# The future of renewable energy systems

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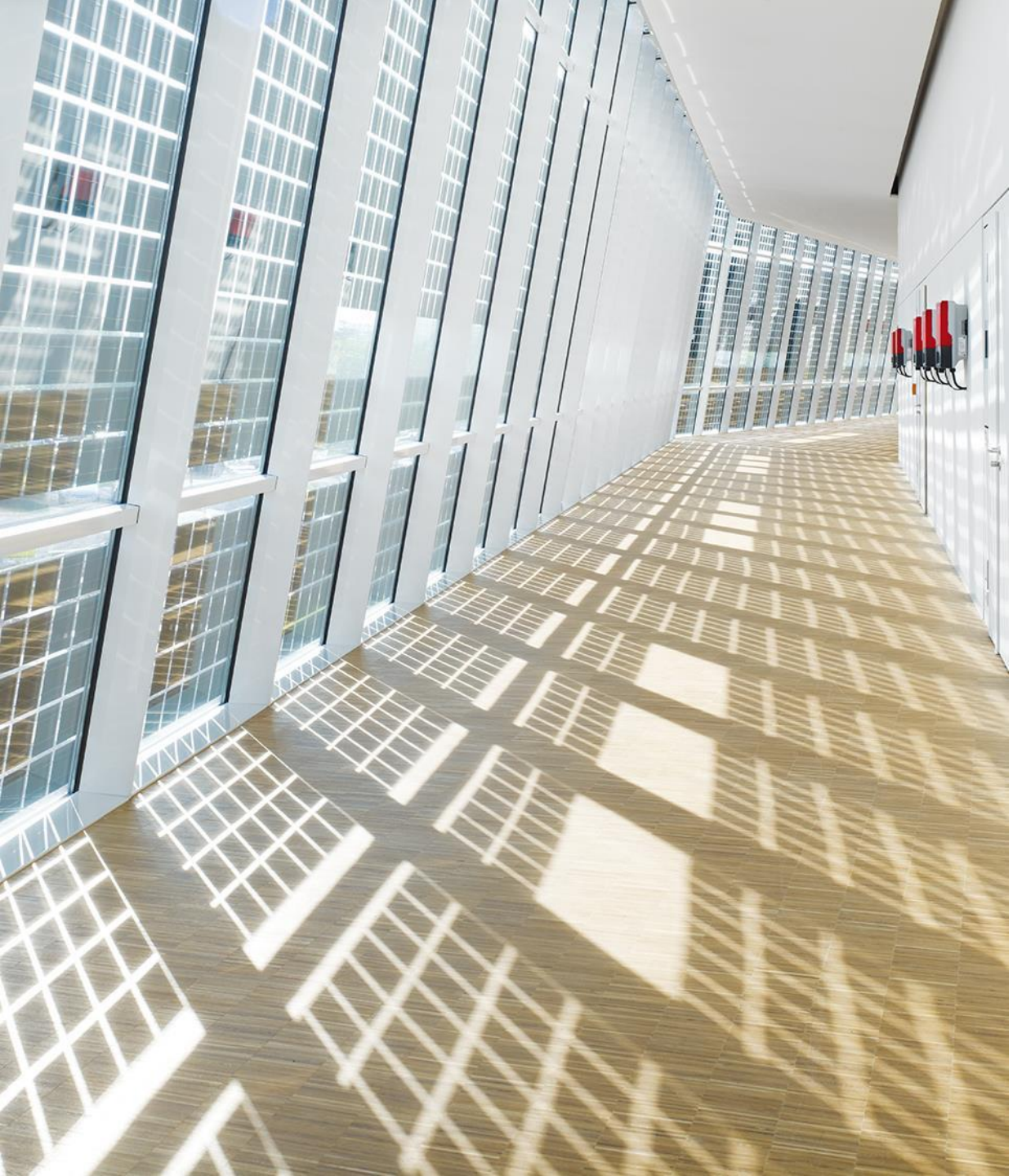
September 5th 2024

