# Energy-efficient. Decentralized. $H_2$-ready.
## With fuel cell power systems by Bosch


**The highly efficient power source – the stationary fuel cell system by Bosch**

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Project Solid Oxide Fuel Cell
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www.bosch-sofc.com

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# Agenda

1 Company introduction

2 Fuel cell portfolio

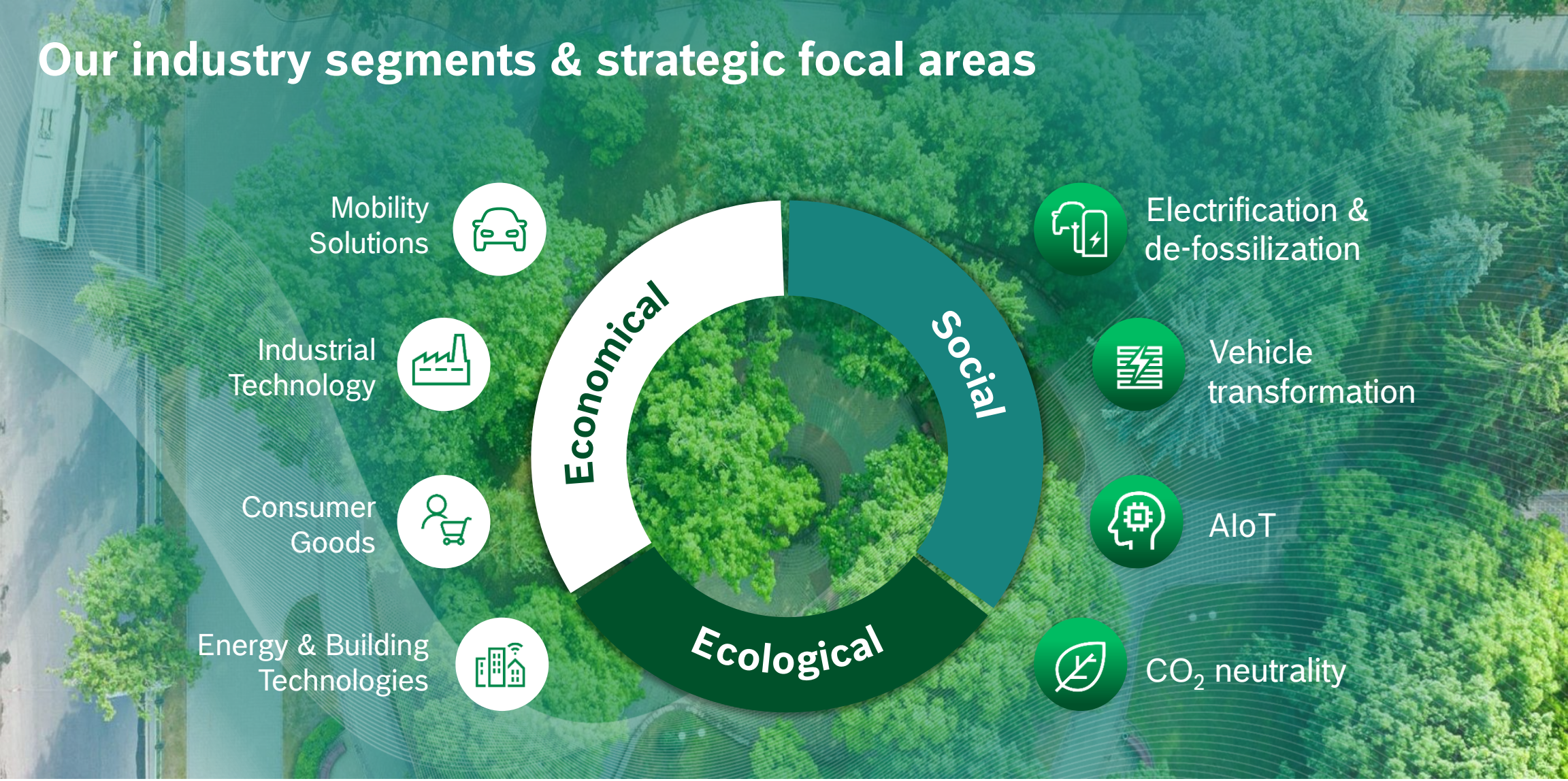
3 SOFC technology

4 SOFC value stream

5 Benefits

6 Use cases & pilot projects

# Our industry segments & strategic focal areas







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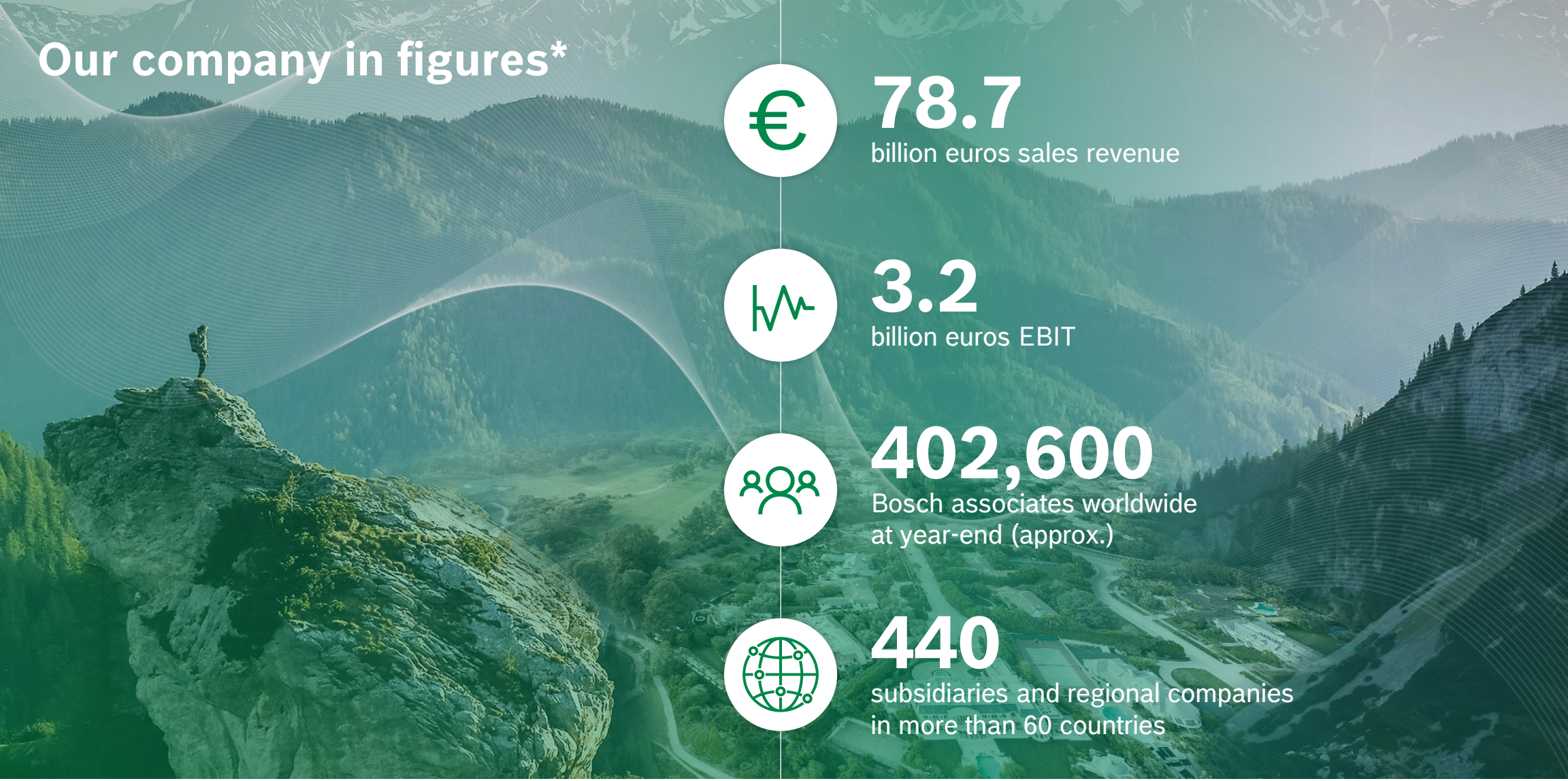
# Our company in figures*



