

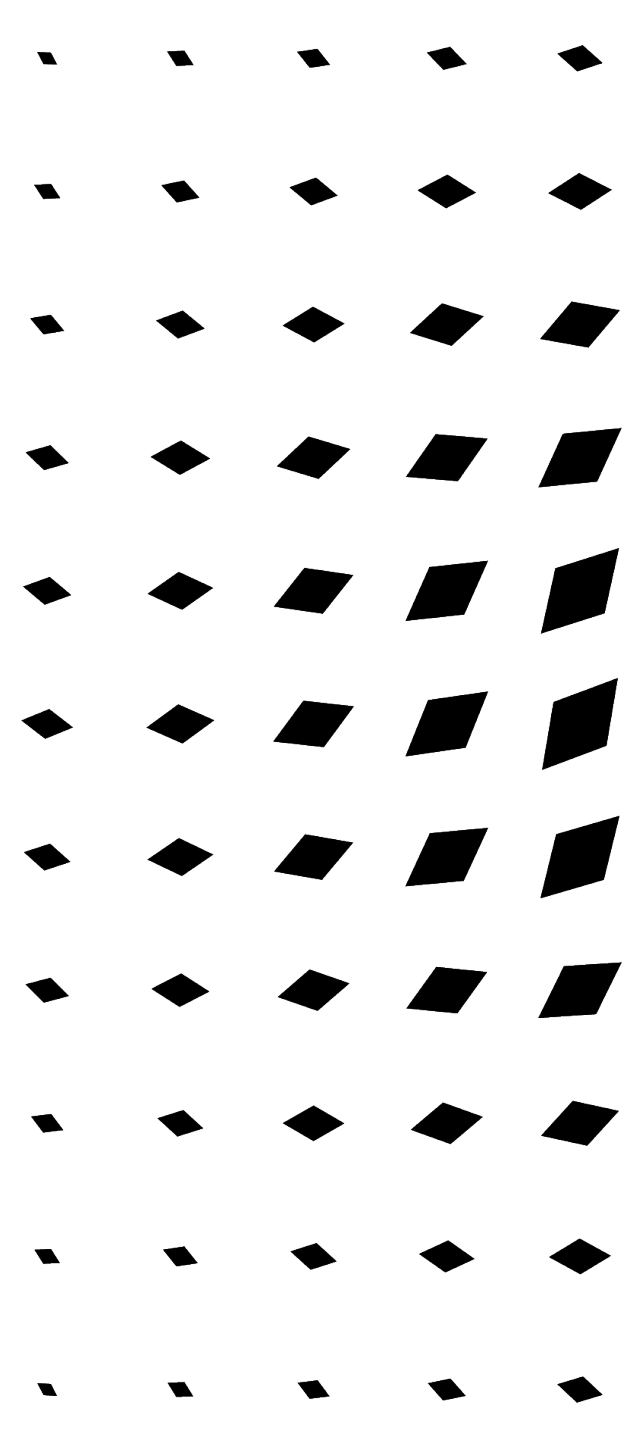
Our Challenge toward Realizing a Sustainable, Circular-Economy Future Society

Research and Innovation Business Planning

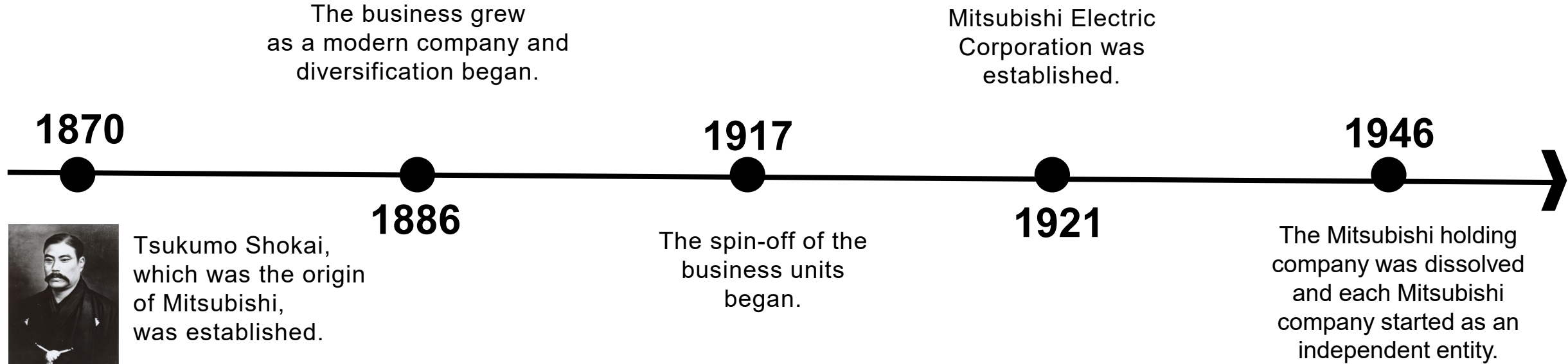
Mitsubishi Electric Europe

Makoto Kanemaru, PhD

May 27, 2026



More than 100 years of innovation



Tsukumo Shokai, which was the origin of Mitsubishi, was established.