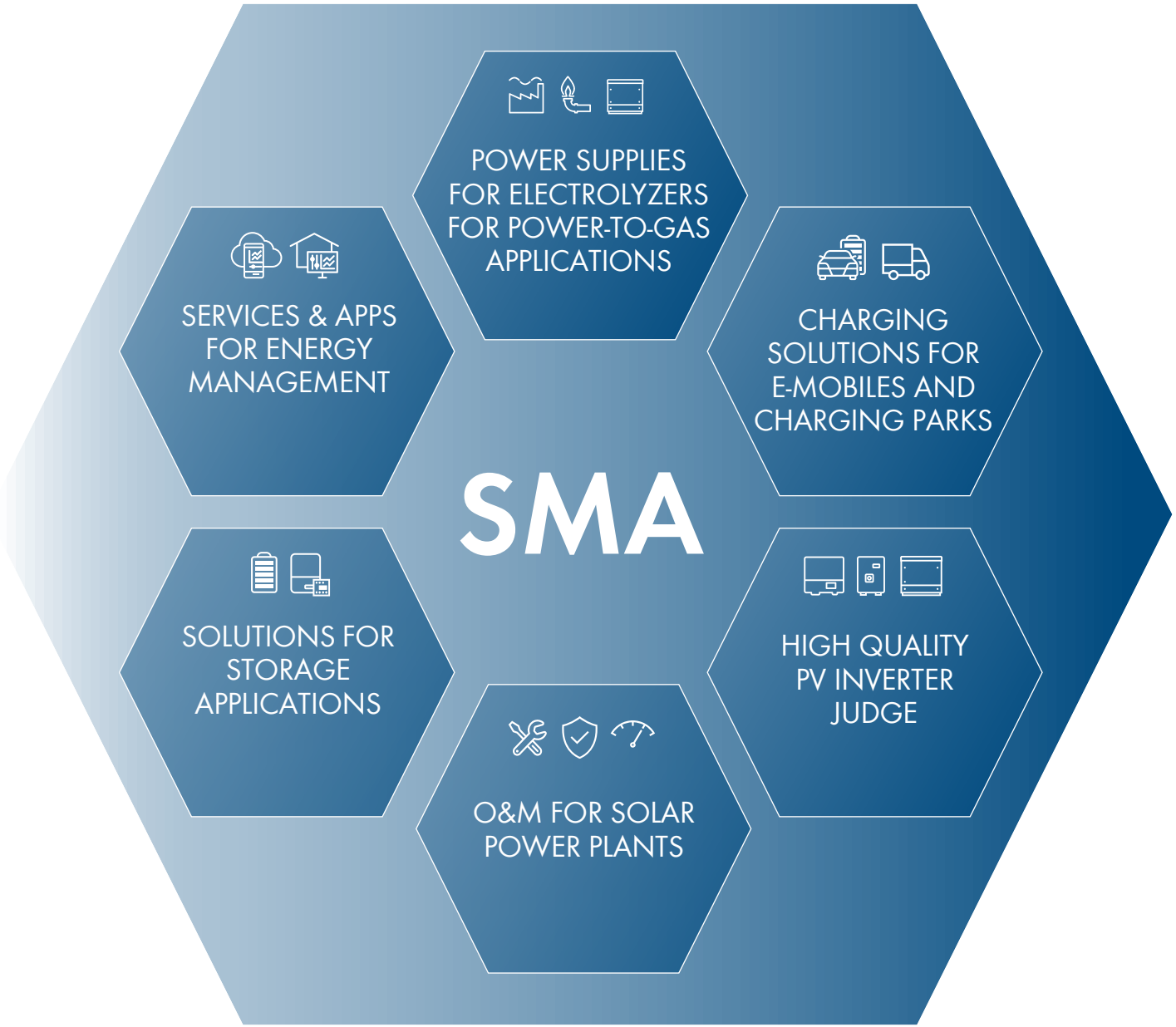


# Agenda

1. Climate change and the need for a shift towards renewables
2. „All electric society“ and „sector coupling“ are the future – but bear their own challenges
3. Power Electronics are a key technology and enabler for a positive future development

# Holistic portfolio for all segments

Our portfolio includes storage solutions, e-mobility charging infrastructure, PV inverters, power supplies for electrolyzers for power-to-gas, O&M for solar power plants, as well as energy management services and apps.




**132 GW**
SMA Inverter Performance since 2004

**1.90 B**
Revenue 2023

## Climate change and the need for a shift towards renewables

The energy transition is progressing inexorably worldwide, and the age of fossil fuels is drawing to a close.

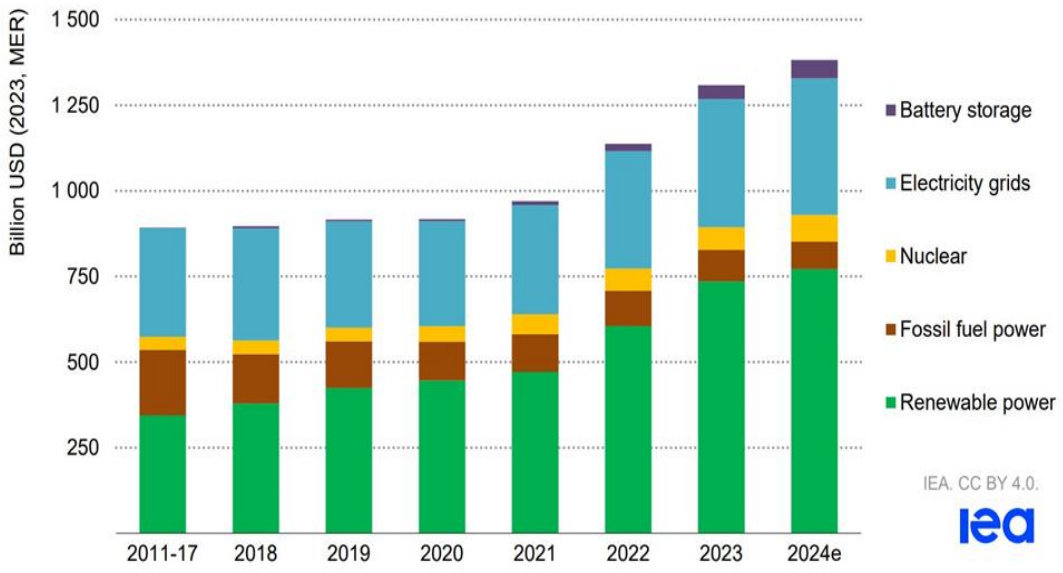
# The reduction of global CO2 emissions can only be achieved with the help of renewable energies