**78.7**
billion euros sales revenue

**3.2**
billion euros EBIT

**402,600**
Bosch associates worldwide
at year-end (approx.)

**440**
subsidiaries and regional companies
in more than 60 countries

# Bosch fuel cell portfolio

**Polymer electrolyte membrane fuel cell** (PEMFC)

Automotive

Data centers

Buildings & urban quarters

**Solid oxide fuel cell** (SOFC)

Industries

Wide range of applications

| | | | |
|---|---|---|---|
| **Type** | **Mobile fuel cell** | **Stationary fuel cell** | |
| **Fuel** | **Hydrogen** | **Biomethane** | **Natural gas** |
| **Power per module** | **Up to 130 kW** | **10 kW up to several MW** | |





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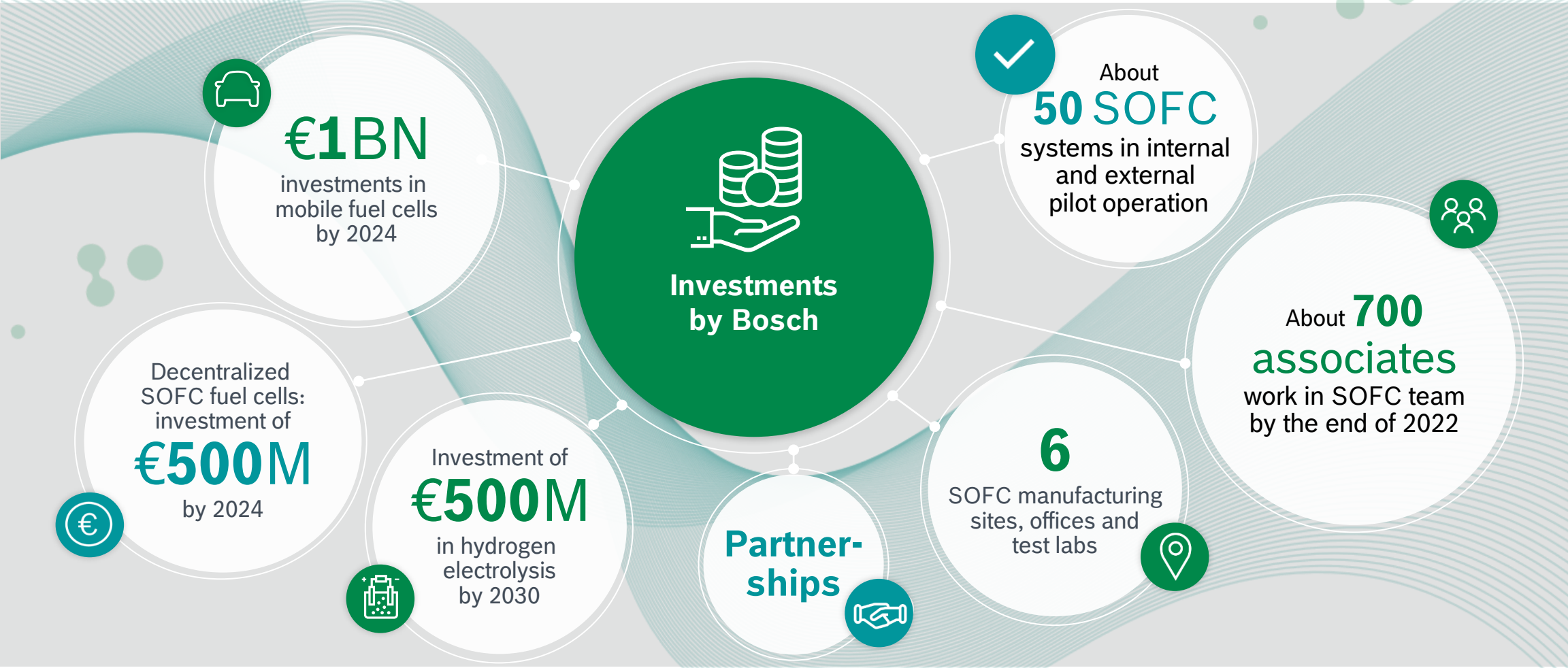
# We believe in fuel cell technologies