„MITSUBISHI“ & DAS 3-RAUTEN-SYMBOL



みつ	Mitsu	>	Drei
ヒシ	Hishi	>	Diamanten

The common history connects

Today, the companies of the Mitsubishi Group are diverse, but united by a common philosophy – the **"Three Principles" (Sankoryo)**, formulated in the 1930s by Koyata Iwasaki, the fourth president of the Mitsubishi organization.

These principles continue to shape the Group's actions to this day.

所期奉公

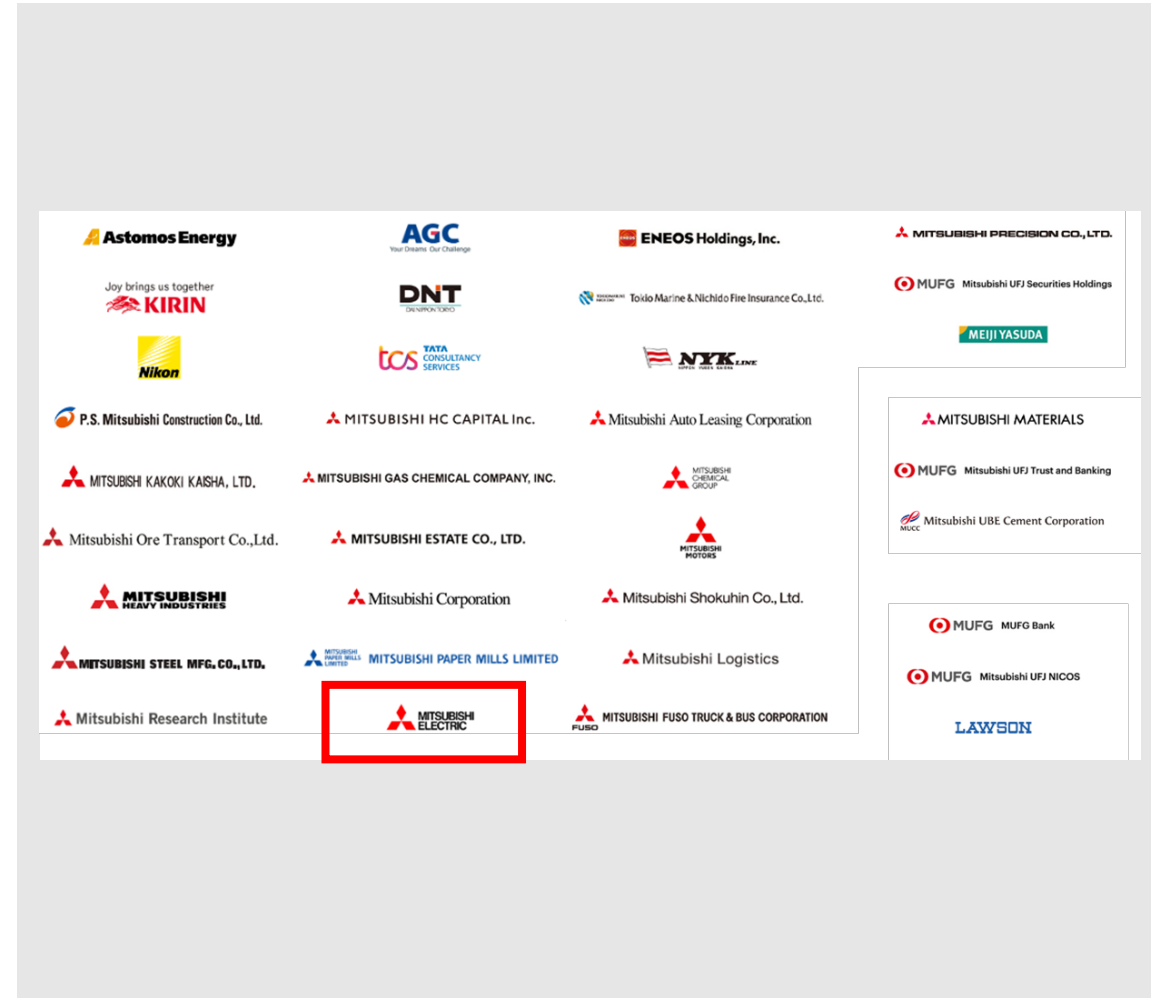
Shoki Hoko
Responsibility towards society