To comply with the Paris Climate Agreement, **global emissions must** be **halved by 2030**

At the same time, more and more **electricity** is needed, also to **electrify processes** in transport and industry

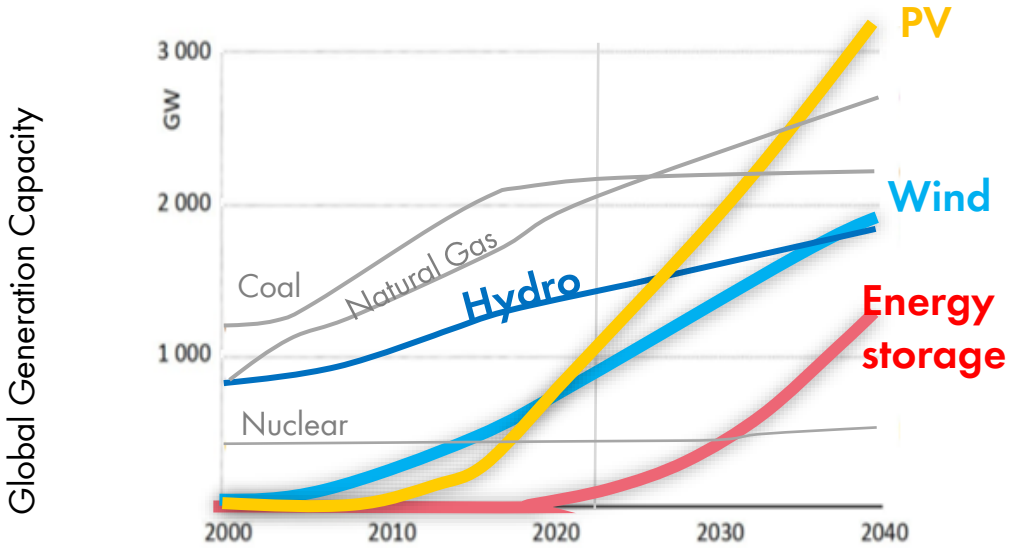
# Global investments in renewables are dominating. Growth in battery storage is enormous

## World Energy Investment 2024 Report




Source: https://www.iea.org/reports/world-energy-investment-2024 on 13.08.2024

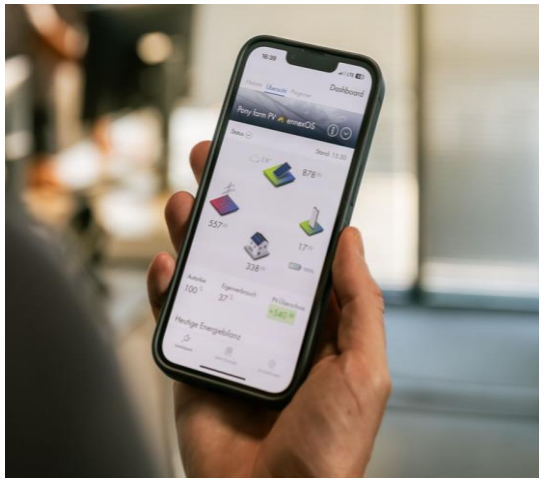
## Renewables will take over in the near future