# Technical set up, performance and application of SOFC


| | |
|---|---|
| 1 | A stack of several hundred cells |
| 2 | Recirculation |
| 3 | Reformer |
| 4 | Heat exchanger |
| 5 | Inverter |

## Performance

> 60 %
Electrical efficiency (AC)*

> 85 %
Overall efficiency*

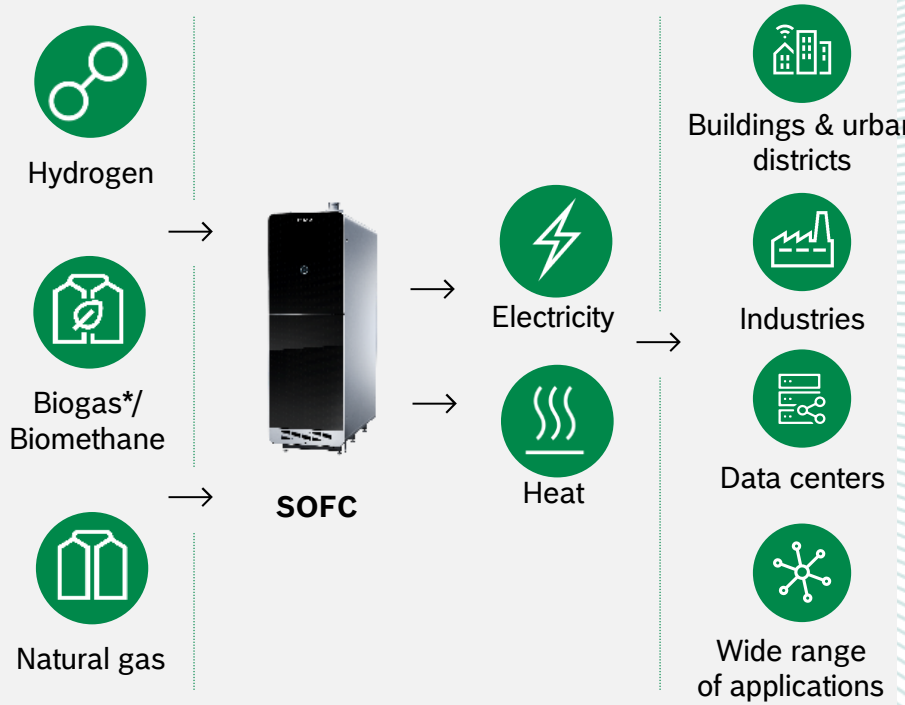
10 $kW_{el}$
Nominal power (AC)*

> 3 $kW_{th}$
Thermal output*

* Currently in the pilot phase, the Bosch SOFC system is to be mass-manufactured by 2024. All technical specifications given in this informational document are development objectives.

* Beginning of life

## Multi-fuel system & flexible application




* Biogas processed according to DVGW G260

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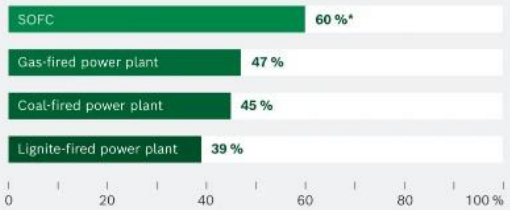
# SOFC provides answers to market requirements

## Clean energy-efficiency

### Efficient energy generation

Electrical efficiency[1]




