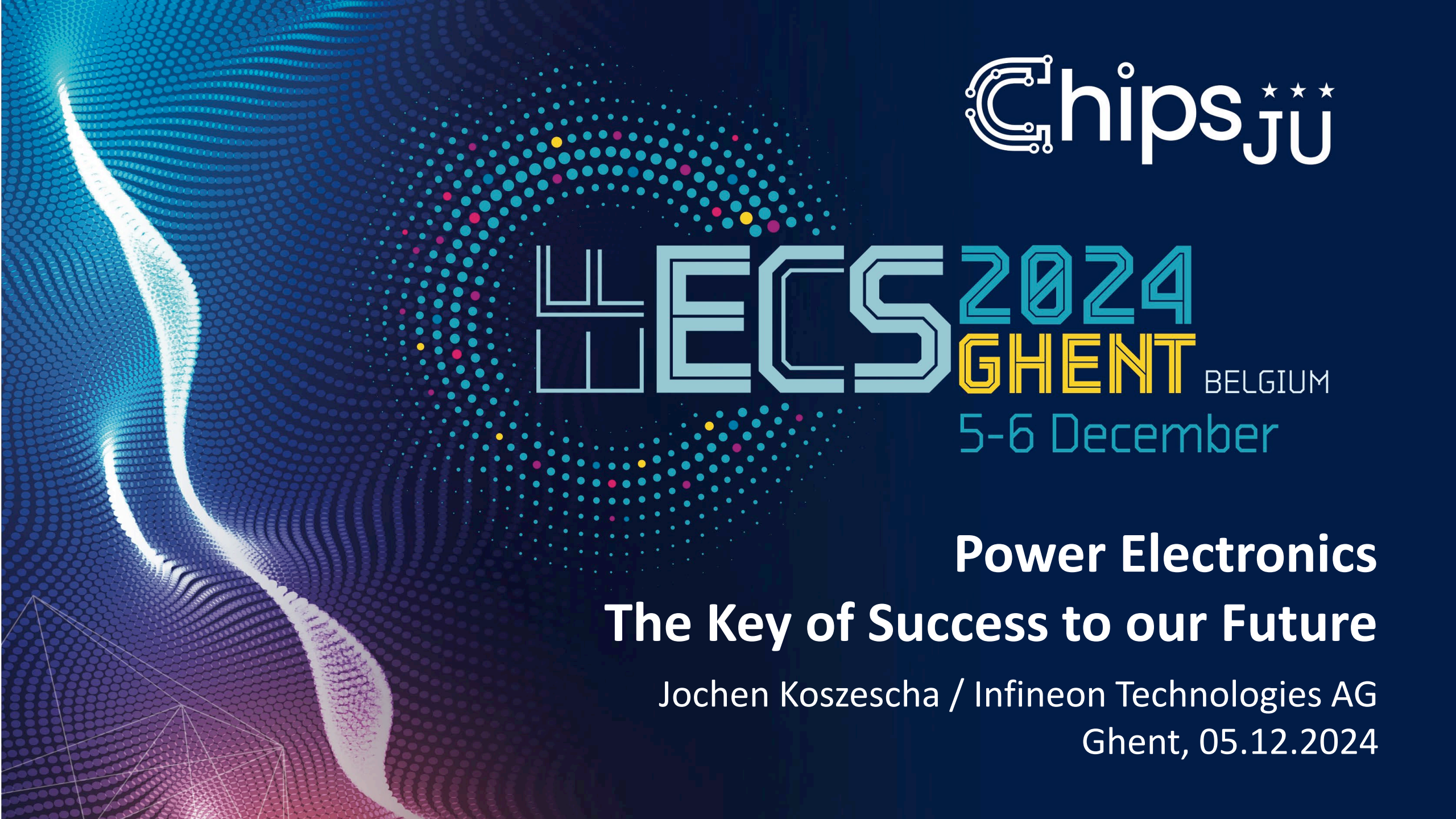
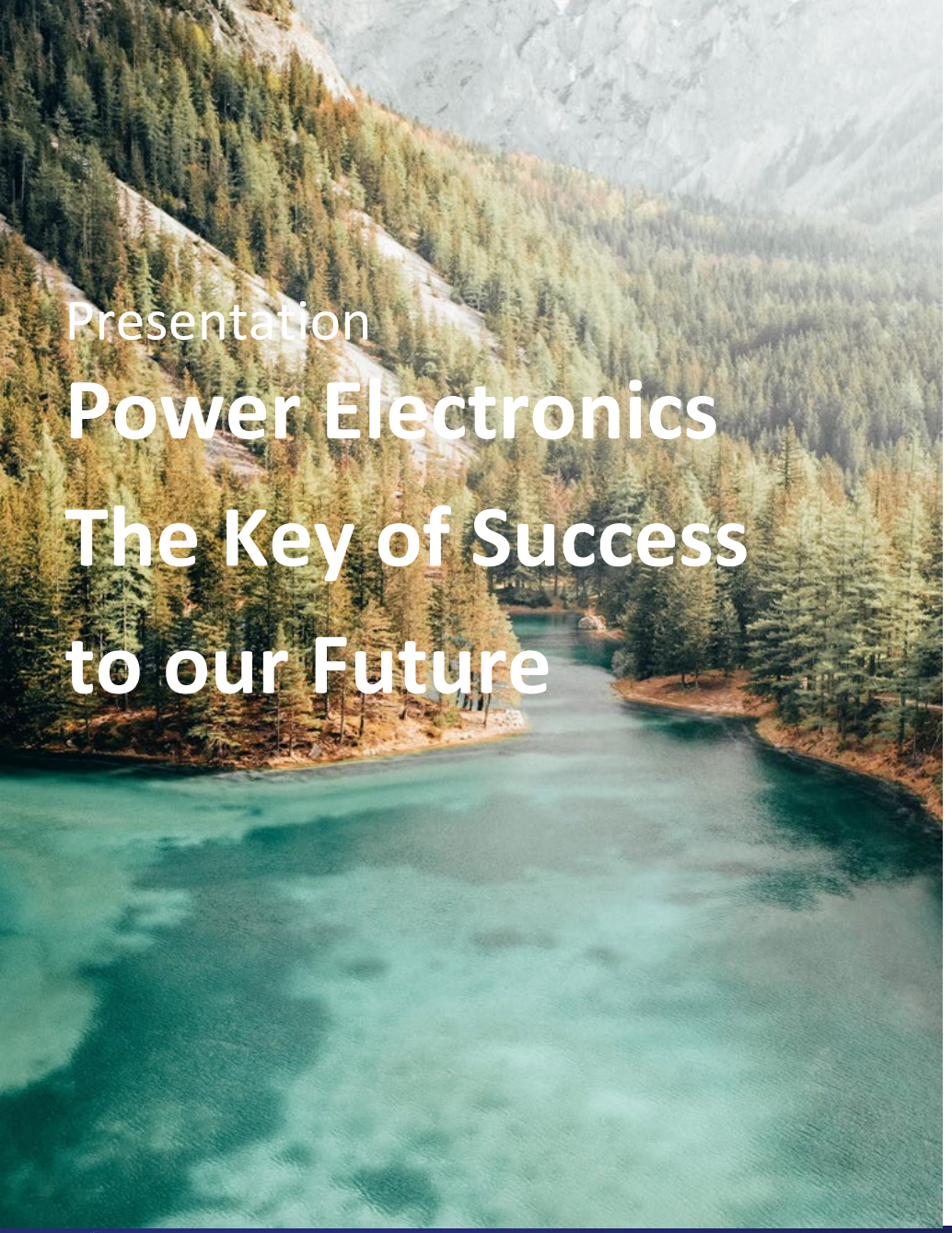