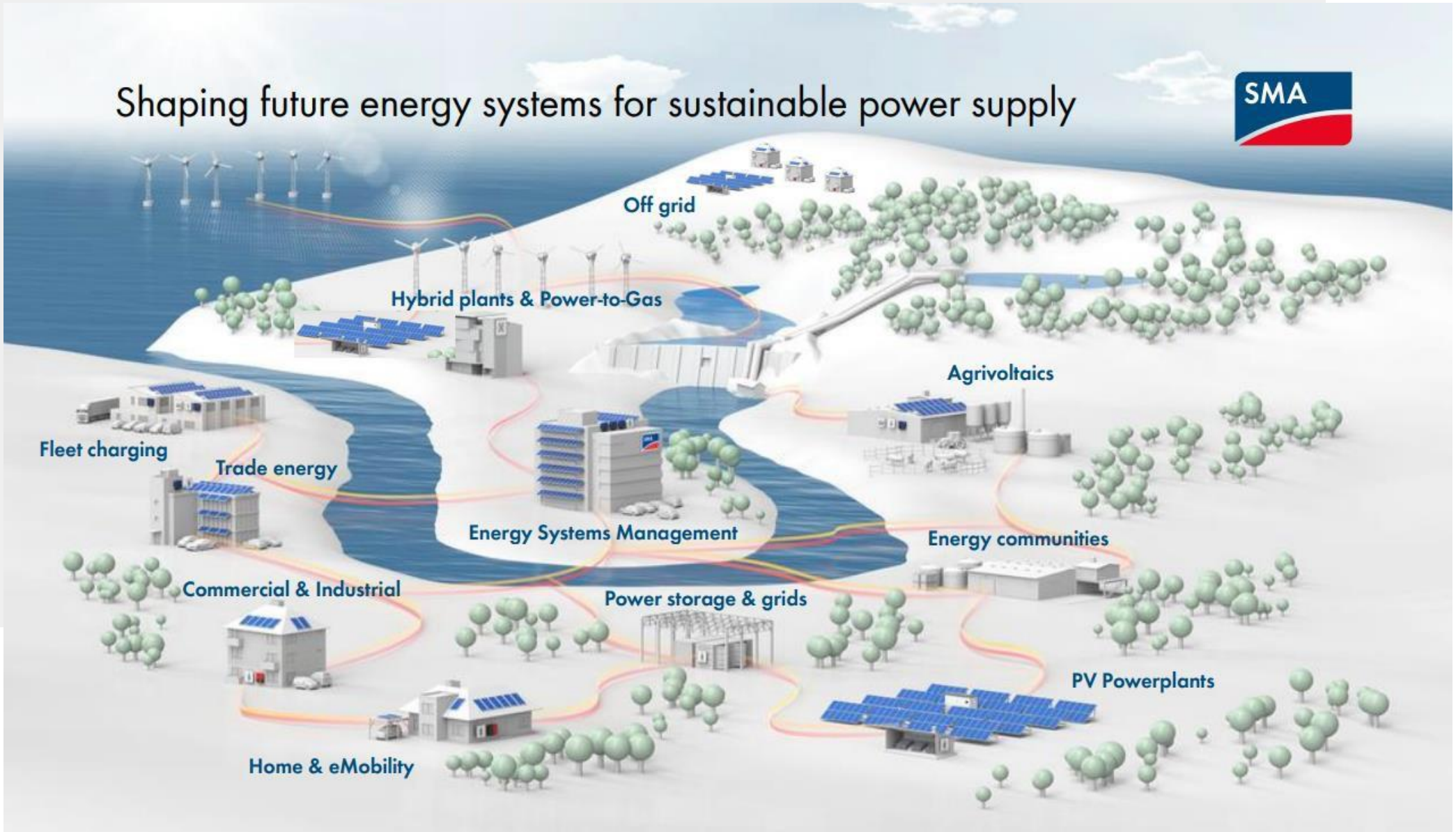
# Our challenges are complex...


**STABILITY & FLEXIBILITY: GRID INTEGRATION**

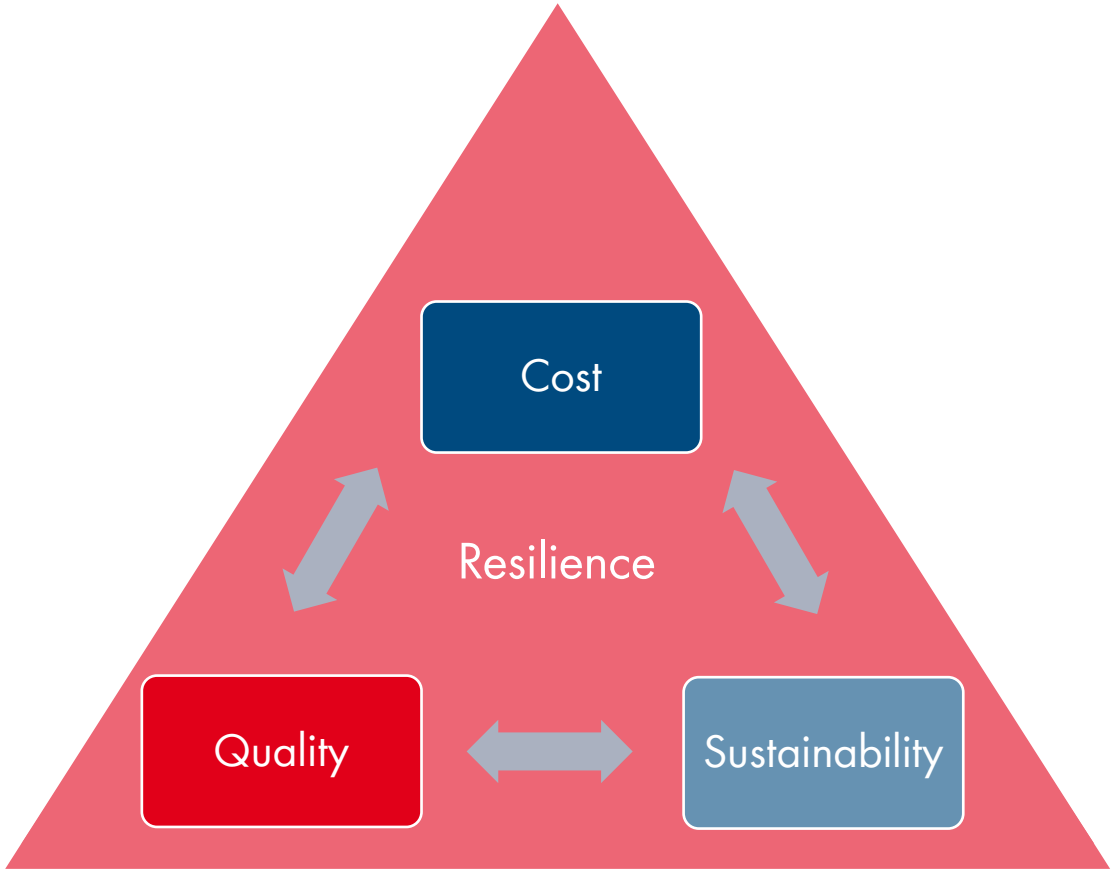
**ELECTRIFIED & DECENTRALISED: A NEW LANDSCAPE**



