Sumitomo Heavy Industries Group's Initiatives for Carbon Neutrality

Reduction Contribution / Energy-Saving Edition

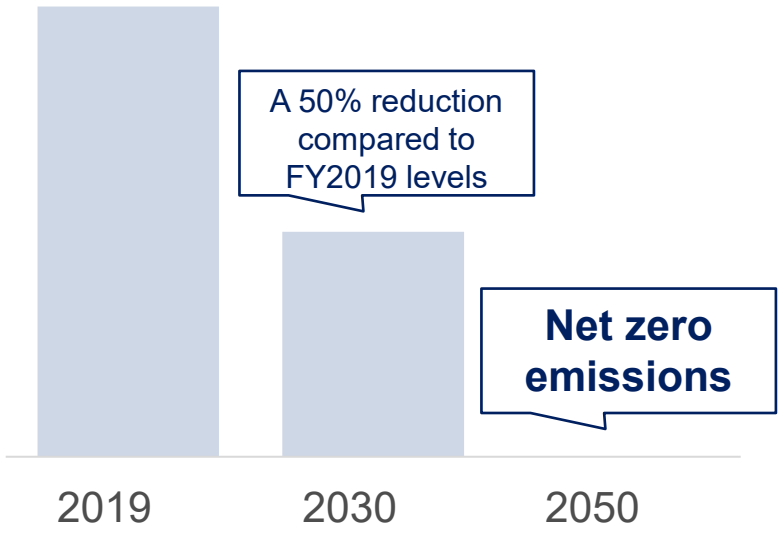
Sumitomo Heavy Industries, Ltd.

October 2024
(Last update: June 2025)

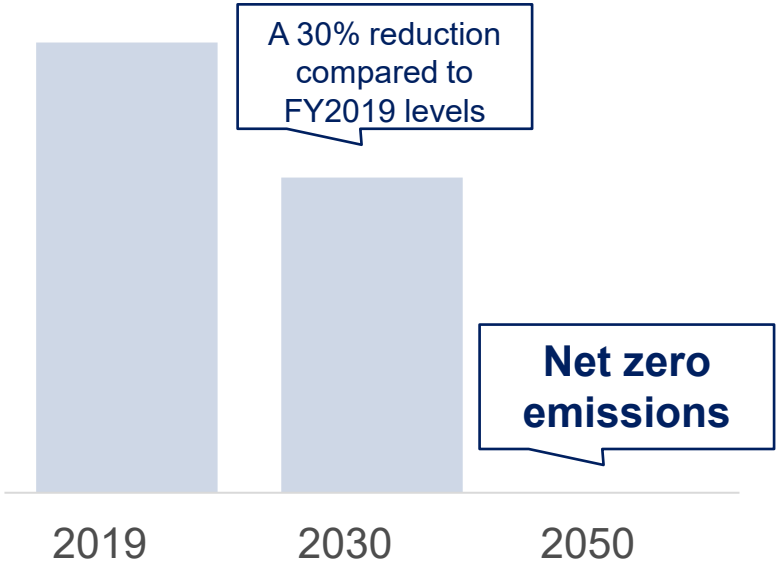
Response to Climate Change Risks

- The Sumitomo Heavy Industries Group (SHI Group) is working on reducing environmental impacts from the perspectives of "reducing the impact its business activities have on the environment" and "improving the environmental performance of its products." Notably, the SHI Group positions "climate change" as a social issue it should contribute to solving.
- The SHI Group aims to become carbon neutral by 2050 and set CO_2 emission reduction targets up to 2030 to achieve the ultimate goal.

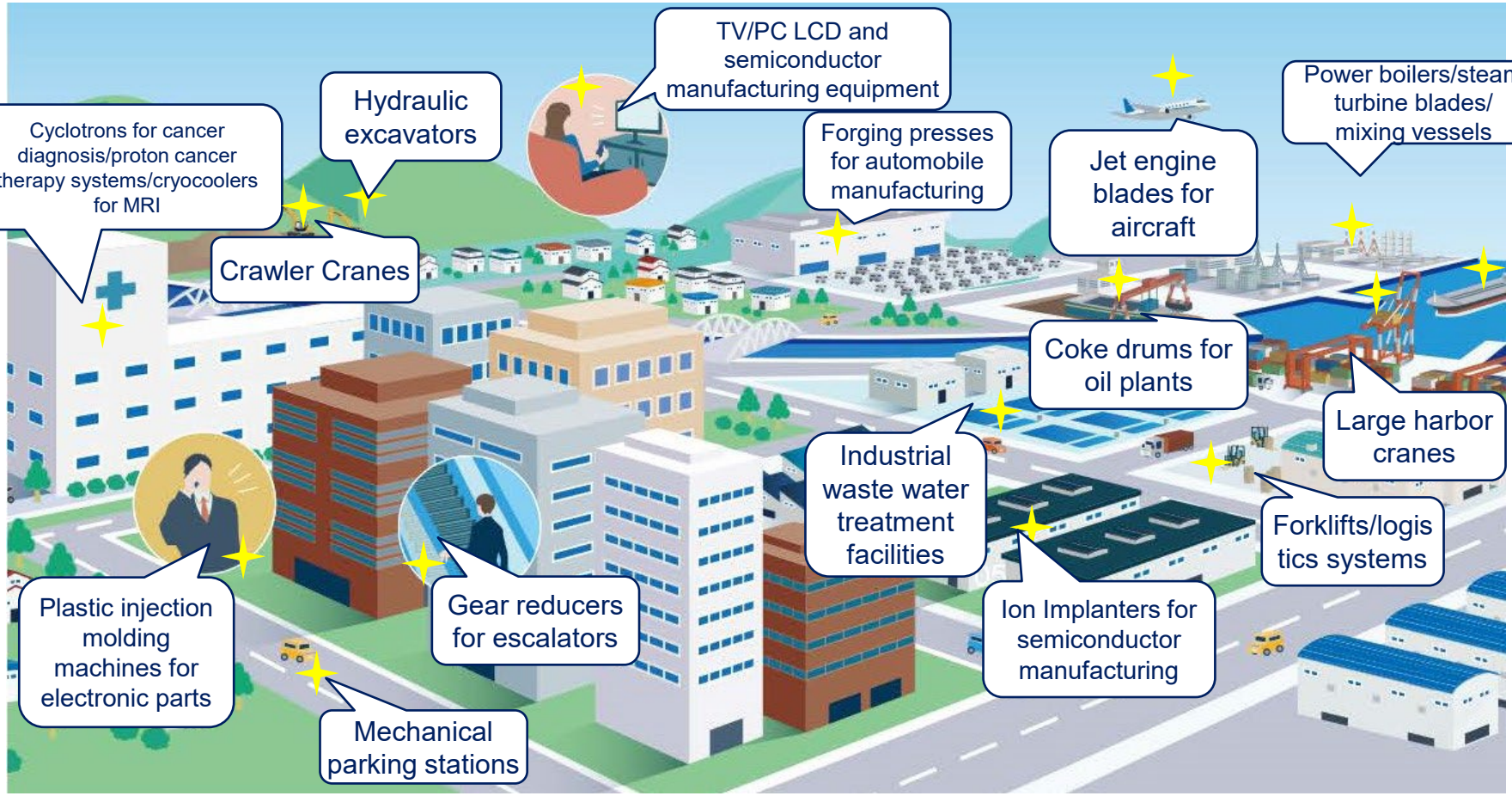
Targets for reducing CO_2 emissions from product manufacturing (Scope1,2)



Targets for reducing CO_2 emissions from product use (Scope 3 Category 11 emissions)



Sumitomo Heavy Industries Group's Products that Support Society



Various products made by the SHI Group are working around you.
This presentation will explain the initiatives SHI is implementing for carbon neutrality.