Power Electronics
The Key of Success to our Future

Jochen Koszescha / Infineon Technologies AG

Ghent, 05.12.2024



Presentation

Power Electronics
The Key of Success to our Future

Jochen Koszescha

Senior Director Funding Projects & Coordination

Infineon Technologies AG

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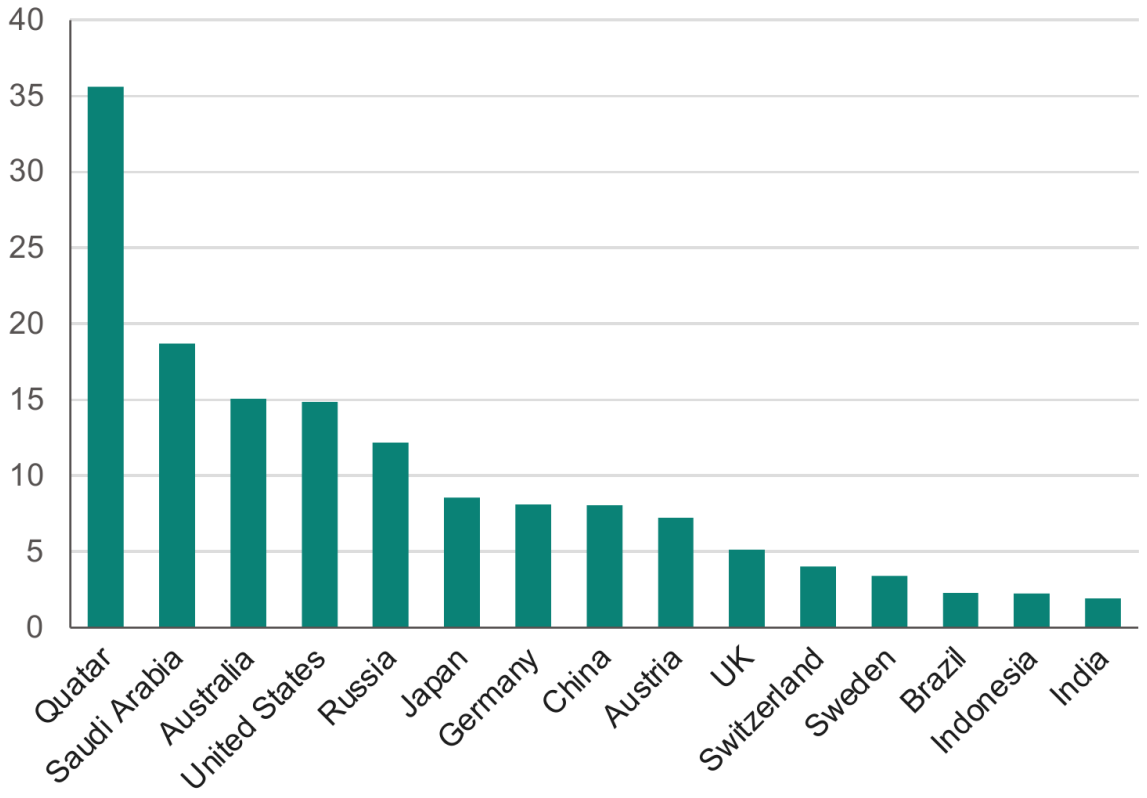
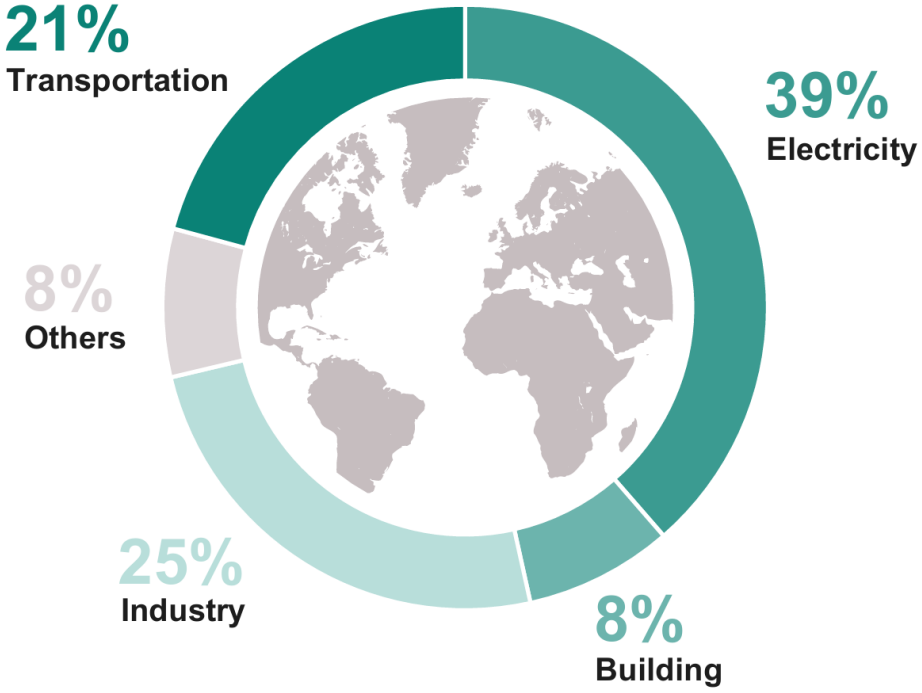
Can we still limit climate change to 2°C or even 1.5°C?

CO_2 emissions per capita 2021 in tons



Source: ourworldindata.org

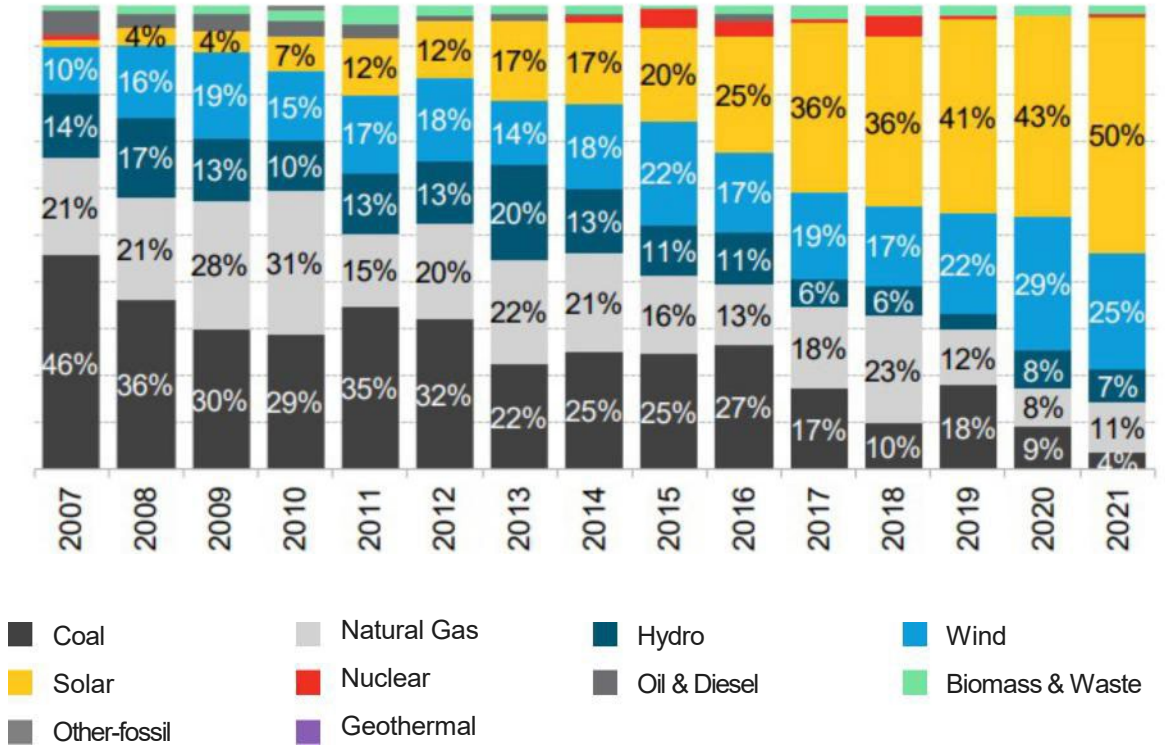
Energy-related CO_2 emissions by sector 2020 37 Gt