**SMART & USER-CENTRIC: DIGITAL ENERGY MANAGEMENT**


Shaping future energy systems for sustainable power supply
SMA
Off grid
Hybrid plants & Power-to-Gas
Agrivoltaics
Fleet charging
Trade energy
Energy Systems Management
Energy communities
Commercial & Industrial
Power storage & grids
PV Powerplants
Home & eMobility

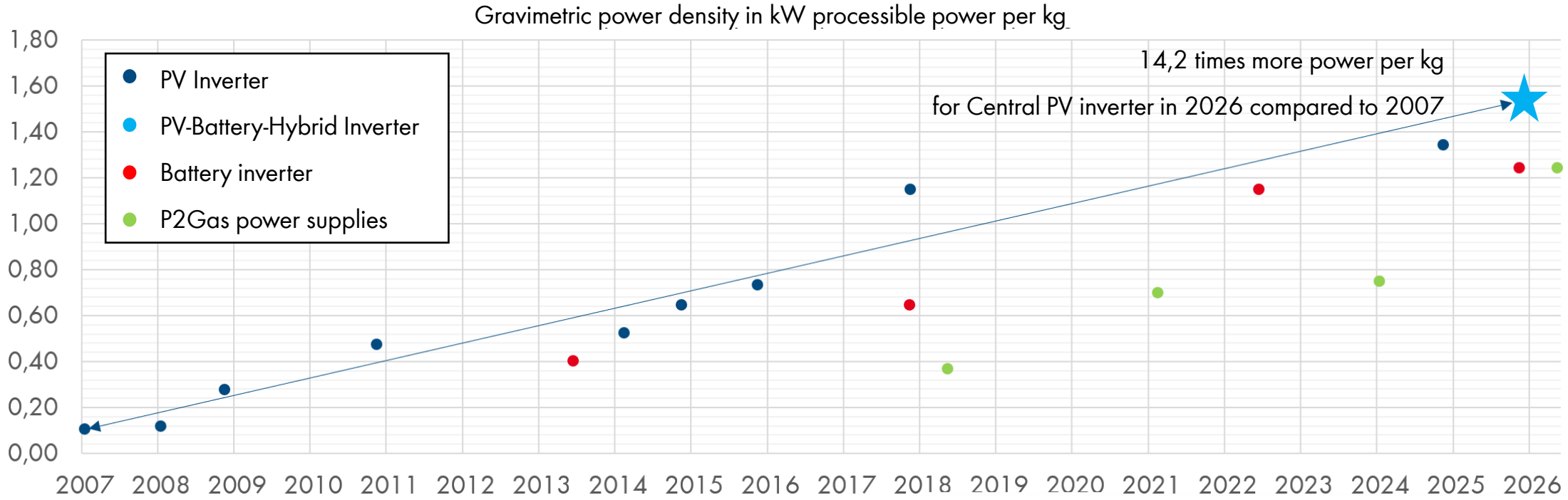
# Future energy system is dominated by power electronics




## Focus Topics

- **Increased Power Density**
- **Managed complexity**
- **Optimal Lifetime and Reliability**
- **Grid forming capabilities**