Decarbonizing Our Products for Carbon-Neutral

- SHI's products are classified mainly into the following four categories. For each product category, SHI is committed to pursuing energy saving, mechanical efficiency improvement, fuel conversion, and effective energy use.

Manufacture Things (Components)

- Gear reducers
- Motors
- Inverters
- Cast iron & steel rolls for hot rolling, etc.

→ Increasing motor efficiency, recycling, etc.

Manufacture Things (Equipment)

- Injection molding machines
- Machine tools
- Processing equipment
- Food machinery, etc.

→ Reducing electricity and energy consumption

▶ Related initiatives are presented on the following pages

Move and Carry Things

Hydraulic excavators, crawler cranes, harbor cranes, forklifts, etc.

→ Energy saving promotion/conversion to carbon-neutral (CN) fuels/electrification

Create and Store Energy

Biomass power generation, biogas systems, gasification systems, energy storage systems, etc.

→ Conversion to carbon-neutral (CN) fuels/energy storage

▶ Related initiatives are presented in a separate series

Products That Use Electricity (Part 1 of 2)

Examples of our response to carbon neutrality

Increasing motor efficiency

Gear reducers
p.6

Motors with a built-in inverter
p.7

Inverters
p.8

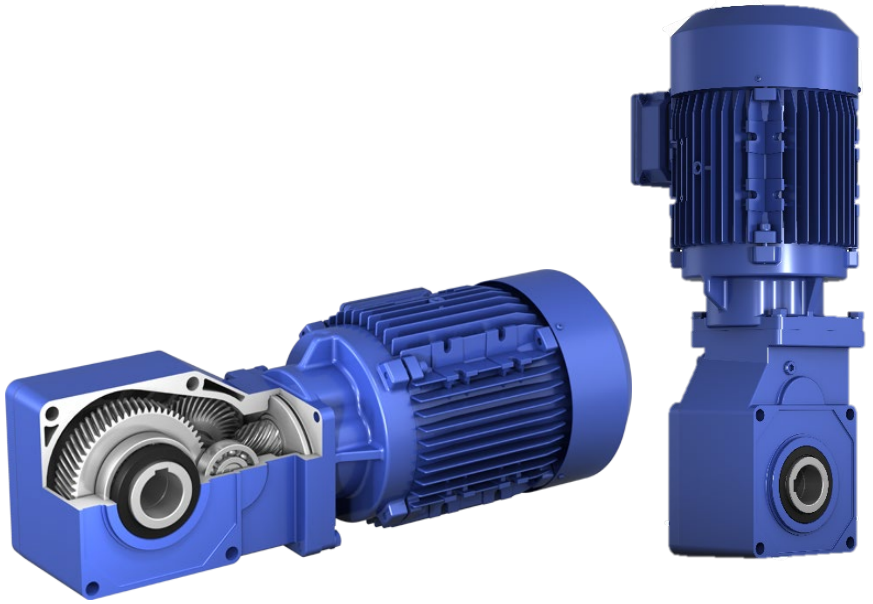
Motor design support
p.9

MBM

Bevel Buddybox® H Series Gear Reducers

Power Transmission & Controls Group

- Bevel Buddybox® H Series gear reducers combine the IE5 motors to achieve highly efficient gearmotors.
- IE5 refers to the highest efficiency class (ultra premium efficiency class) among the categories (IE1 to IE5) set forth in the international standard (IEC60034-30) for motors.
- Since the permanent magnets are used in the rotors, there are no losses of secondary current, which can **achieve the highest efficiency class, IE5, as classified by the international standard**.
- By directly connecting an IE5 motor to bevel and helical gears, we have created an environmentally friendly, highly efficiency gearmotor that reduces electricity consumption.



Carbon Neutral Contribution points

- ✓ The highest efficiency class, **IE5, as classified in the international standard has been achieved**
- ✓ Contributing to the **reduction of electricity consumption**

HPI: A PM Motor with a Built-in Control Inverter

Lafert S.p.A

- HPI (High Performance Integral) is a product that combines a control inverter with a PM motor (permanent magnet motor).
- HPI has achieved **the highest efficiency class, IE5 (ultra-premium efficiency), as specified by the international standard**, and **contributes to reducing electricity consumption**.
- Since it is a one-piece product, the motor characteristics are pre-configured in the inverter before shipment.
- HPI is available in three package types: "Smart," "Flow," and "Plus," and supports both variable torque and constant torque applications.

Carbon Neutral Contribution points

- ✓ The highest efficiency class, **IE5, as specified in the international standard has been achieved**
- ✓ Contributing to the **reduction of electricity consumption**

OPTIDRIVE E3

Invertek Drives

- Optidrive E3 is an inverter that features reliability and usability based on innovative technologies. It can perform sensorless vector control of **all types of motors**, including IE5 motors.
- Initial parameter settings are already configured for various applications, such as fans and pumps.
- **Can achieve up to 60% energy savings** compared to an IE1 three-phase motor, depending on the application. Application example

Carbon Neutral Contribution points

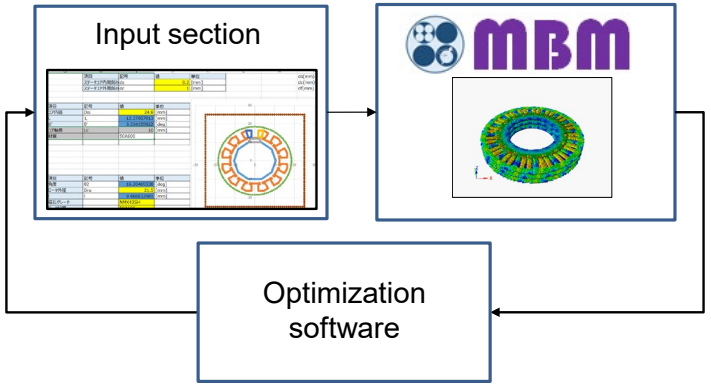
- ✓ **Controls IE2, IE3, IE4 and IE5 motors in an accurate and highly reliable manner**
- ✓ **Can achieve up to 60% energy savings** compared to an IE1 three-phase motor, depending on the application

