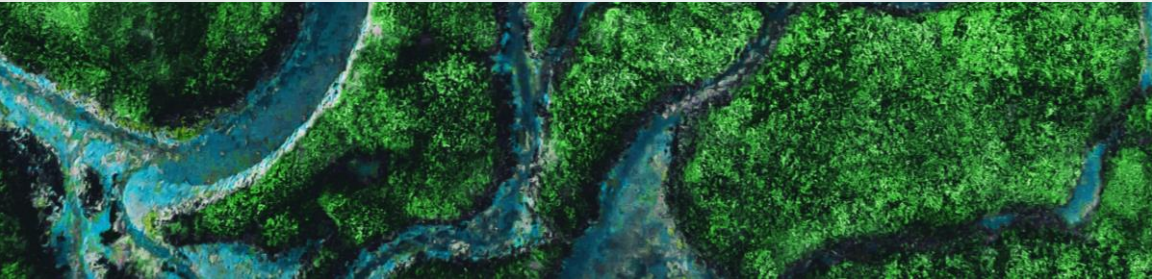




# **Circular Economy Electrolysers & Fuel Cells**

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*13th EEDF, Kawasaki City, 2024-01-25*



We have summarized the focal points of our sustainability management in the “New Dimensions – Sustainability 2025” target vision. It describes six topic areas that set the framework for our activities in the coming years.

# Circular Economy — Electrolysers & Fuel Cells

## Focal Points of Our Sustainability Management

### Climate action

- 1 | Reducing CO<sub>2</sub> emissions
- 2 | Energy efficiency and renewable energies

It is Bosch's ambition to be a climate action pioneer – advancing the expansion of renewables and striving continuously for energy efficiency.

### Health

- 1 | Occupational health and safety
- 2 | Substances of concern

Bosch contributes to human health – with innovative products and services and by ensuring that people and the environment do not come to harm through its production processes.

### Human rights

- 1 | Responsibility
- 2 | Transparency

Bosch takes on responsibility and is sensitive to human rights being respected – along the entire value chain.



### Water

- 1 | Water scarcity
- 2 | Water quality

For Bosch, water is a resource to be treated sparingly. Regions in which water is scarce are a special concern.

### Circular economy

- 1 | Materials efficiency
- 2 | Second life

Bosch is reducing its ecological footprint and striving to create social benefit. In this endeavor, Bosch takes its lead from the circular economy principle.

### Diversity

- 1 | Equity
- 2 | Inclusion

For Bosch, diversity, equity, and inclusion are key to long-term success in business. In addition, Bosch contributes to the common good in the communities near its locations.

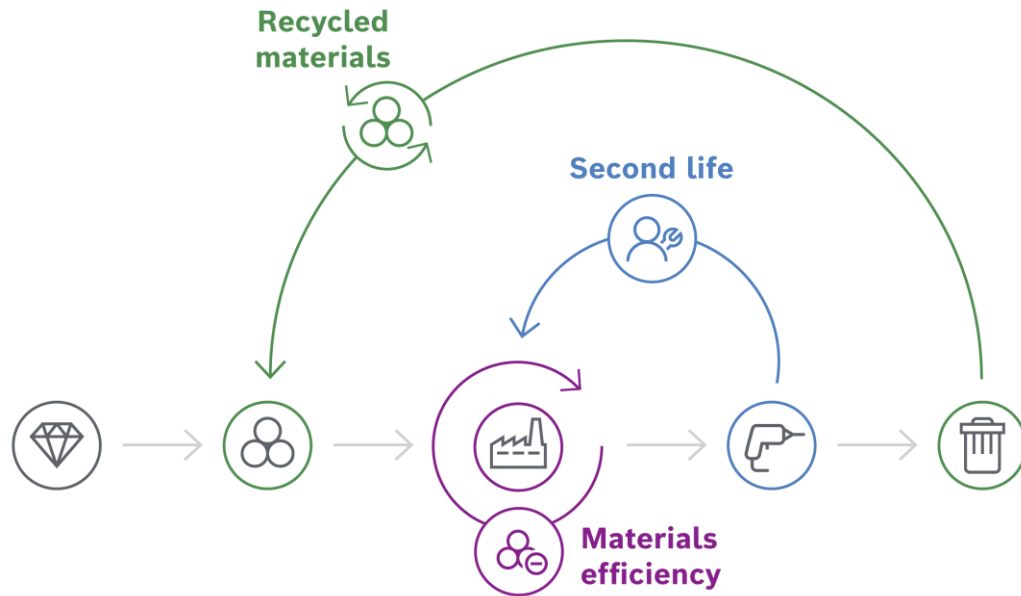


With our circular economy strategy, we want to enhance the sustainability of our products throughout their entire life cycle – from procurement and production to use, return, and remanufacturing, and right through to recycling and reuse of materials.