慶事光明

Shoji Komei
Integrity and fairness

立業貿易

Ritsugyo Boeki
Global understanding through business



Portfolio

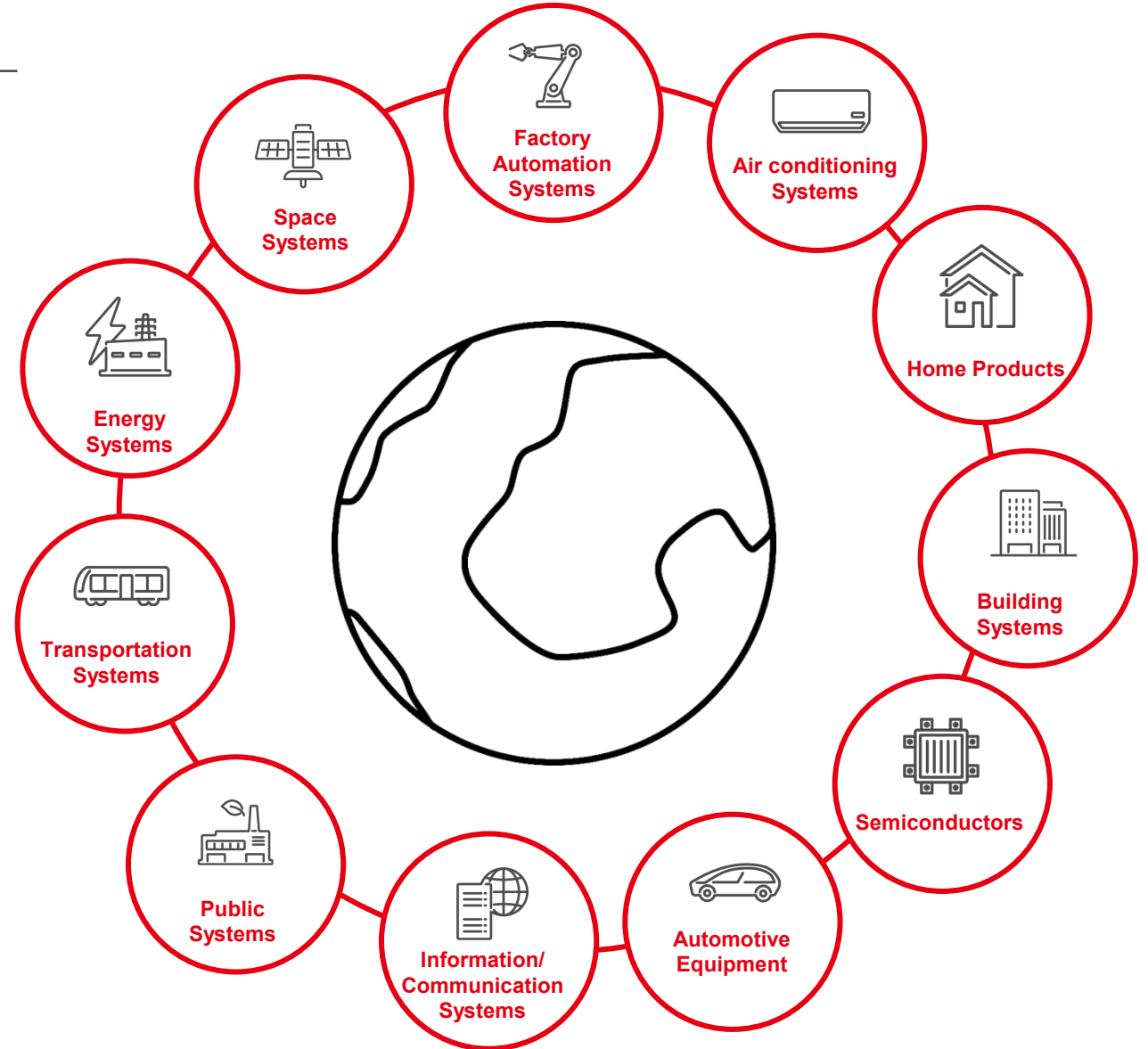
Our goal is to overcome social challenges through our business activities – and thus actively shape sustainable development.

