper and other precious metals from recovered copper-based materials and printed circuit boards in our copper smelting process. Thus, we maximize the effect of synergies within our Group. In fiscal 2023, we recycled 2,746 thousand units of home appliances at six plants of our five affiliated companies (6 companies, 7 plants, 3,647 thousand units) *². Recycling of this volume could reduce landfill disposal equivalent to 121 thousand tons.

▶ [Home appliance recycling plant](#)

* This data is only available in Japanese on the website.



*1 Major partners: Hitachi, Ltd., Sharp Corporation, Panasonic Corporation

*2 There are 6 companies and 7 factories for home appliance recycling, but 5 companies and 6 factories are subject to LCA evaluation.

Advanced Products (Electronic Materials & Components)

■ Recycling Fluorine Resources

We manufacture a range of fluorine compounds at the Group company Mitsubishi Materials Electronic Chemicals Co., Ltd., including materials for use in semiconductor manufacturing, flame retardant and antistatic materials, and hydrofluoric acid. Since fiscal 2007, we have been engaged in the recycling of fluorine resources in which we recover calcium fluoride waste emitted by companies using fluorine compounds and recycle it back into fluorine resources that can be used as alternative raw materials for fluorite. We will promote the recycling of fluorine resources through further technical innovation.

Metalworking Solutions

■ Recycling Tungsten

Waste containing rare metals contains such a high percentage of rare metals that it is possible to extract them more efficiently than obtaining metals from natural resources. A prime example is tungsten, the main raw material used in cemented carbide products. Making the most of the Mitsubishi Materials Group's comprehensive capabilities as a manufacturer, from raw materials through to finished products, we are currently focusing on recycling used cemented carbide products in an effort to secure stable supplies of raw materials.

Affiliated Business

■ Recycling Industrial Waste and Byproducts

Using a burning process that reaches temperatures of 1,450°C, the Group's cement plants detoxify and make effective use of industrial waste and other difficult-to-treat materials without generating any secondary waste. As well as using substances such as coal ash, construction sludge, sludge, incineration fly ash, copper slag byproducts from copper smelters, and gypsum as the raw materials of cement, we also turn materials such as waste plastics, waste tires and wood waste back into cement, by using them as a source of thermal energy.

■ Incineration Fly Ash Recycling

The Company promotes a recycling business that dechlorinates the incineration fly ash generated when household waste, etc. is burned to recycle it as material for cement.

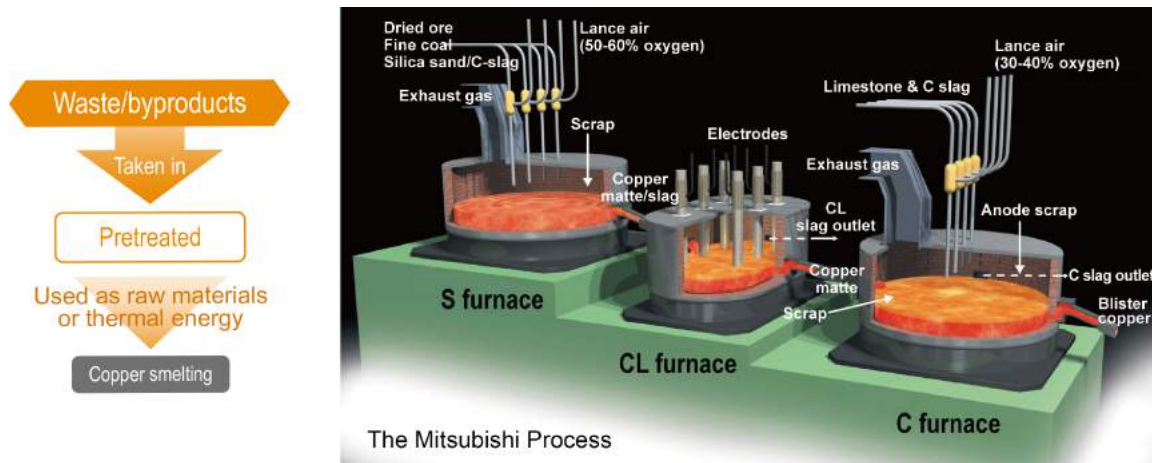


Kitakyushu Ash Recycle Systems Co., Ltd.