# Circular Economy — Electrolysers & Fuel Cells

## Circularity for a More Sustainable Product Portfolio

### Circular economy strategy



### Three levers for circularity



#### Materials efficiency

The best solution for the environment is to use fewer materials



#### Second life

Reuse, repair, and remanufacture to extend a product's life cycle  
Closing the loop within Bosch



#### Recycled materials

Use of recycled materials  
Closing the loop outside Bosch

# Circular Economy — Electrolysers & Fuel Cells

## Circular Economy — Here and Now



Materials  
efficiency



### Microelectromechanical systems (MEMS)

BME688: The sensor is housed in a compact package, measuring just 3.0 x 3.0 x 0.9 mm<sup>3</sup>.



Second  
life



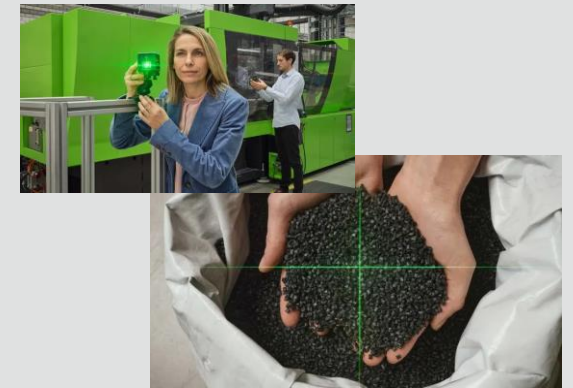
 BlueMovement

POWERED BY BOSCH

**Lease-based model** for  
household appliances.



Recycled  
materials



### Quigo Green

The product housing of the new green cross-line laser comprises 85 percent **recycled plastic**.

# Circular Economy - Electrolysers & Fuel Cells

## Our Products



PEM Electrolyzer



PEM Fuel Cell



Solid Oxide Fuel Cell

PEM = Polymer Electrolyte Membrane (aka Proton Exchange Membrane)

# Circular Economy — Electrolysers & Fuel Cells

## PEM Electrolyzer and Fuel Cell: Closing the Material Loop

### Optimizing the carbon footprint

H<sub>2</sub> technologies reduce greenhouse gases (GHG)

Inherent high loading of PGMs<sup>a</sup> burdens carbon footprint; recycling reduces PGM PCF<sup>b</sup> by > 95%<sup>c</sup>



### Tailoring recycling technology

Recovering PGMs<sup>a</sup> from stack components: **Recycling**

Research in mild extraction technologies: Green Recycling

**Bosch technology** for application @ partners (e.g., PGM refiner): 23 patent families submitted



### Economic & ecological sustainability

Rethinking value chain for more sustainability and value:

**New Business Models**

Increasing life-time and re-use:

**Digital Twin**





# Circular Economy — Electrolysers & Fuel Cells

## PEM Electrolyzer and Fuel Cell: Closing the Material Loop

### 01 | Production & installation

- Use of recycled PGM<sup>a</sup> to reduce CO<sub>2</sub> footprint
- Improved access to raw materials

### 03 | End-of-life

- Repurchase agreements provide Bosch the right of first refusal (from OEM / end users)
- Value proposition: significantly lower PCF<sup>b</sup>, effort reductions, and residual value estimations



### 02 | During operation

- State of health diagnosis
- Predictive maintenance
- Digital twin as an enabler

<sup>a</sup>Platinum Group Metals, <sup>b</sup> Product Carbon Footprint  
24-01-25

# Circular Economy — Electrolysers & Fuel Cells

## SOFC: Digital Twin for CE & Optimized Lifecycle

### 01 | Production & installation

- Digital twin contains production data
- Enables real-time information on state of health of SOFC

### 03 | End-of-life

- Accurate state of health of each component  
→ targeted use of refurbishment/recycling



### 02 | During operation

- State of health monitoring
- Predictive maintenance & tailored services to prolong lifetime
- Continual updates of software and hardware during operation
- Learning from one generation for the next