WIPO PATENT APPLICATIONS

No. 7 in the world (top 5 for ten consecutive years)

No. 1 in Japan (nine years in a row)

1,956 patent registrations in 2024



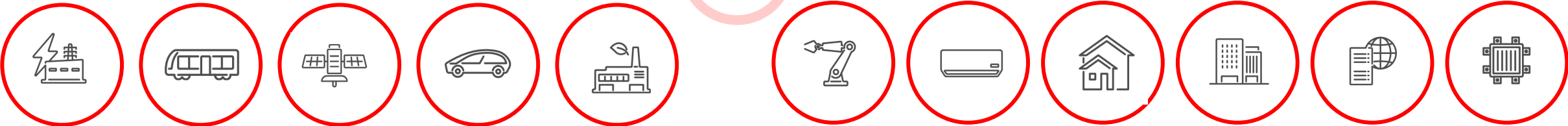
Our Value Creation Process



**Our Purpose:
Sustainability**



Circular-Digital Engineering



Sustainability in the German branch

Fully equipped with our own products

Efficient air conditioning and heating technology
Smart Energies
Modern building management

Climate neutral

The building is powered exclusively by renewable energy

LEED Platinum Certification

Leadership in Energy and Environmental Design -
The highest award for resource-saving, sustainable buildings



Sustainable mobility

Charging stations for e-cars in the underground car park
Direct connection to public transport

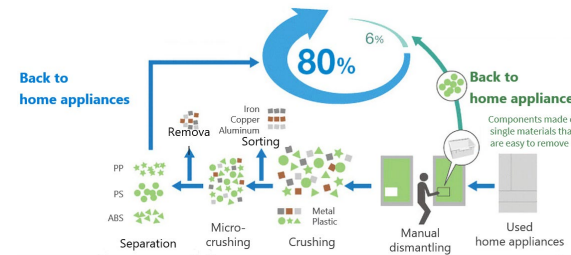
Circular Economy Activities

Eco-Design for Power Semiconductors



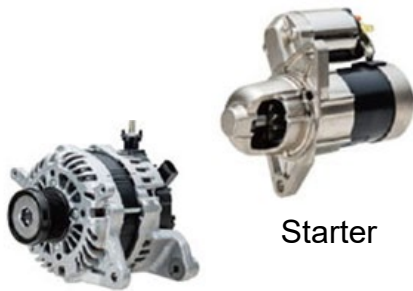
- Power semiconductors reduce GHG emissions across energy systems
- PELCA supports data-driven eco-design.

Plastic Recycling



- Plastics from end-of-life appliances are reused in our products.
- Technology has been developed to separate high-purity plastics from mixed waste.

Rebuilt Automotive Parts

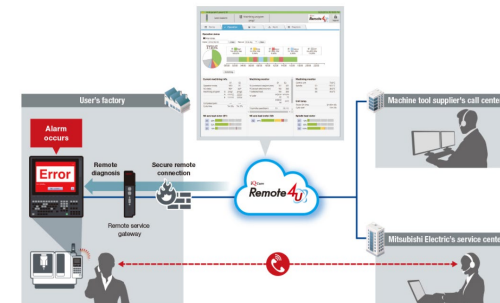


Alternator

Starter

- Each year, about 20,000 starters and 12,000 alternators are remanufactured from collected units, reducing aluminum use by over 200 tons annually.

Optimal Factory Automation Maintenance



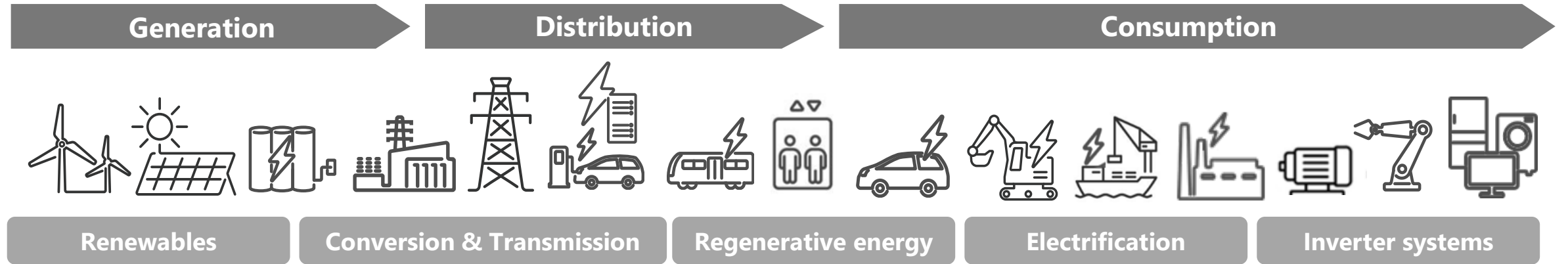
- Remote inspection for machine tools enables the replacement of only failed parts.
- AI tools for anomaly detection enhance operational efficiency.