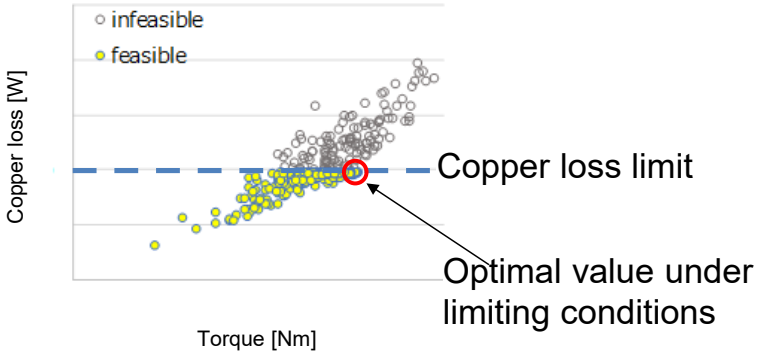
Design Support
Optimum Design System for Magnetic Motors

R&D | FS/demonstration | Product/service

Technology Research Center

- This automatic design system for motor magnetic circuits uses our unique magnetic field analysis software, "MBM: Magnetic Beads Method," along with optimization software.
- To **design a highly efficient motor**, it is necessary to use high-precision magnetic field analysis technology that enables accurate evaluation of losses and to identify optimal specifications under specified limiting conditions.
- The Magnetic Beads Method allows for magnetic field analysis of 3D actual unit shapes and is suitable for analyzing small and flat motors.
- Coordinating with optimization software **enables the optimal design of magnetic circuits** under various constraints.





Carbon Neutral Contribution points

- ✓ By conducting numerical experiments using **high-precision magnetic field analysis technology**, we can **eliminate the need for creating prototypes**
- ✓ **Designing an optimal magnetic circuit under various limiting conditions allows for the reduction of electricity consumption**

Products That Use Electricity (Part 2 of 2)

R&D | FS/demonstration | Product/service

Examples of our response to carbon neutrality

Reducing electricity consumption

Compressors for cryocoolers
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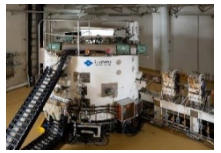
Superconducting cyclotrons
p.12



Cyclotron systems
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Injection molding machines
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Magnet separators
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Surface grinding machine
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Mixing vessels
p.17

For Energy Saving Operation of 4KGM Cryocoolers Inverter-mounted

Compressor E-77A

R&D | FS/demonstration | **Product/service**

Precision Equipment Group

- The E-77A compressor is equipped with a **dual inverter, enabling energy-saving operation** of the 4KGM cryocooler RDE-412 while maintaining its high cooling capacity.
- In cryostats (low-temperature vacuum vessels) with liquid helium tanks, such as those used for MRI superconducting magnets, 4KGM cryocoolers are operated steadily. To prevent the internal pressure of the liquid helium tank from becoming negative due to excessive helium gas re-condensation, a heater was conventionally used to control and maintain a positive internal pressure.
  (*If the helium tank's pressure becomes negative, the tank may inhale external air, causing the safety valve to freeze and clog. This could lead to a severe accident.)
- Using the E-77A compressor enables the operation of cryocoolers and compressors at reduced speeds, allowing for control and maintenance of a positive internal pressure without using a heater. As a result, it **becomes possible to save energy compared to steady operation**.

Carbon Neutral Contribution points

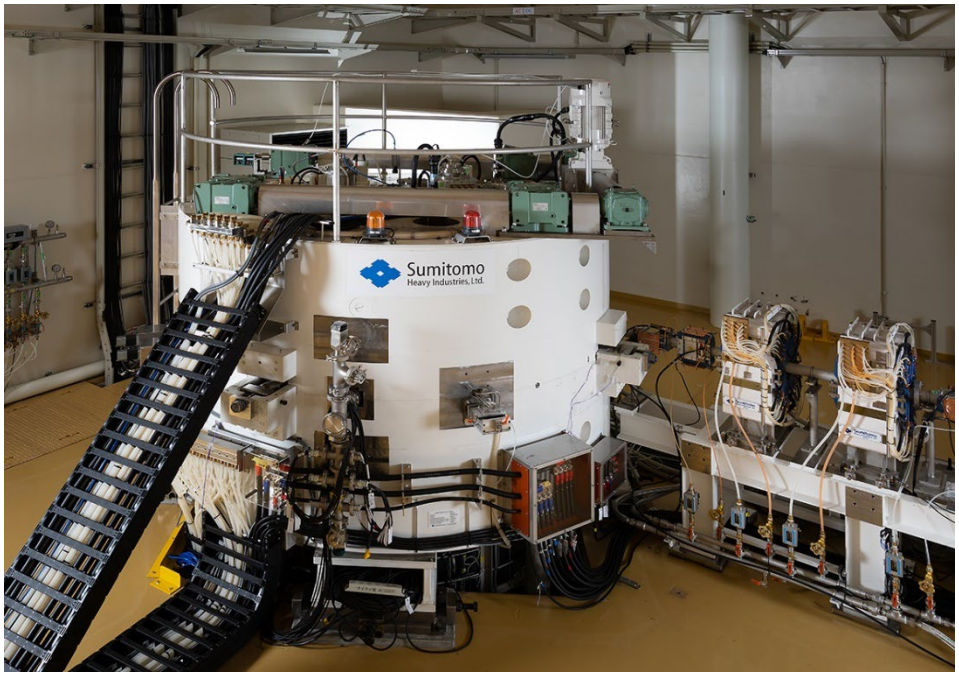
- ✓ Can save more energy than conventional compressors. **(Electricity consumption can be reduced by more than 40-50%)**
- ✓ Downtime for various equipment can be reduced with the boosted cooling function.

For Proton Therapy Systems
Superconducting Cyclotron SC230

R&D | FS/demonstration | **Product/service**

Technology Research Center and Industrial Equipment Div.

- In proton therapy, to irradiate protons at cancer located deep within the body, an accelerator is needed to accelerate the protons to approximately 70% of the speed of light.
- Our superconducting cyclotron accelerator **uses a superconducting coil as the main coil that generates the main magnetic field. This allows for a reduction in electricity consumption by approximately 40% compared to a cyclotron accelerator with conventional normal-conducting coils**.
- For technologies that cool coils to maintain the superconducting state, **the conduction cooling method using a cryocooler has been adopted. This eliminates the need for liquid helium,** and replenishment is unnecessary if liquid helium is lost due to evaporation or other reasons.



Carbon Neutral Contribution points

- ✓ **Reducing electricity consumption by approximately 40%**
- ✓ **Adopting the conduction cooling method using a cryocooler eliminates the need for liquid helium**
- ✓ **Space efficiency has been achieved**

For PET scans
Cyclotron System HM-18HC

R&D | FS/demonstration | **Product/service**

Industrial Equipment Div.