# Increased gravimetric **power density** for improved sustainability and reduced cost





100 kVA


250 kVA

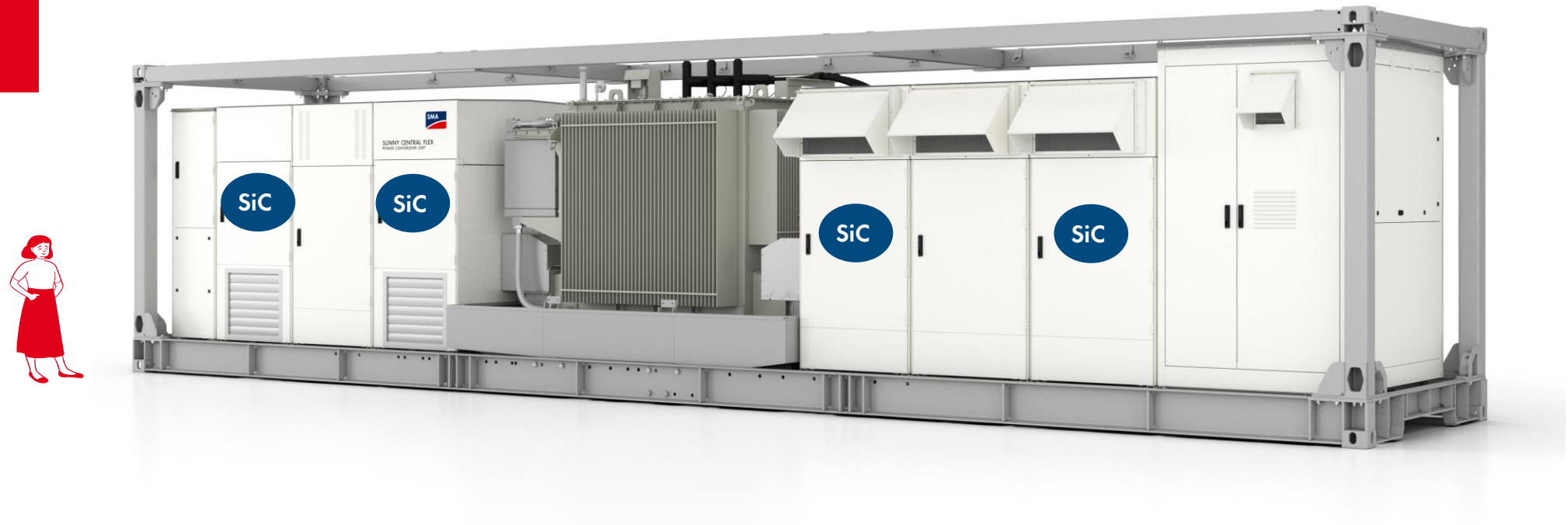

630 kVA
-> 1000 kVA


2500 kVA
-> 4600 kVA

6400 kVA..9100 kVA

# Increased gravimetric **power density** for improved sustainability and reduced cost: 1500 V PV-Battery Hybrid Inverter