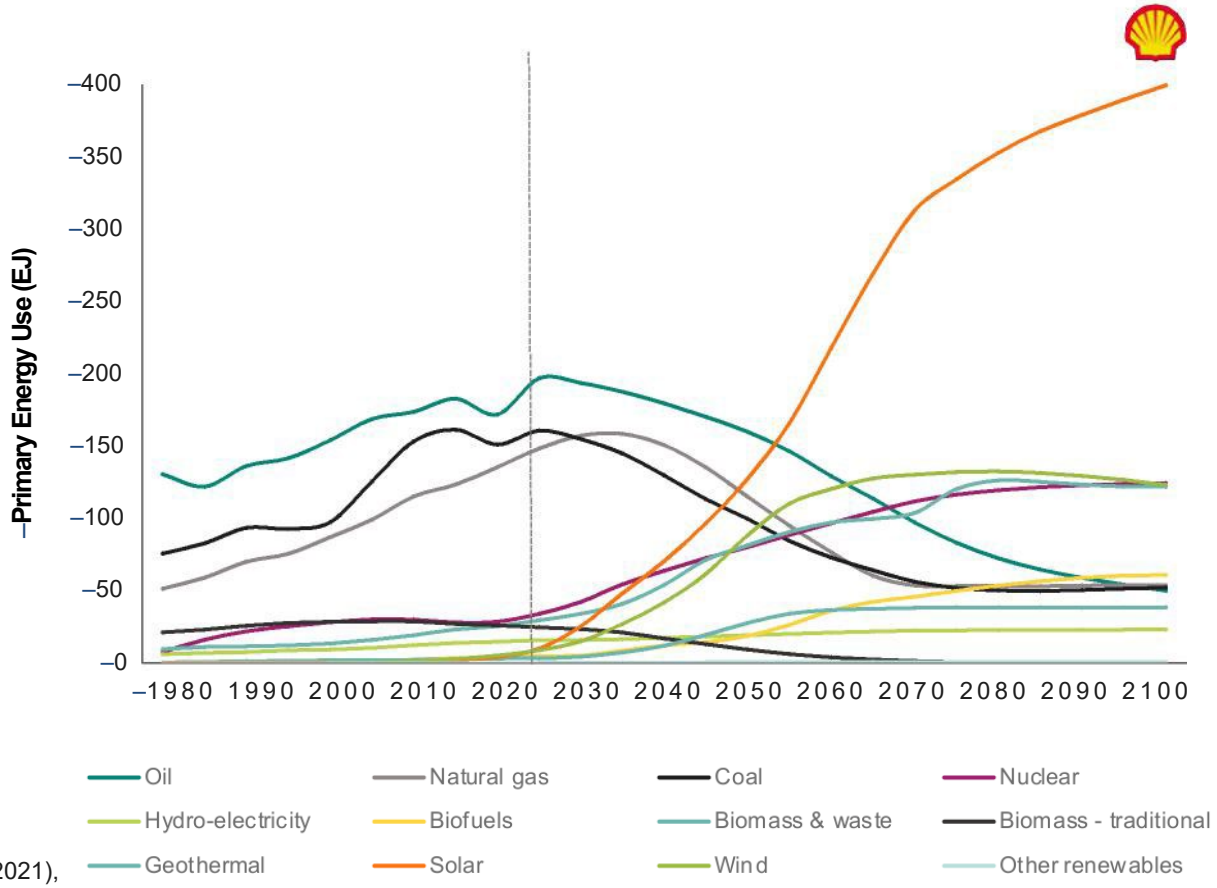
Source: World Energy Outlook 2022, IEA Nov 2022

The change has started: renewables dominate – especially solar is growing massively

Fossil energy is phased out



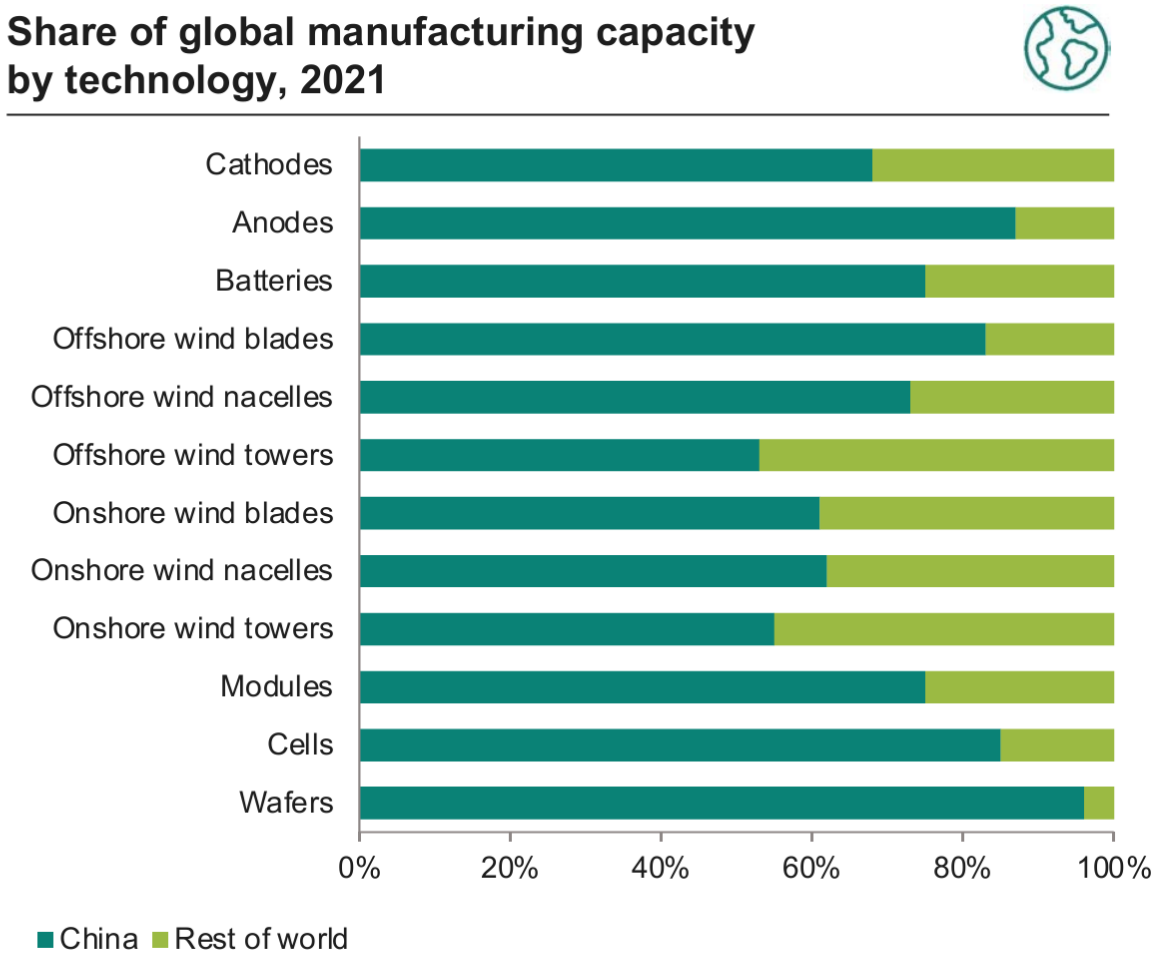
Solar is becoming the world's dominant source of energy