- PET scans, which are highly effective in imaging diagnosis of tumors, cerebral infarctions, cardiac diseases, and more, require labeled RIs like 18F-FDG, which accumulate in cancerous lesions and help pinpoint their location.
- Our cyclotrons for PET assure a safe and reliable supply of the radioactive isotopes necessary for producing these labeled RIs.
- Our new cyclotron systems have achieved **approximately a 12% reduction of electricity consumption compared to conventional systems***, by combining the following two newly developed products.

  (i) Cyclotron with an external ion source: HM-18HC
  (High beam current output is achievable)
  (ii) 18F high yield target with enhanced cooling
  (High beam current irradiation is achievable)

  * Comparison was made by producing an equivalent amount of radioactive isotopes

Carbon Neutral Contribution point

✓ **Reducing electricity consumption by approximately 12%**

SE-EV-S Series Injection Molding Machines

R&D | FS/demonstration | **Product/service**

Plastics Machinery Div.

- This product pursues energy-saving performance and exerts a significant electricity conservation effect even when it replaces a general electric motor.
- A direct drive (*1), which enables accurate screw control by a servo motor, and a highly rigid and low-vibration frame are used to **allow for molding with low injection pressure and low clamping force, achieving defect reduction and energy conservation**.
- A guidance function, which improves the usability of the feature supporting low injection pressure and low clamping force, has been enhanced along with **the function contributing to energy conservation, thereby enhancing the carbon neutrality performance of the molding environment**.

*1 Mounted on SE-EV-S and SE-EV-S-HD-CT-6spec

*2 Comparison was made with a 1,000kN class molding machine

Carbon Neutral Contribution point

✓ **The SE-EV-S Series has achieved a 65% reduction in electricity consumption compared to our first electric motors and a 35% reduction compared to conventional products (*2).**

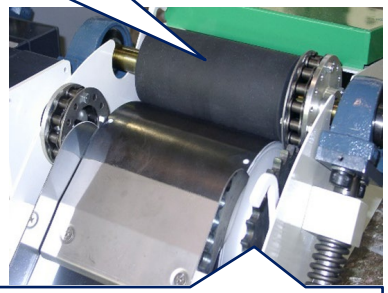
FINEMAG UK Model

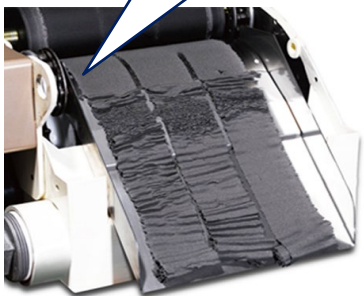
Sumitomo Heavy Industries Finetech, Ltd.

- This filtration device recovers micron-sized fine metal chip (sludge) from coolant used primarily in grinding machines that process metals with grinding wheels. The device then dehydrates the collected sludge with a squeeze roller, minimizing coolant loss.
- Our FINE MAG UK has achieved the industry's highest magnetic field strength of 9,000 gauss on the magnetic drum surface, enabling the recovery of single-digit micron-sized fine sludge and weakly magnetic materials that were previously difficult to collect with conventional magnets. In the recycling of carbide, which are weakly magnetic, **the drying process can be omitted** because of high recovery capabilities and dehydration performance.
- This product **saves electricity** because it uses only a 25W motor to rotate a magnetic drum.
- It does not use filters or other waste materials, resulting in no CO_2 emissions from waste incineration.

Powerful dehydration of sludge is achieved by force-driving the squeeze rollers

Powerful dehydration capabilities reduce coolant loss





High filtration accuracy, due to ultra-high magnetic strength, reduces the deterioration of coolant

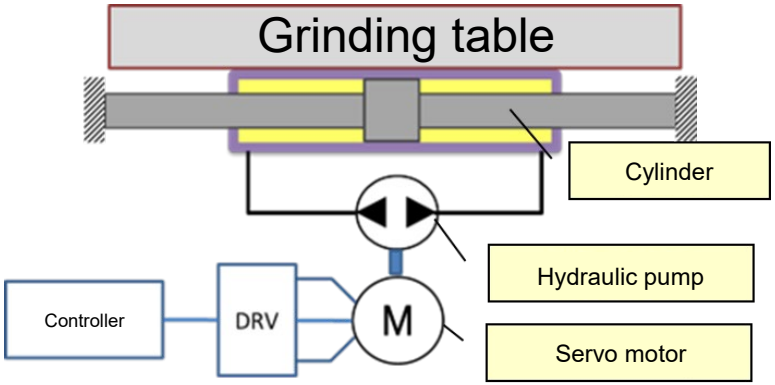
Carbon Neutral Contribution points

- ✓ **Extending the service life of machining fluid** reduces **CO_2 emissions** during industrial waste processing
- ✓ **No CO_2 is generated when disposing of the filtration material**
- ✓ **Electricity conservation product** driven with one 25W motor

Eco HST Drive, Drive Units
for Surface Grinding Machines

Sumitomo Heavy Industries Finetech, Ltd.

- A surface grinding machine is a machine tool that uses rotating grinding wheels to gradually remove uneven parts from the surfaces of subject materials, making them smooth.
- This is the first machine tool to adopt the **Hydro Static Transmission (HST) method** for the hydraulic system that drives the table.
- Unlike conventional hydraulic systems, this system uses **a servo motor to drive the hydraulic motor and synchronize it with the table, achieving high efficiency.** This control method reduces hydraulic oil usage by a factor of seven, resulting in a **50% reduction in electricity consumption** and a significant decrease in CO_2 emissions.
- Compared to conventional hydraulic systems, the **table reversal distance and setting distance are reduced by 50%**, allowing for a shorter total processing time.



Conventional **Eco HST Drive**

Carbon Neutral Contribution points

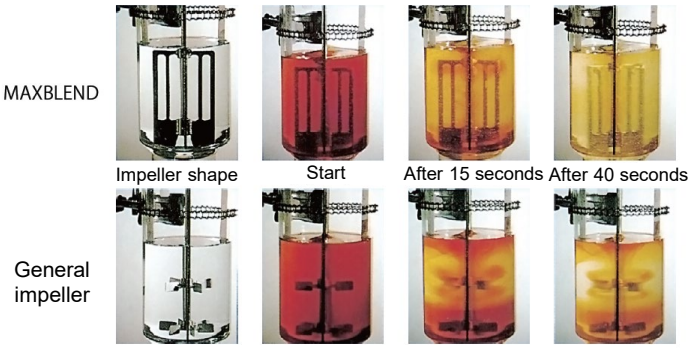
- ✓ **Reducing electricity consumption by 50%**
- ✓ **Stopping the table also stops the servo motor, reducing CO_2 emissions**
- ✓ Reducing processing time

For the Chemical Industry
Mixing Vessels: MAXBLEND

R&D | FS/demonstration | **Product/service**

Sumitomo Heavy Industries Process Equipment Co., Ltd.

- In the chemical and other industries, mixing processes are performed for various purposes, such as dissolution, dispersion, separation, absorption, and heat transfer. Even for mixing processes that seem simple at first glance, productivity can be greatly enhanced by using more effective methods. Our "**MAXBLEND**" features a unique impeller shape that allows for **reduced energy consumption during operation**.
- Compared to general impellers, MAXBLEND **achieves complete mixing in a shorter time when using the same mixing power. To reach the mixing status of the same level as general impeller, it can operate with less power**.
- MAXBLEND achieves energy-saving operation by generating an ideal entire circulation flow within a vessel.