Use case 1

Eco-Design for Power Semiconductors

Power Semiconductors

Power semiconductors are the critical and ubiquitous component across all energy-related products



Delivering Greenhouse Gas reduction during product use

Efficiency drives Greenhouse Gas reduction

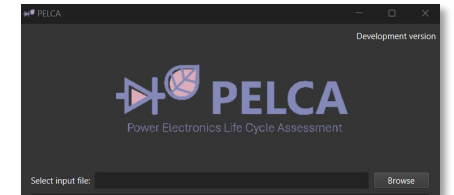
Via inverter control : 50% energy reduction vs. on/off control

SiC power semiconductors : 7% loss reduction in EV drive systems

PELCA (Power Electronics Life Cycle Assessment)

PELCA is a tool that supports decision-making for circular design.

- Progress toward a circular economy depends on data-driven decisions, not intuition.



<https://github.com/merce-fra/PELCA>

Products Design

Performance
Reliability
Cost
LCA analysis
Maintenance
EOL
Recyclability

Life Cycle Simulation

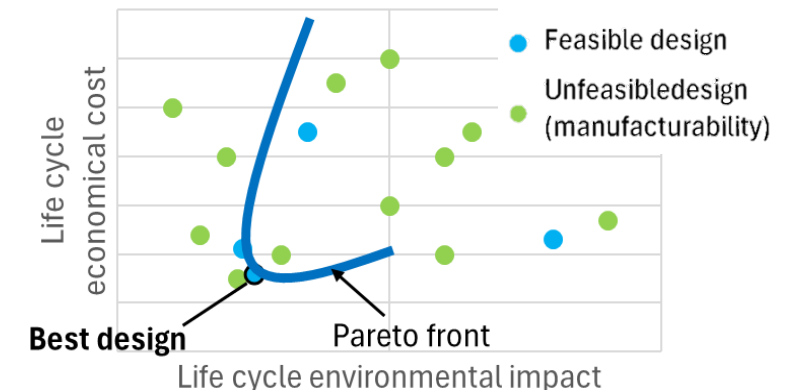
Economical cost

- Material cost
- Maintenance cost
- EOL cost etc.

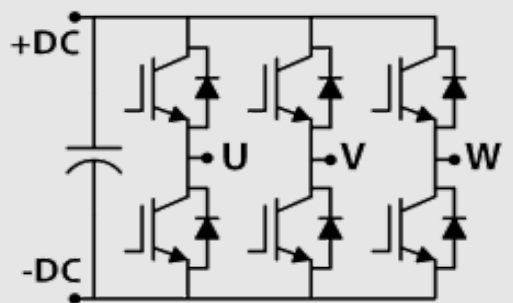
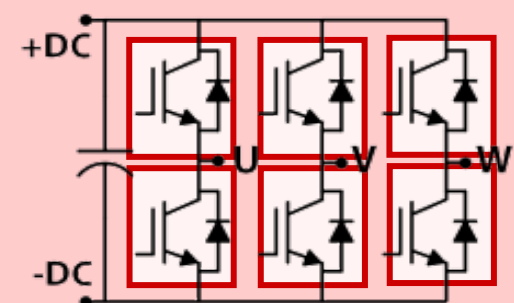
Environmental impact

- CO₂ emission
- Energy efficiency
- Recyclability etc.