*beginning of life

### Low emission energy generation

$CO_2$ reduction compared to coal fired power plants:

**68 %**
by using Natural Gas

**100 %**
by using pure Hydrogen

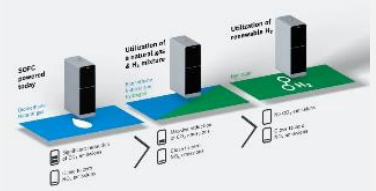
## Flexibility

### Energy where it's needed

Decentralized power supply independent of power grid

### Ready for transformation

Energy generation today by fueling with Natural Gas or Biomethane and with pure Hydrogen in the future.



### Free scalability

From one individual unit to an entire power plant depending on energy requirements.

## Reliability

### Decentralized power supply

Maintain secure energy supply, independent of grid stability and shutdowns.

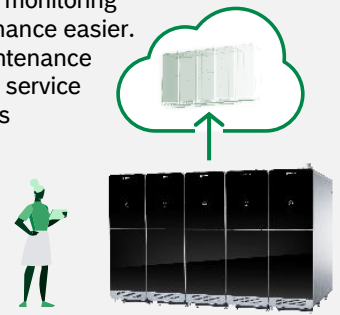
### Integrated backup solution

Individual SOFC units connected independently together to form a stable system – no further backup necessary.

## Connectivity

### Digital twin & AI

Real-time data monitoring makes maintenance easier. Predictive maintenance enables longer service life and reduces downtimes.



### Sector coupling

at the point of use: Electricity - heating - cooling

**10 $kW_{el}$**
*Nominal power (AC)**

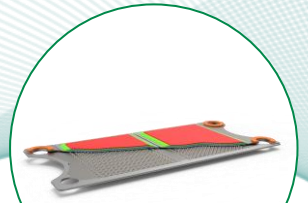
**>3 $kW_{th}$**
*thermal output**

Currently in the pilot phase, the Bosch SOFC system is to be mass-manufactured by 2024. All technical specifications given in this informational document are development objectives.
[1]Source: Average gross efficiency of conventional power plants, German Environment Agency

# SOFC: Complete value stream covered at Bosch

Digital Twin

**Bamberg plant**



Pitcrure reference: Ceres

Cell

Stack

**Homburg plant**

Hotbox

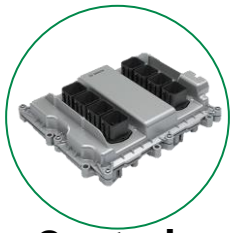
**Wernau plant**

Unit

**Point of use**

Decentralized energy supply system

**Bosch BoP Components**



Control unit

Anode recirculation blower

Air valves

Air volume flow meter

BoP: Balance of Plant





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# Transformation towards $H_2$

optional

## SOFC powered today


Significant reduction of $CO_2$ emissions

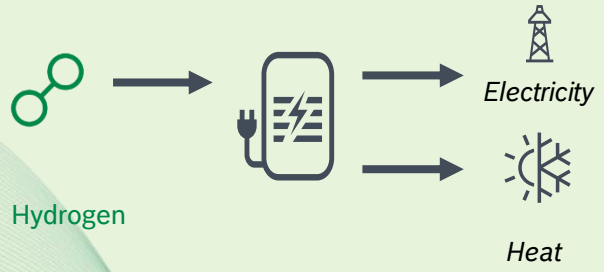
Close to zero $NO_x$ emissions

## Utilization of a natural gas & $H_2$ mixture


Massive reduction of $CO_2$ emissions

Close to zero $NO_x$ emissions

## Utilization of renewable $H_2$




No $CO_2$ emissions

Close to zero $NO_x$ emissions

# Applications and pilot projects

Buildings & urban quarters

Industries

Data centers

Wide range of applications

## Bamberg

## Stadtwerke Bamberg

## Feuerbach

## $H_2$ hub Homburg

## Renningen

## Salzgitter

## Schwieberdingen

## Telekom Berlin

## Wernau

# Join us in shaping the energy supply of tomorrow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