Comparison of mixing times using the iodine decolorization reaction (where the liquid becomes transparent as mixing progresses)

Carbon Neutral Contribution point

✓ Generating an ideal flow within a vessel **reduces energy consumption during operation by up to 80%*** compared to general impellers(*Under solid-liquid condition)

Examples of our response to carbon neutrality

Reducing energy consumption

Distillation system
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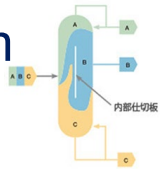

Extractor
p.20

Cast iron & steel rolls
"Special heat treatment"
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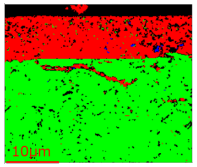
Cast iron & steel rolls
"Recycled"
p.22

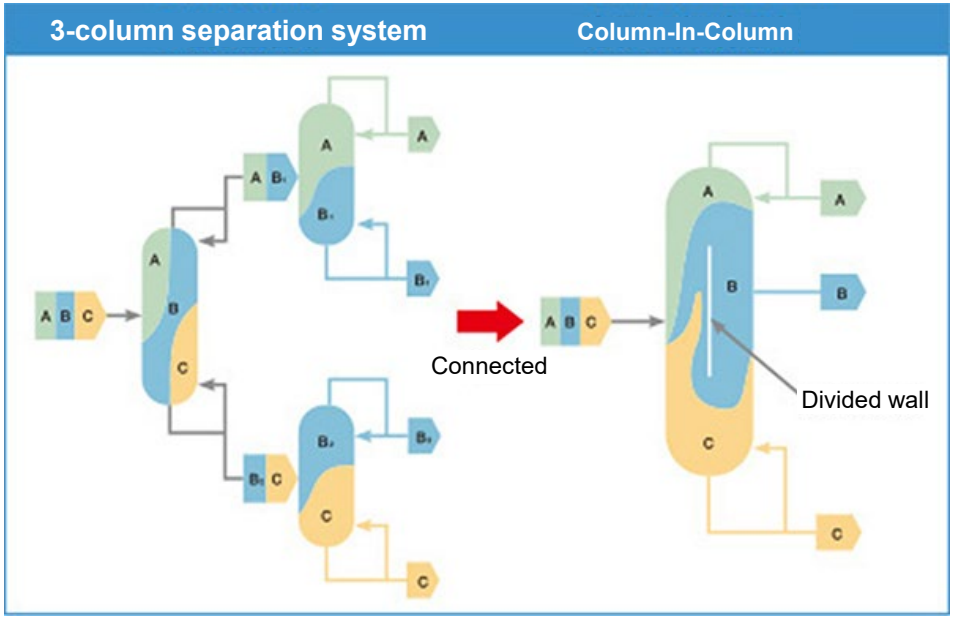
Nitridation technology
p.23



Integrated-Flow Energy-Saving Distillation System

Sumitomo Heavy Industries Process Equipment Co., Ltd.

- Our "**Column-In-Column" integrates the functions of three distillation columns into one**, achieving **approximately a 40% reduction in CO_2** emissions during operation.
- Distillation is a process that separates desired components based on their different boiling points. It involves repeated heating and cooling, which accounts for 40 to 50% of energy consumption in the chemical industry, making it energy-intensive. In particular, separating three or more components requires multiple distillation columns, which increases the need for energy conservation. Column-In-Column has a divided wall inside a distillation column, effectively simulating the operation of three distillation columns. Therefore, **multiple components can be separated with one column, reducing the number of heating and cooling processes and achieving energy conservation.**



Carbon Neutral Contribution point

✓ Reducing CO_2 emissions by 40% during multi-component separation process

For the Beverage and Seasoning Industries

Multi-Purpose Extractor

R&D | FS/demonstration | **Product/service**

Izumi Food Machinery Co., Ltd.

- Traditionally, tea, coffee, and similar products were produced on dedicated lines. However, there is now a shift towards producing them on multi-purpose lines.
- Our Multi-Purpose extractor offers various extraction methods, including conventional dip extraction, drip, semi-dip, pressurized extraction, deoxygenation, aroma recovery, circulation, and more. This versatility allows for multi-product production with just a single unit, tailored to customer needs.
- Furthermore, adopting a closed-type tank reduces **thermal dissipation (and consequently steam consumption) more effectively than a conventional open-type tank, thereby achieving a reduction in CO_2 emissions.**
- Previously, it was necessary to disassemble part of the product for manual washing. However, **with CIP (Cleaning-In-Place) now possible, washing water usage and the workload on operators can be reduced**.

Carbon Neutral Contribution points

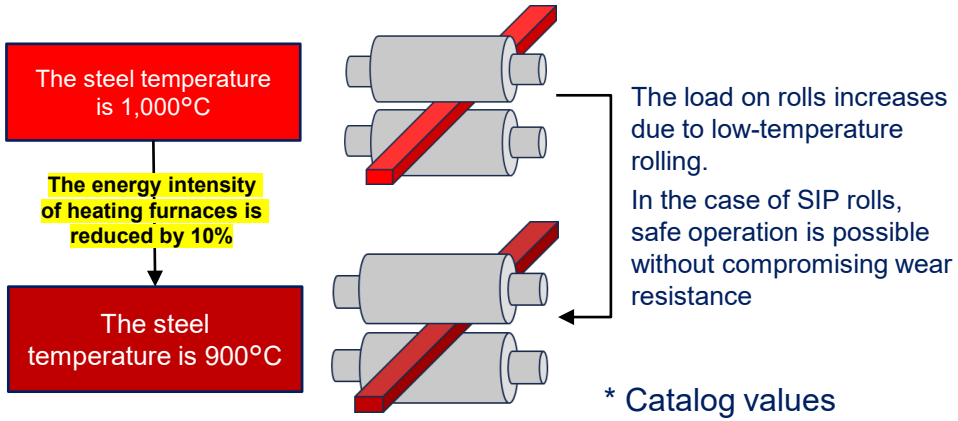
- ✓ **Reducing thermal dissipation and lowers CO_2 emissions by up to approximately 30% compared to conventional products**
- ✓ Multi-item extraction is possible with just a single unit, reducing the number of **CO_2-emitting products**

Cast Iron & Steel Rolls “Special heat treatment”

Sumitomo Heavy Industries Himatex Co., Ltd.

- At iron works, cast iron & steel rolls are used in the rolling process where steel materials are stretched by applying pressure. Our SIP (**S**umitomo **I**mproved **P**enetration of hardness) rolls are distinguished by our proprietary heat treatment process. This allows them to **withstand higher loads more effectively while maintaining excellent wear resistance**, outperforming conventional products.
- In recent years, as part of energy-saving and carbon neutrality measures, steelmakers have been performing low-temperature rolling by reducing the temperature of heat applied to steel materials so that the energy intensity of heating furnaces can be enhanced. This results in higher loads on rolls.
- Using our SIP rolls allows for **safe operation and maintains productivity** even during low-temperature rolling. **Customers** can improve the energy efficiency of their heating furnaces* **by approximately 10%** with our SIP rolls.