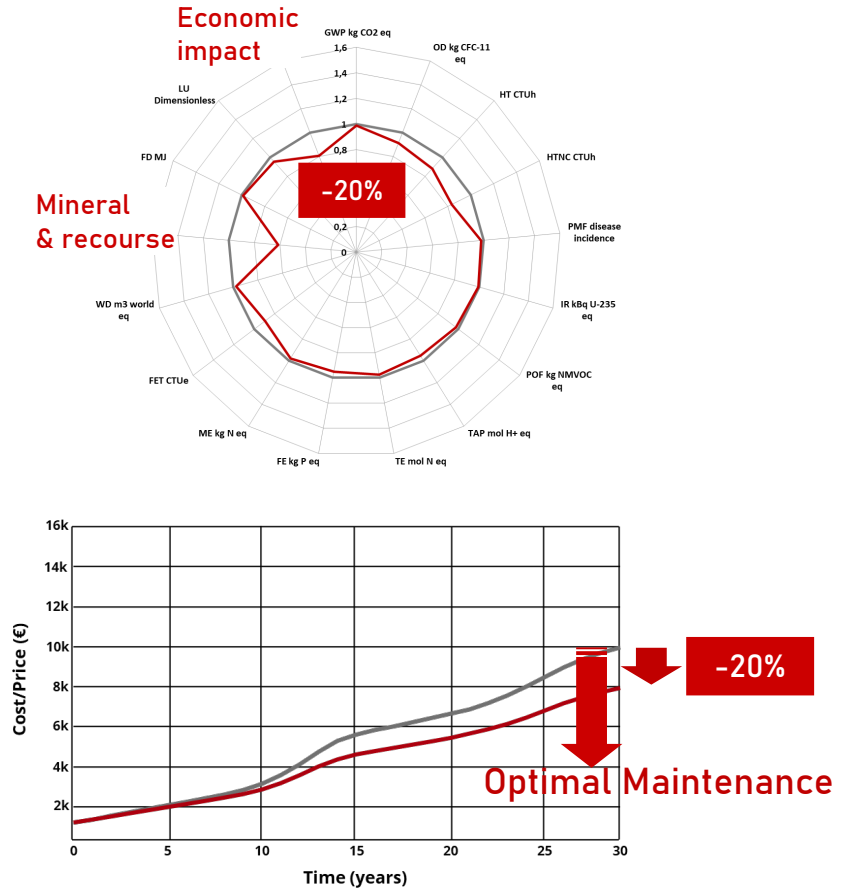
Design Optimization



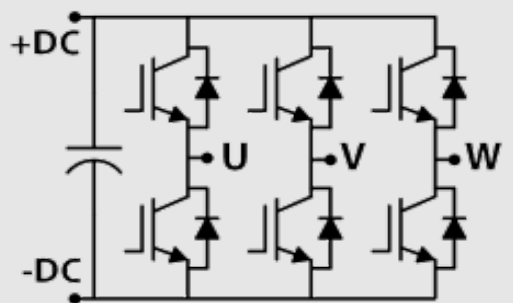
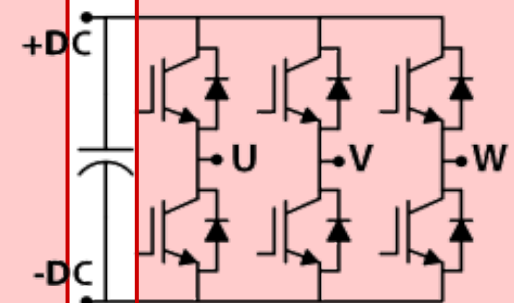
Eco-Design Case Study (1)

	A	B
System configuration		
Disassembly	-	✓
Corrective Maintenance	-	✓
Concept	Without disassembly or maintenance, failures require full unit replacement.	With disassembly and maintenance, performance is optimized through corrective actions.

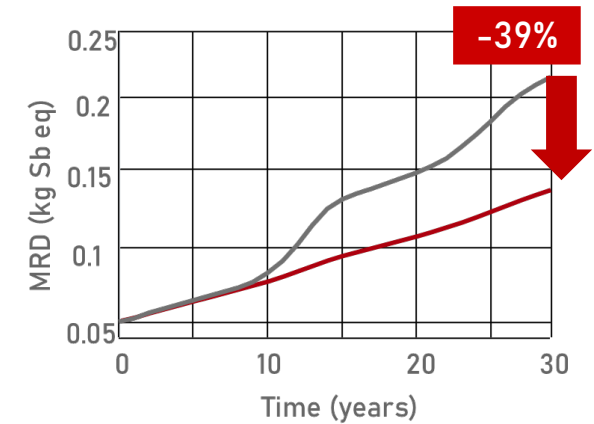
LCA analysis and Life cycle design



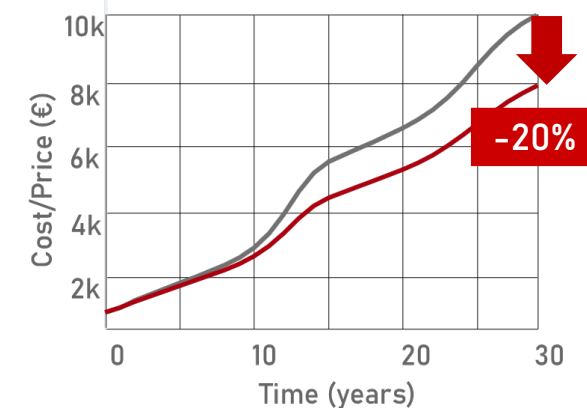
Eco-Design Case Study (2)

	A	B
System configuration		
Disassembly	-	✓
Environmental impact & lifetime	-	✓
Concept	With no disassembly capability and no evaluation of environmental impact and lifetime.	With disassemblable design, evaluation of environmental impact and lifetime, replacement-inclusive maintenance is introduced.