Smelter & Refinery: Recycling Resources from Urban Mines

■ The Mitsubishi Process

Our unique Mitsubishi Continuous Copper Smelting and Converting Process (Mitsubishi Process) continuously produces blister copper from copper concentrate and recycled raw materials by connecting a series of three furnaces with pipes. As the required facilities are compact and help save energy and reduce costs, they have an exceptionally low environmental impact and produce a copper manufacturing process renowned for its high efficiency.

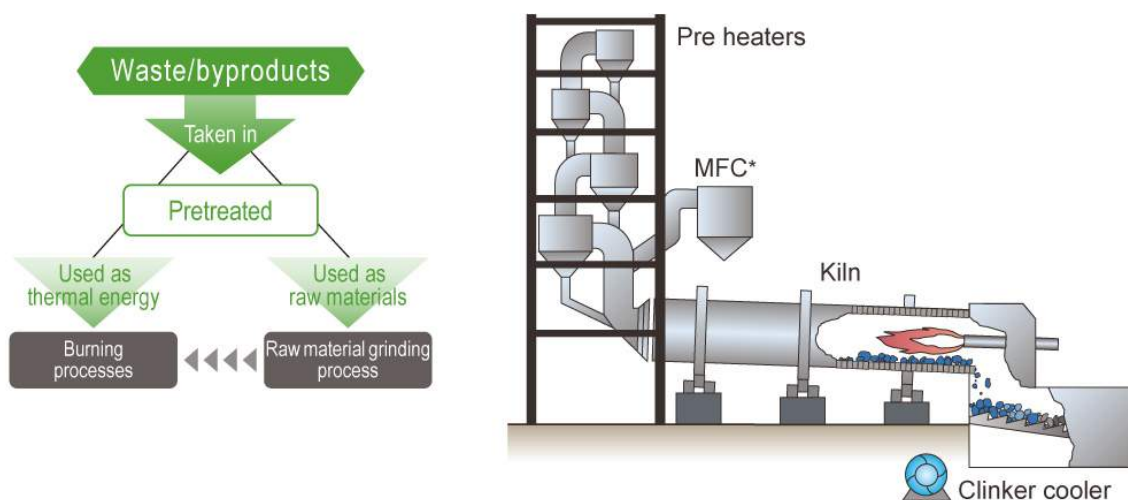


Cement Plants:

Taking in, Detoxifying and Stabilizing Difficult-to-treat Waste from Other Industries

■ High Temperature Burning Process

Raw materials (including wastes and byproducts) are prepared during the raw material grinding process and then sintered at high temperatures to produce a hydraulic mineral during the burning process. Once the raw mixture has reached the maximum temperature (1,450°C) and a series of chemical reactions are completed, it is quickly cooled into an intermediate product called clinker.



* MFC: Calciner

■ Key Features of Waste Treatment at Our Cement Plants

- Capacity to treat large volumes of waste
- Detoxification of waste products
- No secondary waste (extending life span of final disposal sites)

Home Appliance Recycling Plants :
Used Home Appliances are Disassembled and Recovered Items are Supplied as Materials

■ Reduction in Environmental Impact due to Recycling Home Appliances (LCA analysis for fiscal 2023)

If recycling home appliances is conducted, so that resources are recovered from used appliances and reused as new materials.

	Item	Total
Compared to sending used appliances to landfill and manufacturing new materials from natural resources	Reduction in GHG emissions (CO ₂ equivalent)	200,000 tons
	Reduction in consumption of natural mineral resources	139,000 tons
	Reduction in energy consumption (crude oil equivalent)	94,000 tons
	Reduction in waste sent to landfill	121,000 tons



Robot unscrews flat-screen TVs

The above table does not take into account the impact of recovering fluorocarbons (refrigerant fluorocarbon in air conditioners, refrigerators, and washing machines, and insulation fluorocarbon in refrigerators). Expressed in terms of CO₂ emissions, recovering approximately 554 tons of recovered freon would equate to a reduction of approximately 1,350,000 tons.

* There are 6 companies and 7 factories for home appliance recycling, but 5 companies and 6 factories are subject to LCA evaluation.

* "The National Institute of Advanced Industrial Science and Technology IDEA Ver. 3.3" is used to assess the effectiveness of GHG emission reductions and landfill disposal reductions.