Source: BloombergNEF **Note:** Share of global capacity additions excluding retirements | **Source**: Shell Sky Scenario (2021), illustrating a technically possible, but challenging pathway for society to achieve the goals of the Paris Agreement.

The peer pressure is mounting: every other nation wants to become champion in climate technologies

United States	Inflation Reduction Act
China	14th Five-Year Plan
Europe	EU Green Deal
Japan	Green Innovation Fund
South Korea	Carbon Neutral Green Growth



Source: IEA

Power Electronics-
is the key lever for decarbonization

Green energy ⟷ **Electrification** ⟷ **Energy efficiency**

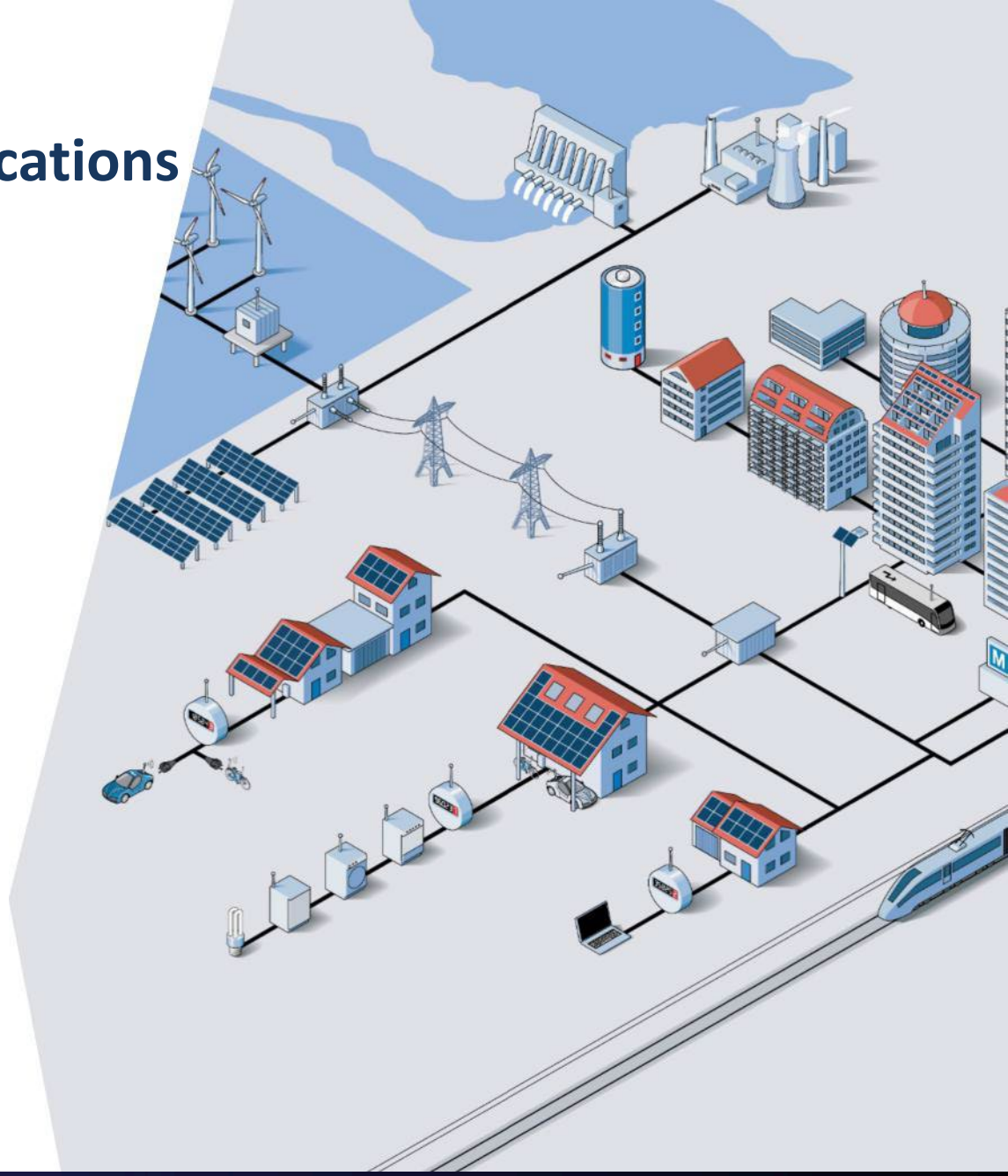
Microelectronics & Power Electronics

Power semiconductors enable efficient and intelligent handling of energy across all applications