* When the temperature of steel discharged from the furnace is reduced from 1,000°C to 900°C



* Catalog values

Mechanical properties	Conventional product	SIP roll
Hardness (Hs)	45±3	**45/50**
Fatigue strength (N/mm^2)	186	**235**
Fracture toughness (Kic)	185	**203**

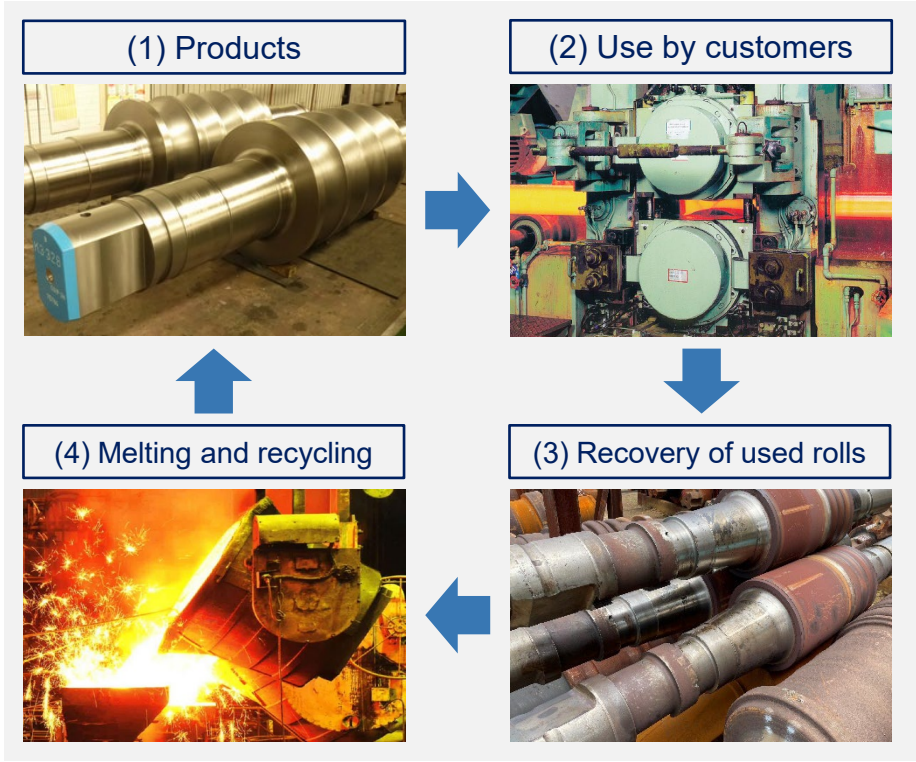
Carbon Neutral Contribution points

- ✓ Capable of **withstanding high loads** while **maintaining wear resistance**
- ✓ **Improving the energy intensity of customers’ heating furnaces by approximately 10%**

Cast Iron & Steel Rolls “Recycled”

Sumitomo Heavy Industries Himatex Co., Ltd.

- We manufacture "cast iron and steel rolls for hot rolling" primarily using iron, a highly recyclable material, through casting and forging production methods. These rolls are mainly used in steel mills.
- By **effectively utilizing recycled materials and reducing the use of virgin materials (such as pig iron and iron alloy)** that generate **CO_2** in the production process, we aim to contribute to the reduction of CO_2 emissions in Scope 3 (procurement of consumables) measures implemented by our customers.
- We have achieved a high ratio of recycled materials in all the cast iron & steel rolls we manufacture.



Carbon Neutral Contribution points

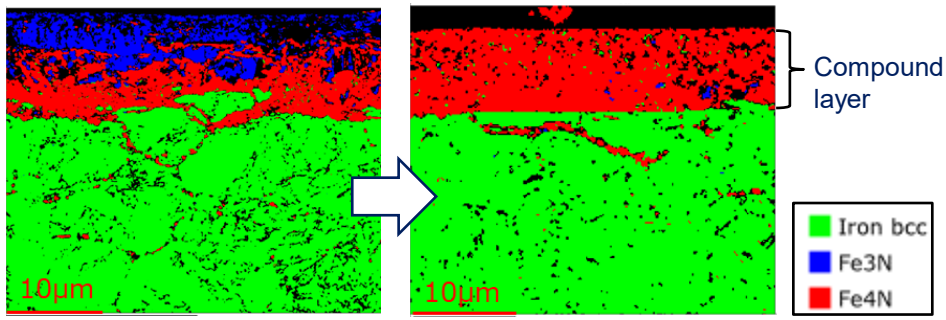
- ✓ Contributing to the reduction of **CO_2** emissions in Scope 3 measures implemented by customers
- ✓ **Helping to establish a recycling society by using recycled materials, such as used rolls**

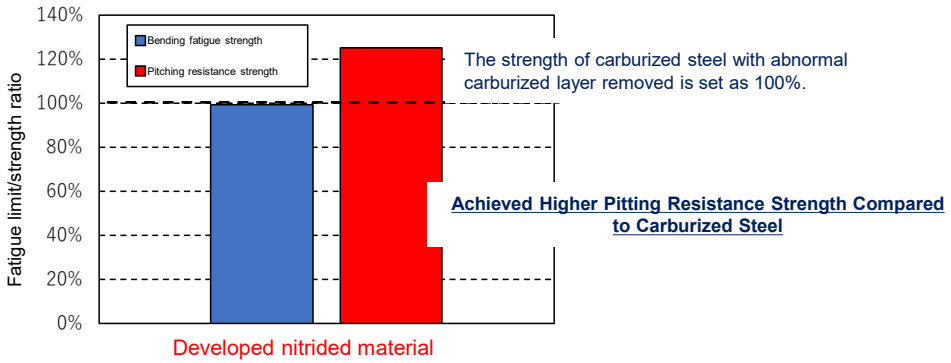
Nitriding as an Alternative Heat-Treatment Process to Carburizing

Technology Research Center

- Carburizing with hydrocarbon gas for surface hardening is commonly used for gears, gear reducers, and other components that require both high strength and good machinability. However, this process produces significant CO2 emissions, contributing to environmental concerns. As a result, there is increasing interest in shifting to processes like nitriding and induction hardening, which have lower CO2 emissions.
- Conventional nitrided parts have lower strength compared to carburized parts, making conventional nitriding unsuitable as an alternative process.
- With our next-generation nitriding process and controlled microstructure, we have achieved strength levels that match or exceed those of carburized components.
- Applying the nitriding process can also reduce heat treatment deformation, thereby minimizing the burden on the finishing process
- We are optimizing heat treatment conditions to enhance strength and utilize nitriding technology into our products.