**99,2% max. inverter efficiency**

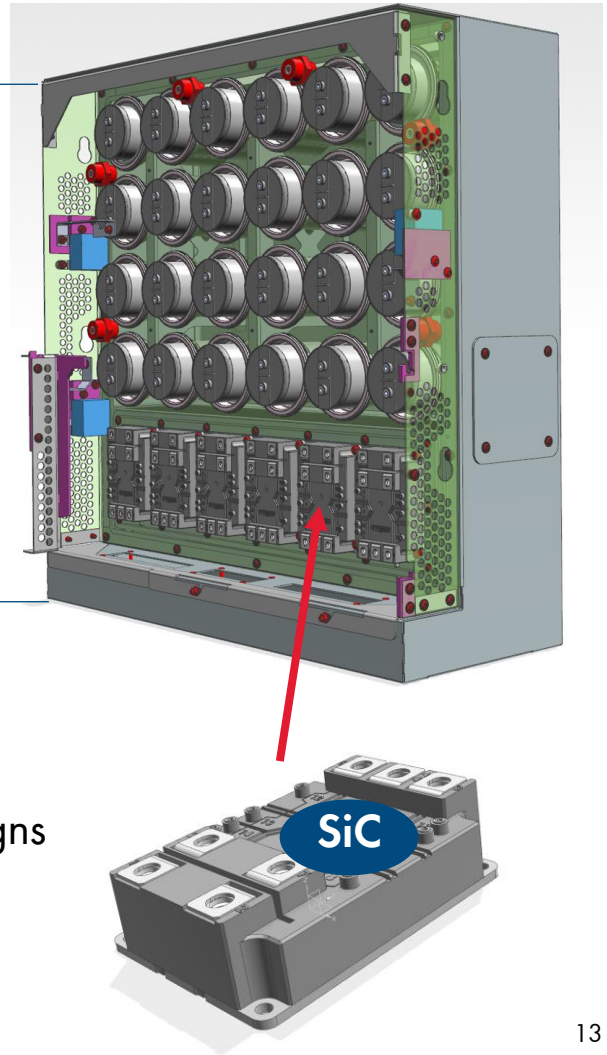


# **Reduced complexity and $CO_2$ footprint** with an improved stack design with SiC

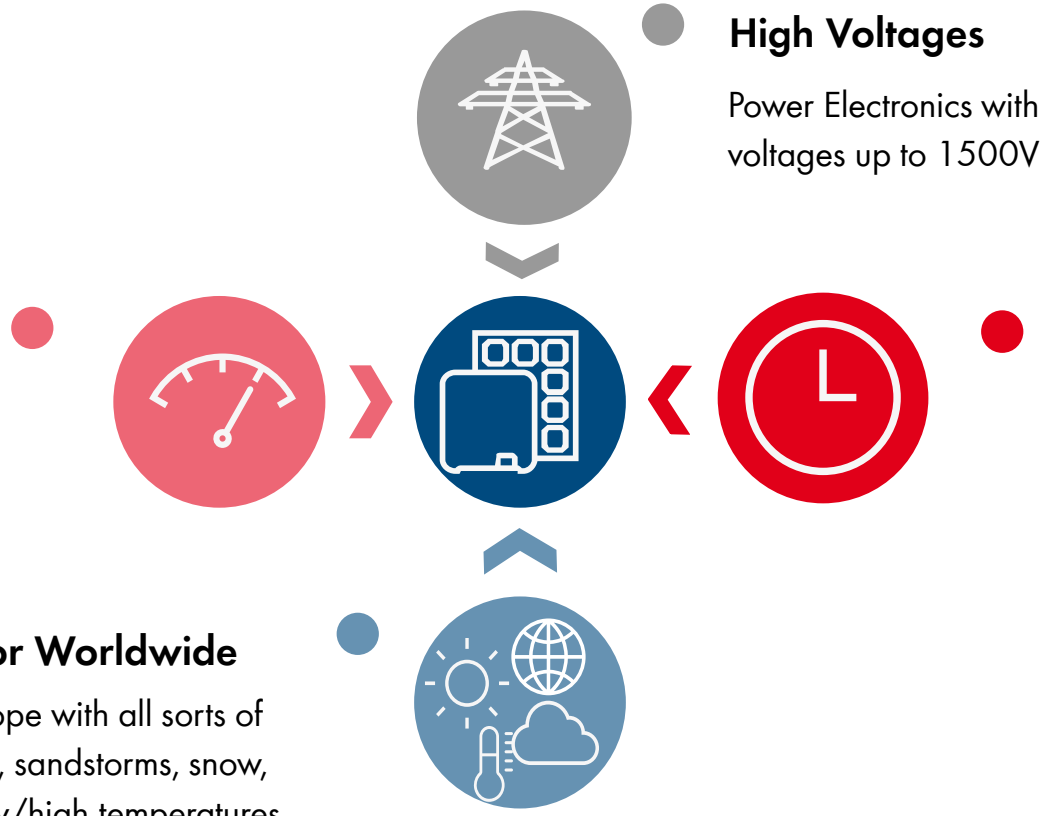
**Advantages:**

- **99,2% max. inverter efficiency**
  - Higher yield for the customer
  - Lower losses => Lower noise & smaller heat sink
- **Higher switching & control frequency**
  - Smaller magnetics
  - Lower harmonics
- **Reduced complexity**
  - 2 Level half bridge with simpler driver compared to previous and alternative designs
  - Common stack design for inverter and DC/DC converters

**Higher Power Density & Less Material**



# PV & Storage Inverters are stressed by harsh environmental conditions compared to other applications



**High Voltages**

Power Electronics with voltages up to 1500V

**High Load Factor**

Extremely high number of working-hours.

**Long Design Lifetime**

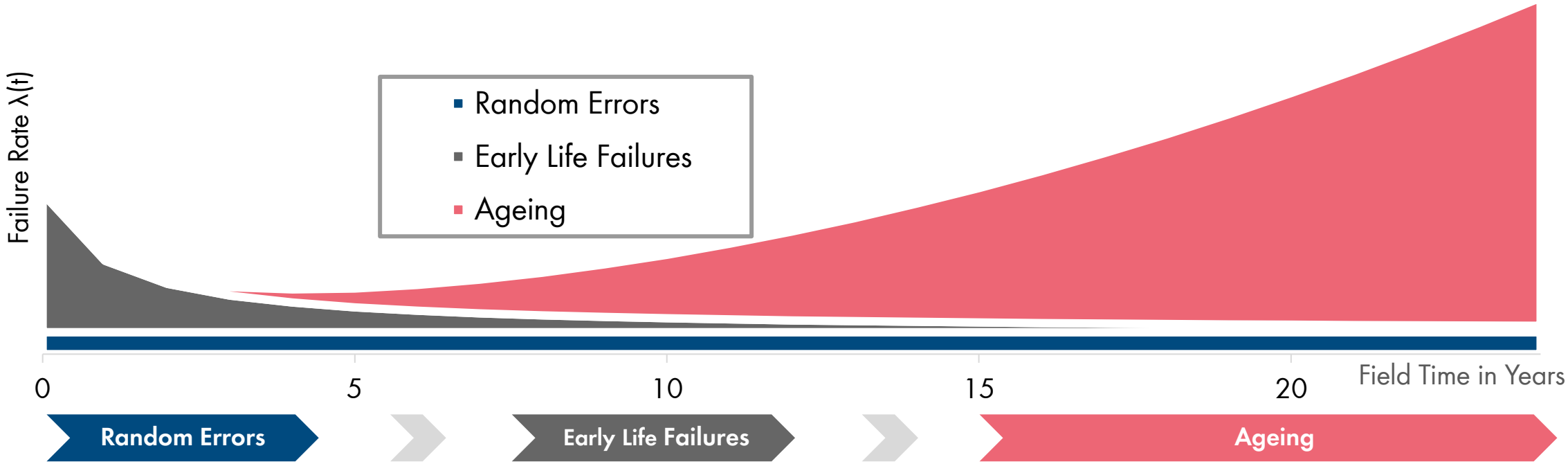
SMA has 20 to 25 years standard.