Renewable energy generation

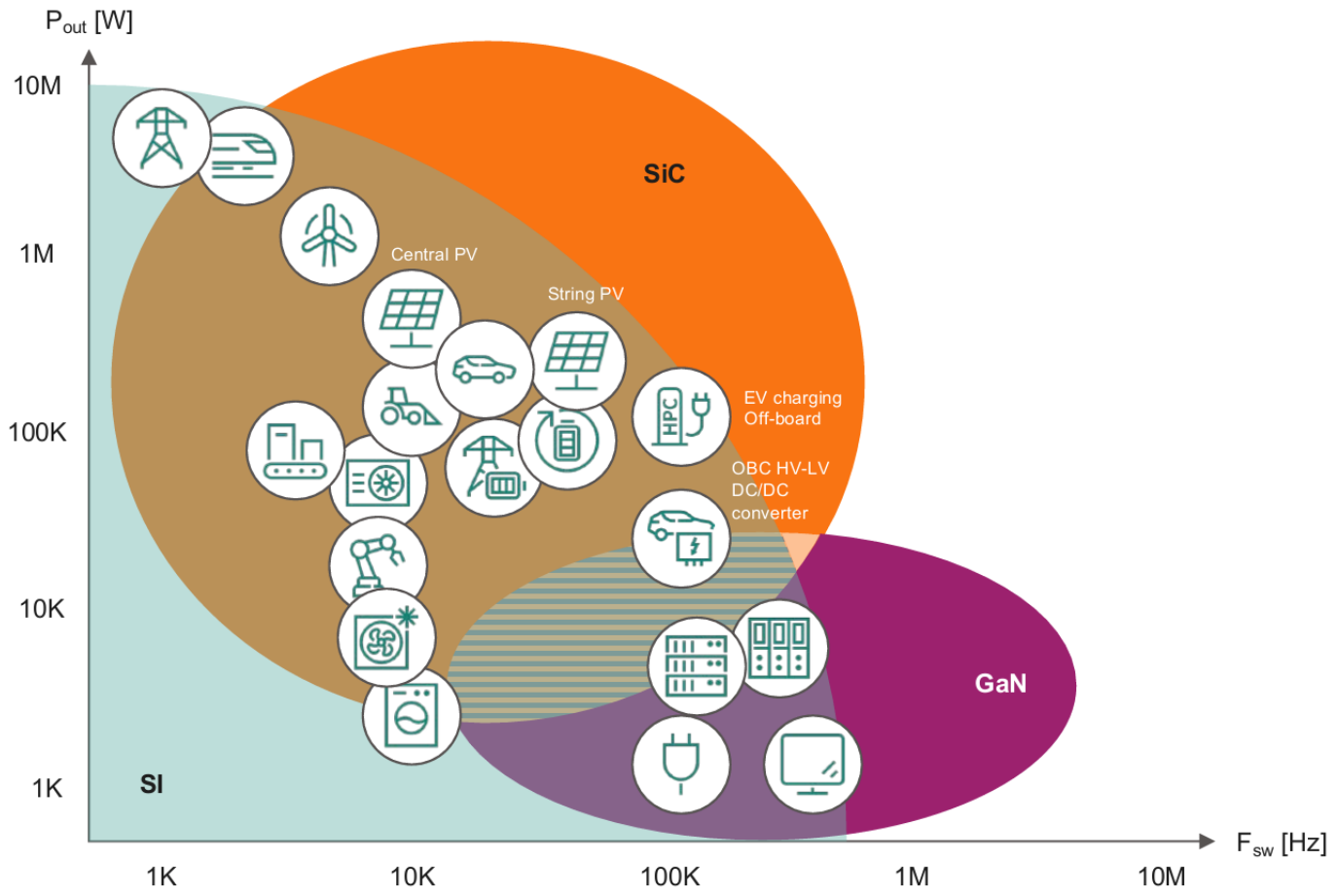
Energy transmission and storage

Energy conversion and consumption



Wide bandgap semiconductors provide high efficiency in many applications

Comparison of technologies



Si

Remains the **mainstream technology**

SiC

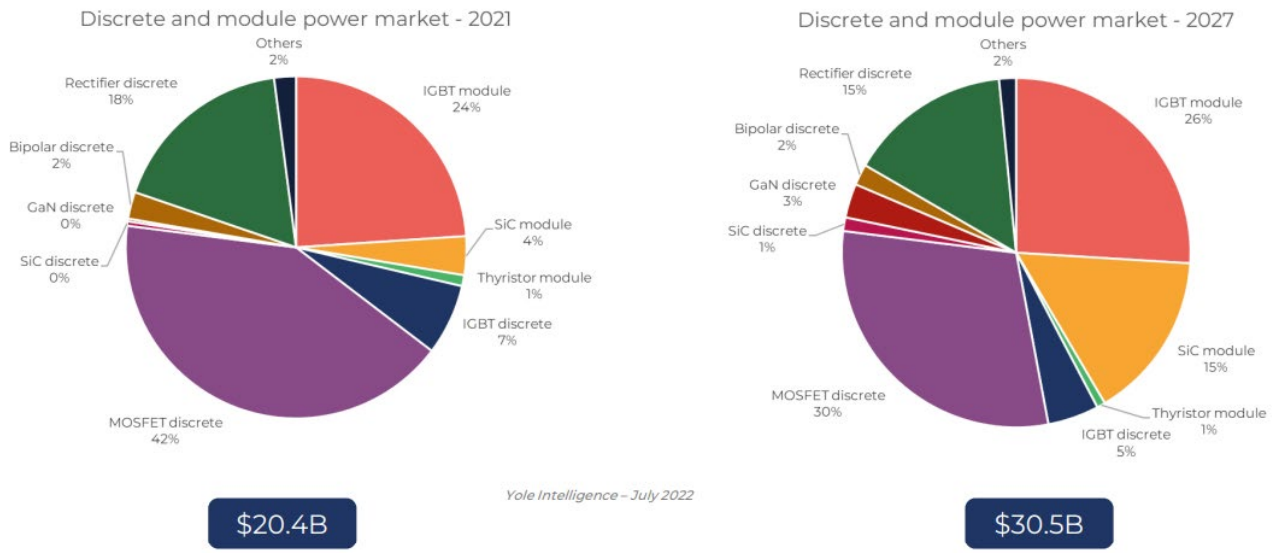
Advantages in **high power switching performance** and **power density**

GaN

Superior switching performance results in **higher efficiency** and **lower system cost**

Wide bandgap semiconductors, but also Silicon has a future need in applications

DISCRETE AND MODULE POWER COMPONENT MARKET
2021-2027, split by component type



Yole Intelligence, *Status of the Power Electronics Industry 2022,* Yole Group, p. 30.

Si-based power devices will play a major role in the Future

- continue to play major role in power semiconductors, despite the emergence of wide bandgap materials
- Outlook/challenges for Si-based Power Electronics:
  - new low ohmic 300 mm substrate materials
  - complex integration bipolar CMOS-DMOS technologies
  - ultrathin wafer manufacturing
  - advanced IGBT concepts and production technologies

→ 300 nm wafer market is expected to grow 30% until 2027

Europe is leading in power systems mastering all three key materials

- Reliable multi sourcing of raw materials
- World-scale fabs

Controller → **Driver IC** → **Power switch** (Si/SiC/GaN)

- Application understanding
- Packaging know-how and hybridization competence

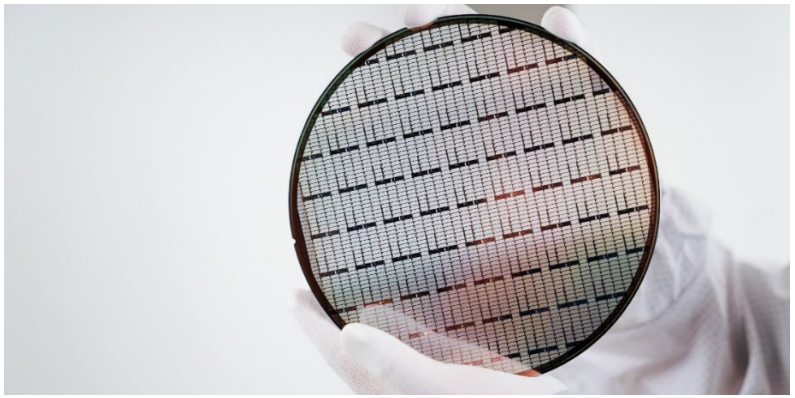
Software + Algorithms

Leadership and Sovereignty in Power Electronics Systems across all materials and technologies need to be saved!