Optimizing the thickness of the compound layer and its microstructure





Carbon Neutral Contribution points

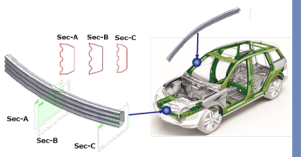
- ✓ **Reducing CO2 emissions during the heat treatment process.**
- ✓ **Minimizing heat treatment deformation, thereby reducing the burden on subsequent finishing processes**

Products that contribute to the achievement of carbon neutrality in society

Contributing to reduction

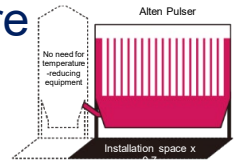
Laser annealing equipment
p.25

STAF system
p.26



T dies for plastic films
p.27

High-temperature dust collector
p.28



For the Power Semiconductor Industry
Laser Annealing Equipment

R&D | FS/demonstration | **Product/service**

Mechatronics Div.

- Our laser annealing equipment is used as a key component in the power semiconductor production process.
- Heat treatment using a laser beam is performed on thin (approximately 100 μm) silicon and SiC wafers to enhance the performance of power semiconductors.
- Power semiconductors are crucial components used in equipment that controls motors “efficiently” and “without loss”.
- They are widely used as key devices in BEVs, PHVs, HEVs, and other electric vehicles, and they contribute to **energy conservation and electricity savings around the world**.
- Through our customers’ products (power semiconductors) manufactured using our products, we are contributing to a reduction in electricity consumption and global **CO_2 emissions, as well as global warming mitigation initiatives**.

Laser annealing equipment: SWA-20US

Carbon Neutral Contribution points

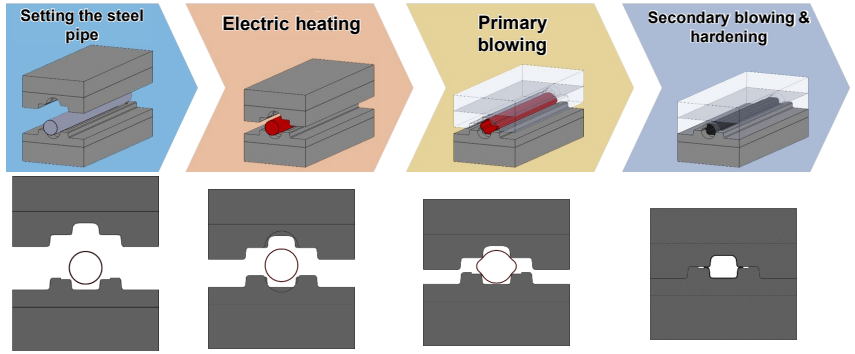
- ✓ **Global energy conservation and electricity savings**
- ✓ **Contributing to a reduction in CO_2 emissions and global warming mitigation initiatives**

For the Car Frame Parts Production Industry
STAF system

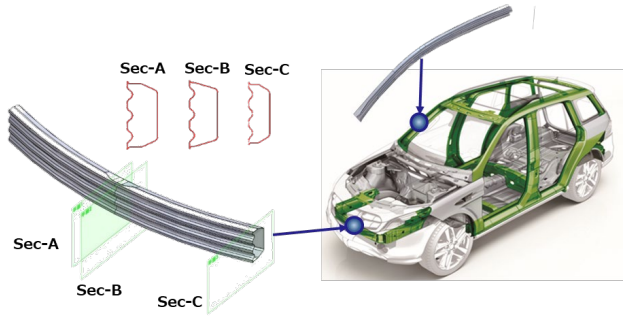
R&D | FS/demonstration | Product/service

New Plastic Processing Development Strategic Business Unit: STAF Project

- The STAF system is the world's first forming system that electrically heats the pipe material inside the press mold, injects high-pressure air into the pipe, and forms continuous, irregular closed-profile members with integrated flanges.
- Adopting electric heating (which directly heats the material) as a heating process **achieves higher energy efficiency than furnace heating and significantly reduces environmental impact**.
- Members with a closed-profile continuous structure and integrated flanges, which are made highly strong through mold hardening, can be produced from pipe materials. Therefore, it is possible to reduce the thickness, **allowing for lighter automobiles and reduced CO_2** emissions.



STAF process flow



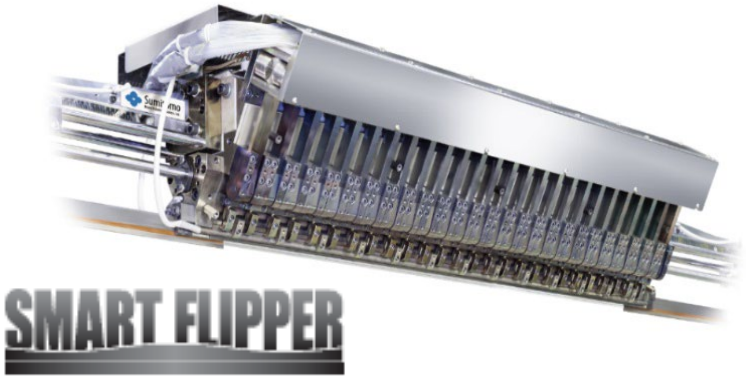
Carbon Neutral Contribution points

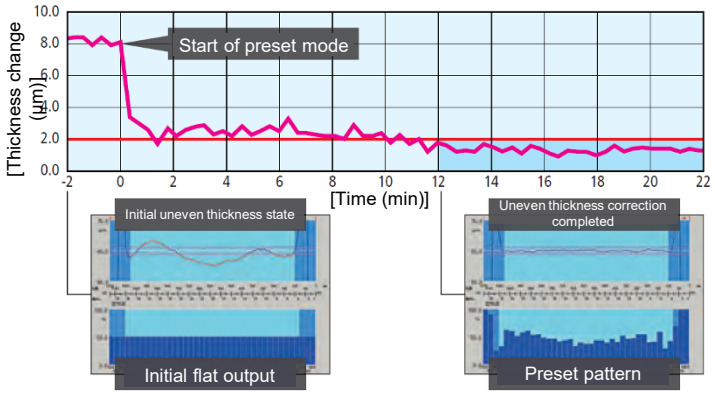
- ✓ **Improving energy efficiency through the electric heating process**
- ✓ **Making car frame parts lighter**

Smart Flipper

Sumitomo Heavy Industries Modern, Ltd.

- We offer a range of T dies (metallic molds) for laminating and casting, designed to **reduce the amount of raw materials used in producing plastic films**, such as those for food packaging.
- **Pneumatic-driven automatic control** has achieved high responsiveness and **precise film thickness accuracy**. Moreover, we have **shortened the film thickness adjustment time**, resulting in a **significant reduction in resin consumption**.
- Using the preset mode, which offers **high reproducibility**, can **reduce production startup and switchover times**. As a result, **resin consumption can be further minimized**.