Tendency for 30 to 40 years

**Outdoor Worldwide**

The inverter needs to cope with all sorts of climates, rain, hail, dust, sandstorms, snow, elevated irradiance, low/high temperatures

# Design reserve: A key to extending **lifetime** and increasing **reliability**




**Random Errors**

**Counter measures:**

- Good component specification and robust design especially for power modules concerning cosmic ray ruggedness
- Internal Field Test

**Early Life Failures**

**Counter measures:**

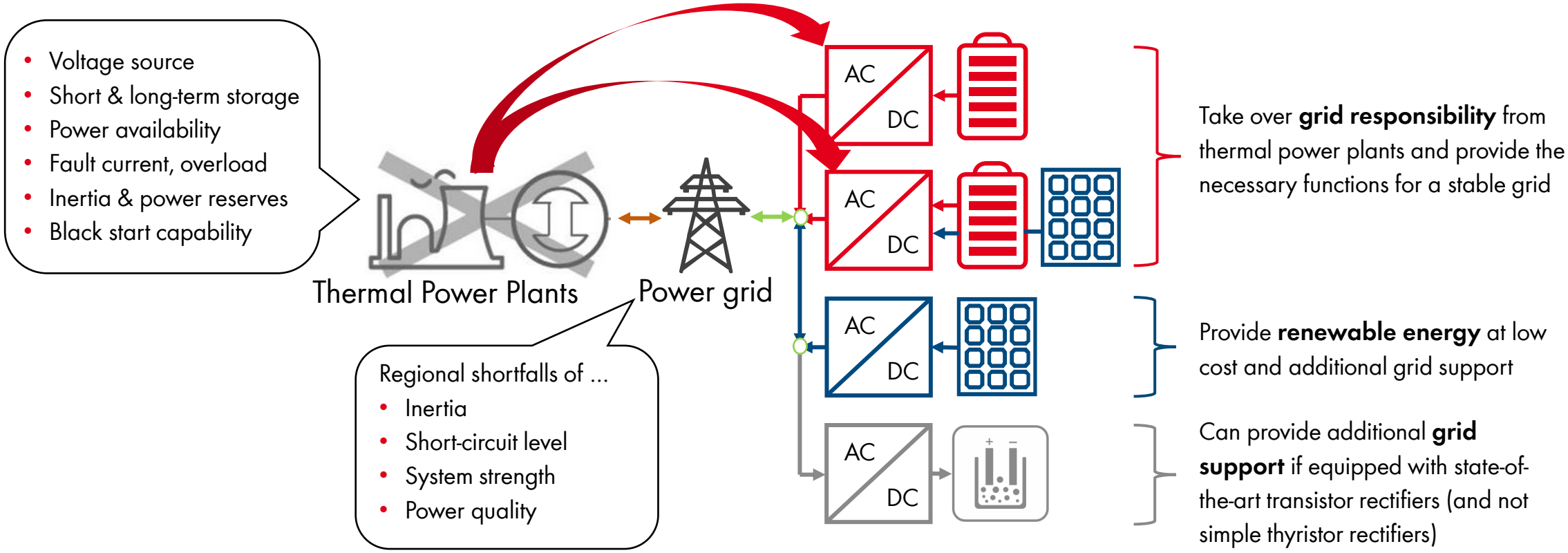
- Incoming goods inspection
- Stable production process
- Effective product end test
- Reliability monitoring by tests which accompany the series production

**Ageing**

**Counter measures:**

- Development of aging models gained from accelerated lifetime tests
- Applying these models to worst case mission profiles

# **Grid-forming:** Power electronic systems will replace spinning reserve in public power supply systems and provide resilience



## Conclusions

- Challenges: Climate change and political instabilities
- Renewables + Storage, „all electric society“ and „sector coupling“ are solutions in the energy sector
- Power Electronics are a key technology and enabler for a positve future development