LCA analysis and Life cycle design



MRD: Material Resource Depletion





Use case 2

Plastic Recycling

Plastic Recycling

Our History of Home Appliance Plastic Recycling

<p>April 1999</p> 	<p>HYPER CYCLE SYSTEMS CORPORATION □ HCS □ First commercial recycling plant in the home appliance industry.</p>
<p>April 2001</p>	<p>Enforcement of Japan's home appliance recycling law. Target: TV, refrigerator, air conditioner, washing machine</p>
<p>2004 □</p>	<p>Initiate development of advanced sorting technology for mixed plastics.</p>
<p>2006 □</p>	<p>Launch pilot plant demonstration testing.</p>
<p>April 2010</p> 	<p>GREEN CYCLE SYSTEMS CORPORATION □ GCS □ Launch mixed plastics recycling business.</p>

Crushed Mixed Plastics from Home Appliance



Maximum Processing Capacity
Approx. 16,000ton/year



Pellets

Flakes

Approx. 11,500ton/year

Closed Recycling System of Home Appliances

HYPER CYCLE SYSTEMS CORPORATION

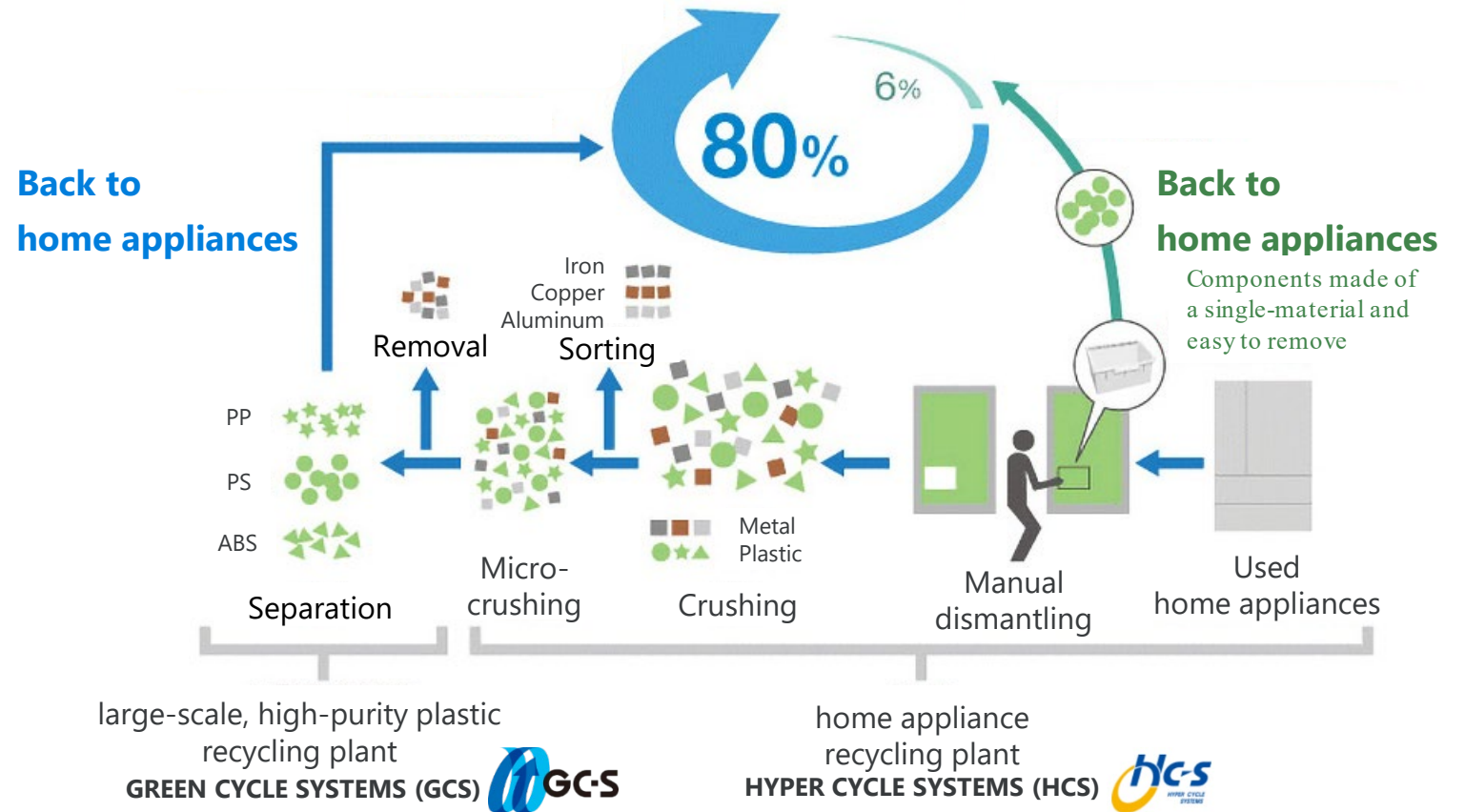


Collect metals and plastics from home appliances

GREEN CYCLE SYSTEMS CORPORATION