Silicon
Diode – MOSFET – IGBT – Driver – Controller

Silicon carbide
Diode – MOSFET

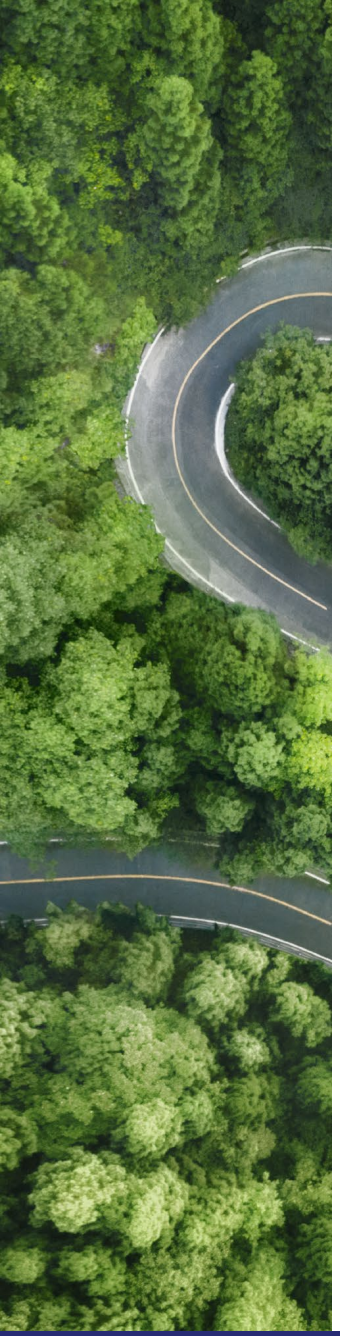
Gallium nitride
HEMT – Driver



PowerizeD

Digitalization of Power Electronic Applications within Key Technology Value Chains

Be PowerizeD



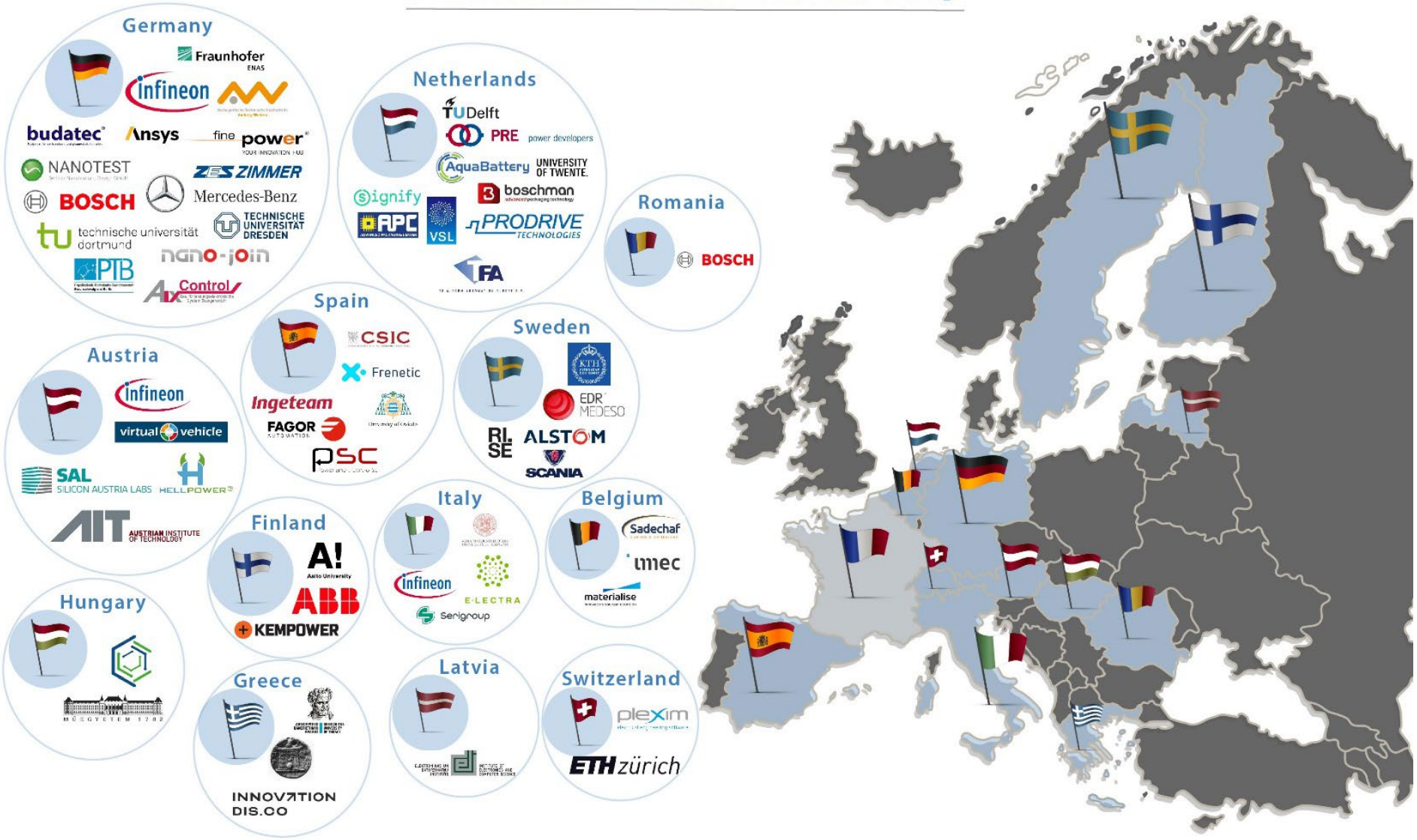
Overview Framework, Timeline, Figures

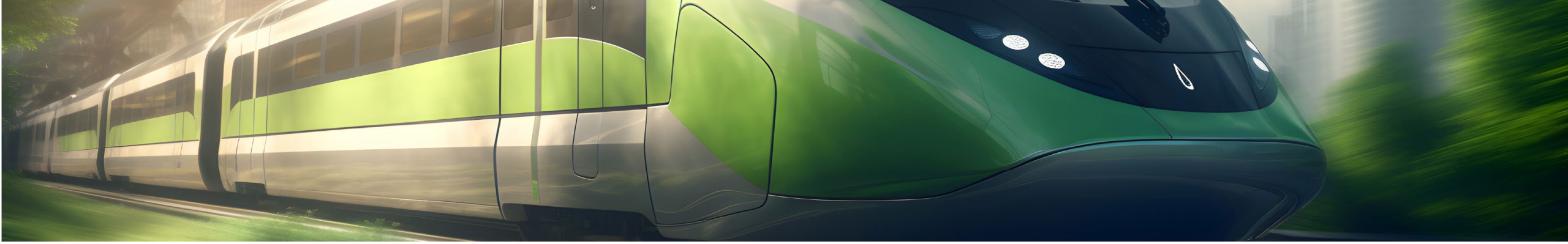
Horizon Europe KDT Call 2021-1; Innovation Action addressing high TRL (5-8)

- Runtime **01.01.2023 – 31.12.2025**
- Large action, merging **61 Partner Organisations** from **13 European Countries**
  - 21 Large Entities
  - 17 Small and Medium Enterprises
  - 23 Research and Innovation Organisations

- Total Effort: 7111 Person Months
- Total Budget EU: € 72.752.838
- EU Funding: €18.333.394, doubled by the national authorities

PowerizeD Consortium Map





Ambitions to fulfil the Digital Agenda

Boosting Design Productivity

* Design time will be reduced by **50%**

Achieve Highest Quality With Affordable Efforts

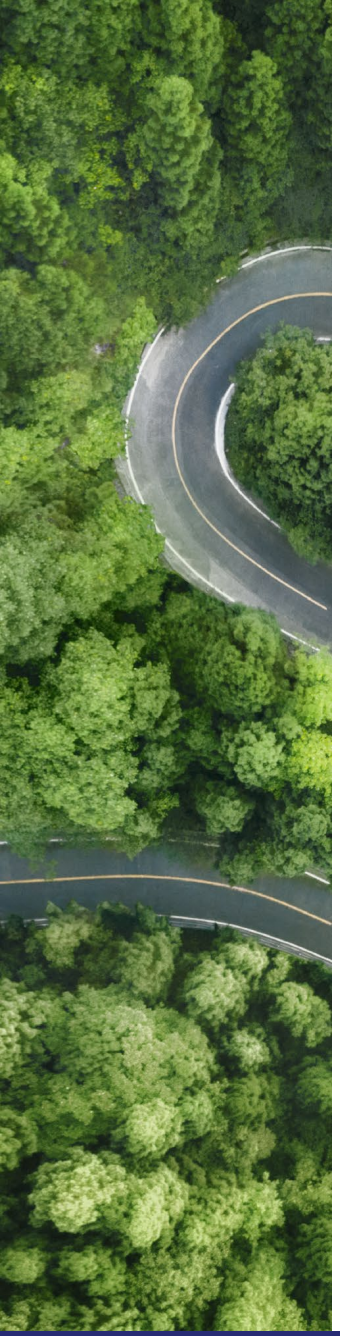
* Achieve a chip size reduction of **20%**