Carbon Neutral Contribution points

✓ Compared to the conventional method*1, **resin consumption has been significantly reduced, resulting in a potential decrease of approximately 160 t/year/unit*2 in CO_2 emissions.**

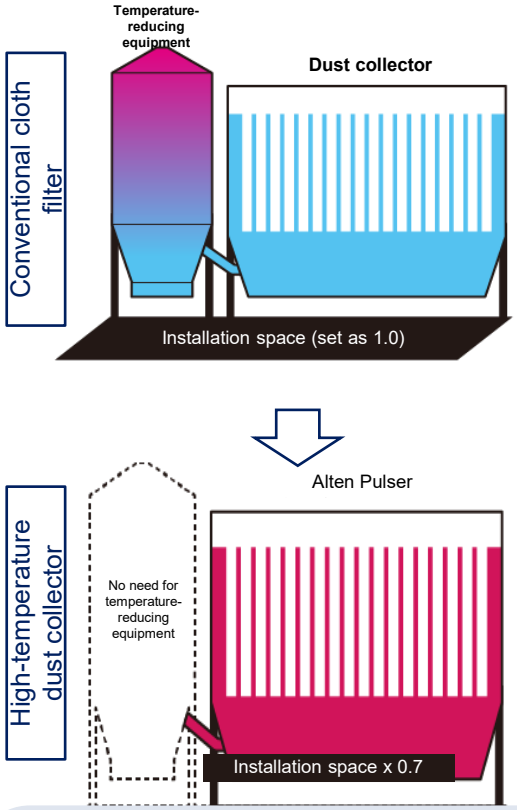
Trial calculation based on the case of manufacturing food packages
*1 Conventional method: Heat bolt (thermal expansion) method
*2 Amount of resin reduction converted to CO_2 + Reduced electricity

High-Temperature Dust Collector: Alten Pulser

R&D | FS/demonstration | **Product/service**

Nihon Spindle Manufacturing Co., Ltd

- Alten Pulser is an **energy-saving high-temperature dust collector (350°C) that eliminates the need for temperature-reducing equipment**. This product is expected to find applications in various industries, including production plants, biomass power generation, wastewater sludge treatment, gasification plants, and industrial waste treatment.
- Traditionally, dust collection from high-temperature exhaust gases required lowering the temperature due to limitations of filter cloths. However, as awareness of decarbonization grows, the need for high-temperature dust collection is increasing.
- Supports powder recovery and dust collection at high temperatures. Additionally, it can handle a wide range of applications, from environmental dust collection to corrosive gases.
- Recovering heat from clean, high-temperature gas after dust collection improves recovery efficiency and contributes to a reduction in CO_2 emissions.



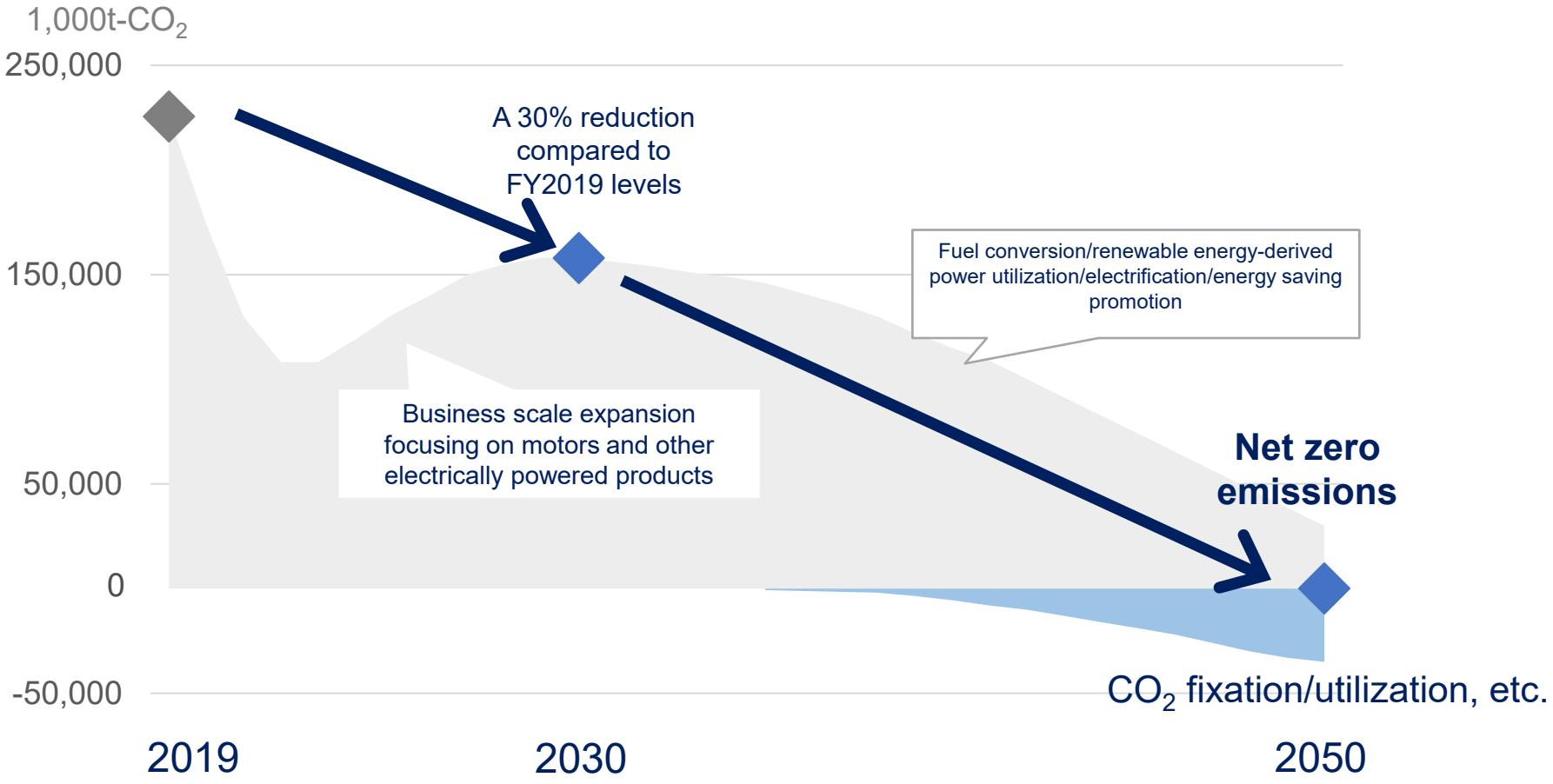
Can collect dust from gases at 250°C or higher, which conventional cloth filters cannot handle!
Alten Pulser does not require temperature-reducing equipment!

Carbon Neutral Contribution points

- ✓ **No need for preparing for temperature-reducing equipment (leading to energy conservation)**
- ✓ **Improved energy recovery rate**

Image of Reducing CO_2 Emissions from Product Use Up to 2050

- SHI aims to achieve the goal of zero CO_2 emissions in 2050 by developing various decarbonization technologies.



Sumitomo Heavy Industries Group
will continue accelerating its initiatives
to achieve a carbon-neutral society.