Manufacture recycled plastics from collected plastics



Electrostatic Separation

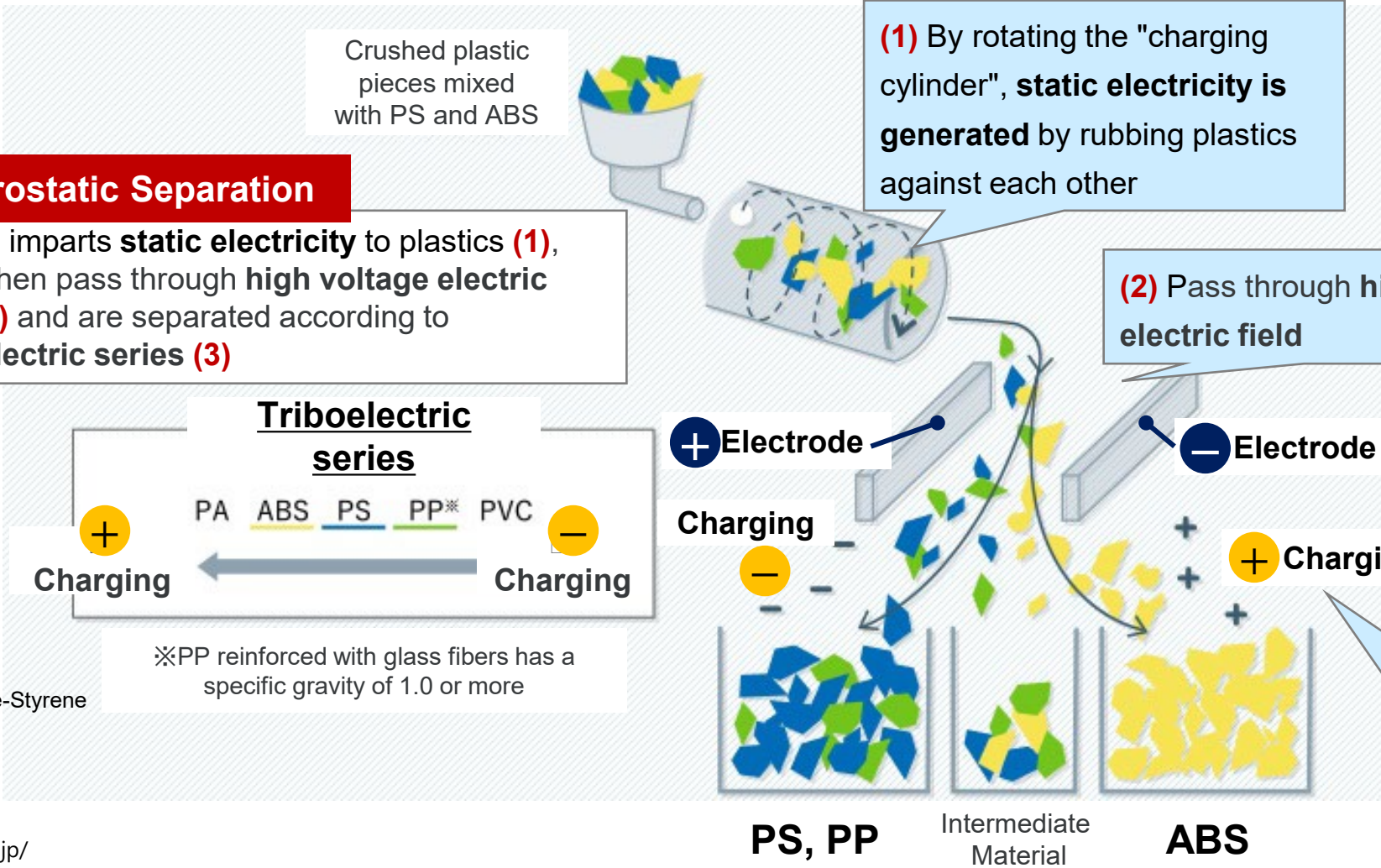
Electrostatic Separation

Friction imparts **static electricity** to plastics (1), which then pass through **high voltage electric field** (2) and are separated according to **Triboelectric series** (3)

(1) By rotating the "charging cylinder", **static electricity is generated** by rubbing plastics against each other

(2) Pass through **high voltage electric field**

(3) Separate based on **Triboelectric series (Frictional charging)**



Triboelectric series



※PP reinforced with glass fibers has a specific gravity of 1.0 or more

- [Plastic Type]
- PA: Polyamide
- ABS: Acrylonitrile-Butadiene-Styrene
- PS: Polystyrene
- PP: Polypropylene
- PVC: Polyvinyl Chloride

Source: <http://www.gc-s.co.jp/>

Smart Plastic Separation Digital Transformation Solution “CIRCUENGINE”

Maintaining quality requires operational know-how for electrostatic separation.
Mitsubishi Electric is working on CIRCUENGINE, a digital transformation solution to automate operations.