Provide Novel Products At Highly Competitive Costs

* Efficiencies up to **50%** above SotA
* Volume reductions reaching **30%** of SotA

Digitalisation As Key Enabler - Advancements On All Levels

* Enhanced power electronic products - more flexibility and functionality



Application Areas, Domains & Use Cases

ECS KEY APPLICATION AREAS

Mobility **Energy**

DOMAINS

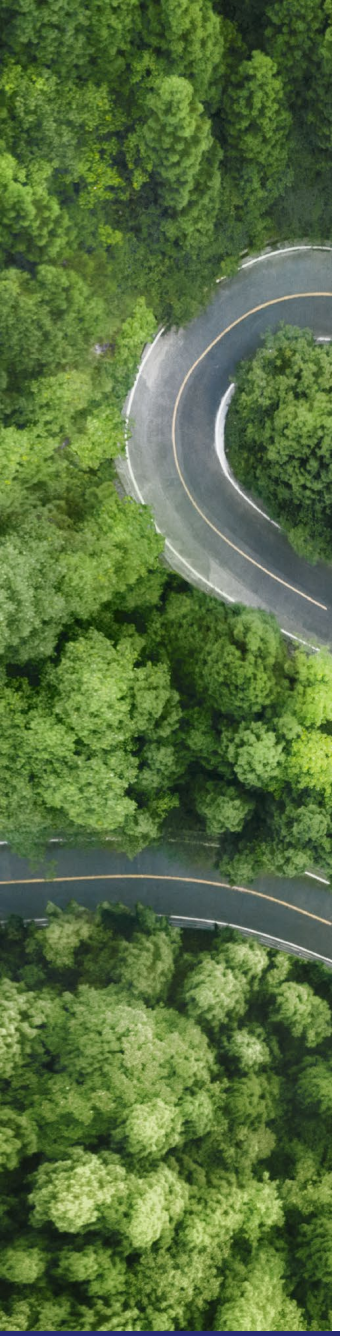
Traction Industry | **Automotive Industry** | **Energy Storage** | **Energy Generation, and Usage** | **Industrial Market**

USE CASES
UC#, Title

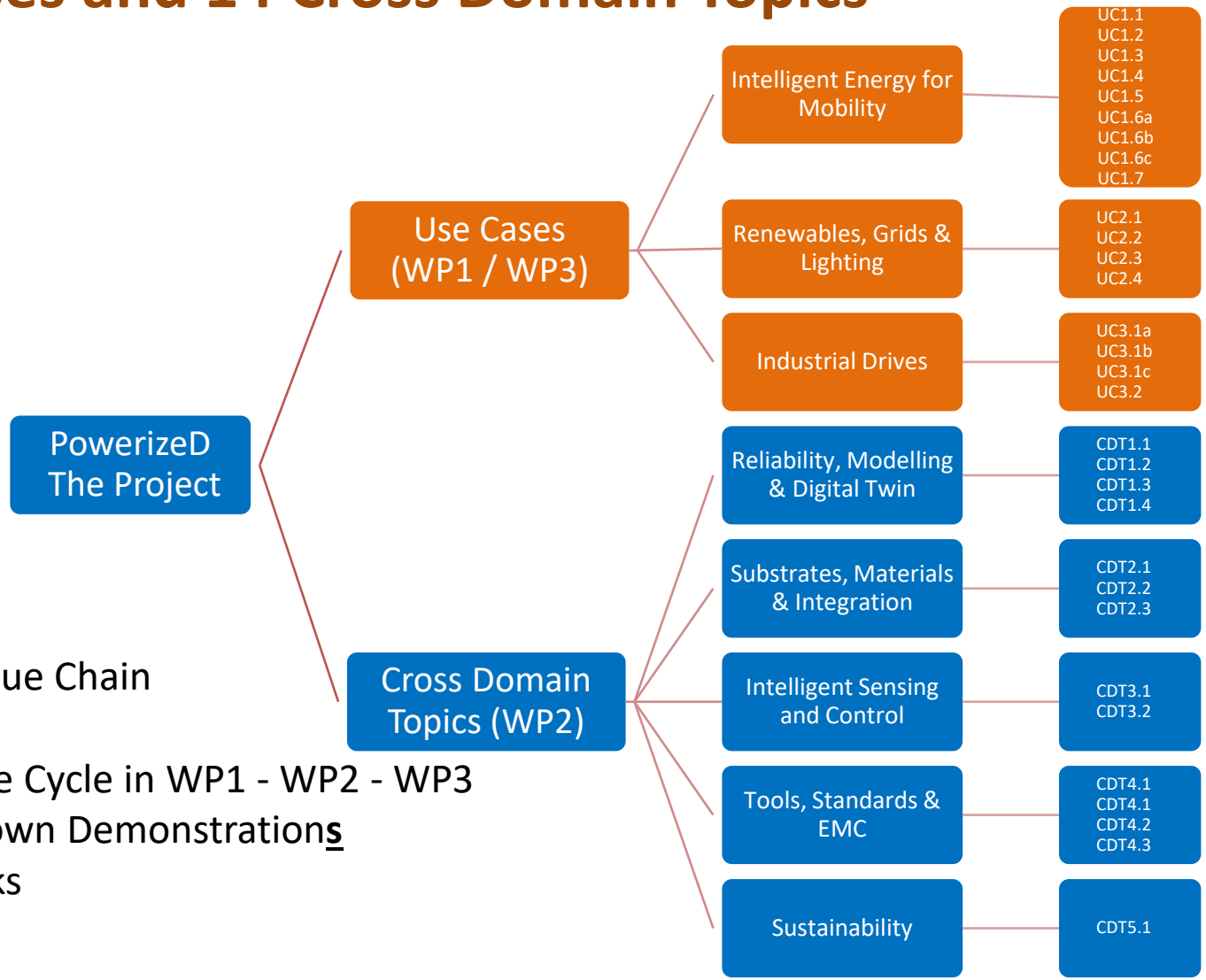
- **UC1.1** Railway Propulsion Systems
- **UC1.2** PEBB[1] for Traction Converters
- **UC1.3** PEBB[1] for DC/DC Converters
- **UC1.4** BE Drive Inverter for High Voltage
- **UC1.5** FCEV- Fuel Cell and PT Inverter
- **UC1.6a-c** Charger Systems
- **UC1.7** System of Systems
- **UC2.1** Flow Battery Power Electronics
- **UC2.2** PE for Green Hydrogen
- **UC2.3** LV DC Distribution Grid and LED Lighting
- **UC2.4** Home & mobile PV with storage
- **UC3.1a-c** Industrial Drives
- **UC3.2** Hyper-sensorised Digital Drive

- Development along the Value Chain within the UCs
- Along the Development Life Cycle in WP1 - WP2 - WP3
- **Each** Level results in their own Demonstrations

[1] Power Electronic Building Block



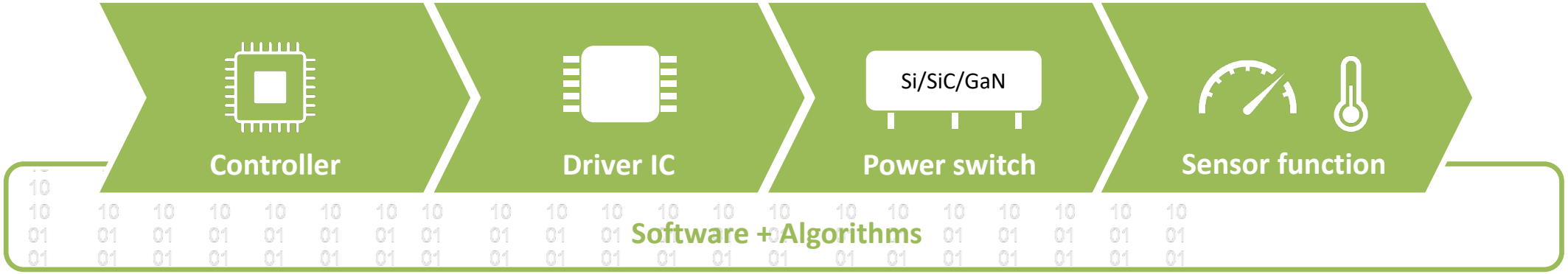
The whole Project in 3 WPs only
17 Use Cases and 14 Cross Domain Topics



From Top to Bottom

- Development along the Value Chain within the UCs
- Along the Development Life Cycle in WP1 - WP2 - WP3
- **Each** Level results in their own Demonstrations
- Story telling within the tasks

Power Systems It´s all about Intelligence



„I have a dream, where ….“

- Analogue Power Electronics become Digital
- Limiting borders disappear or are shifted

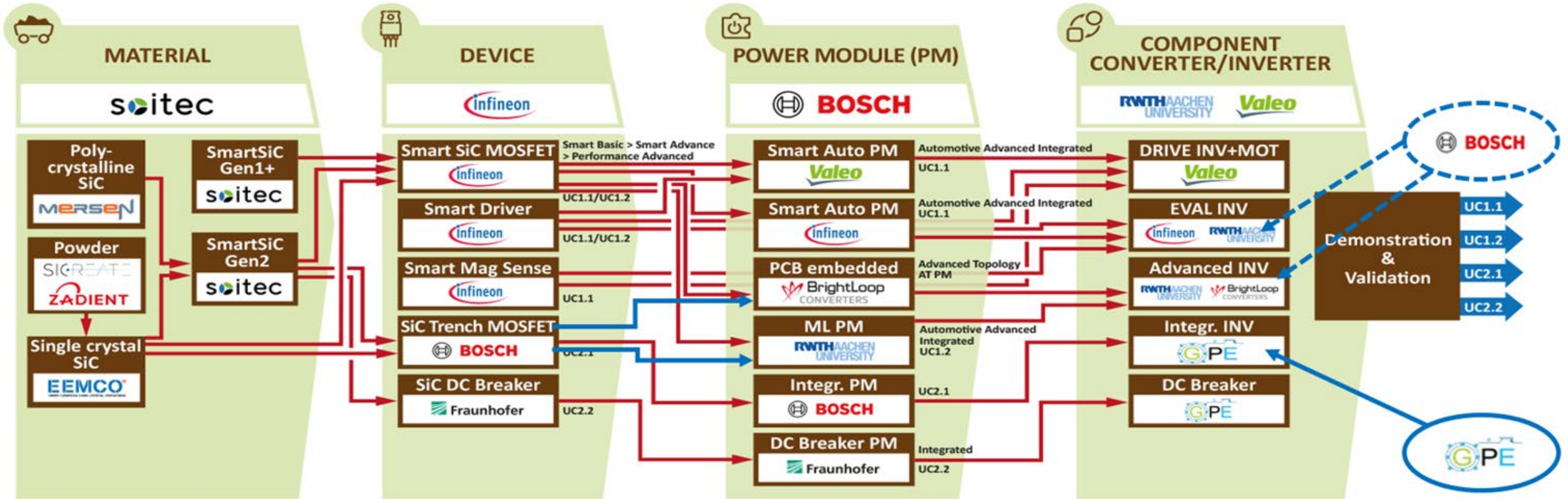
Summary and Message from the Powerize*D* Coordinator

- Exchange and optimisation of models and digital twins, but not of confidential data.
- ***PowerizeD*** will digitalise the analogue power electronics from devices up to the systems.
- Intelligence means more than just Software and AI.
- Be ***PowerizeD*** – Take the spirit, let us work on sustainable future. **Together!**

Funded by the
Chips JU
Grant No 101139788

FASTLANE

FASTLANE main results along the value chain, from material up to the system demonstrators



An all European SiC based Power Electronics Value chain from the powder to the application

Corporate Social Responsibility: We create a net ecological benefit

In various areas of application (automotive electronics, industrial drives, photovoltaics as well as wind energy), our products can achieve CO_2 savings during their lifetime of around 130 million tons of CO_2 equivalents. Compared with the European electricity mix, this is around 17.6 percent of the annual net electricity production of the European Union.

CO_2 burden[1]

of 2.9 million tons
CO_2 equivalents

Ratio around 1:45

CO_2 savings[2]

of 130.3 million tons
CO_2 equivalents

Net ecological benefit: CO_2 emissions reduction of more than 127 million tons

1 This figure takes into account manufacturing, transportation, own vehicles, travel, supplier-specific emissions, water/waste water, direct emissions, energy consumption, waste etc. as well as direct and indirect energy-related emissions by manufacturing service providers. It is based on data collected internally and publicly available conversion factors and relates to the 2024 fiscal year.
2 This figure is based on internally established criteria, which are described in the explanatory notes. The figure relates to the 2023 calendar year and takes into account the following application areas: automotive electronics, industrial drives, photovoltaics as well as wind energy. CO_2 savings are calculated based on the potential savings generated by technologies in which semiconductors are used. The CO_2 savings are allocated based on Infineon's market share, semiconductor share and the lifetime of the technologies concerned, based on internal and external experts' estimations. Despite the fact that carbon footprint calculations are subject to imprecision due to the complex issues involved, the results are nevertheless clear.

Conclusion

Power Semiconductors are a **key lever in the fight against climate change**

Power Semiconductors enable **green energy, electrification, and energy efficiency**

Wide bandgap semiconductors enable **high efficiency along the entire energy conversion chain**

Silicon semiconductors are **not old fashioned and dead** and provide still high benefits for our environment

It belongs to us
how to get there?

The project has been accepted for funding within the Key Digital Technologies Joint Undertaking, a public-private partnership in collaboration with the Horizon Europe (HORIZON) Framework Programme and National Authorities under grant agreement number **101096387.**

Co-Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or KDT JU. Neither the European Union nor the granting authority can be held responsible for them.

The project is supported by the Chips Joint Undertaking (JU) and its members, including top-up funding by Austria, France, Germany, Romania, Slovakia, under grant agreement No 101139788.

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FASTLANE

Boosting the European Value Chain for Sustainable Power Electronics

fastlaneproject.eu @fast-lane-eu @fastlane_eu