

Net-Zero-CO₂ by 2050 is NOT Enough (!)

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Identifying the “Elephant in the Room”

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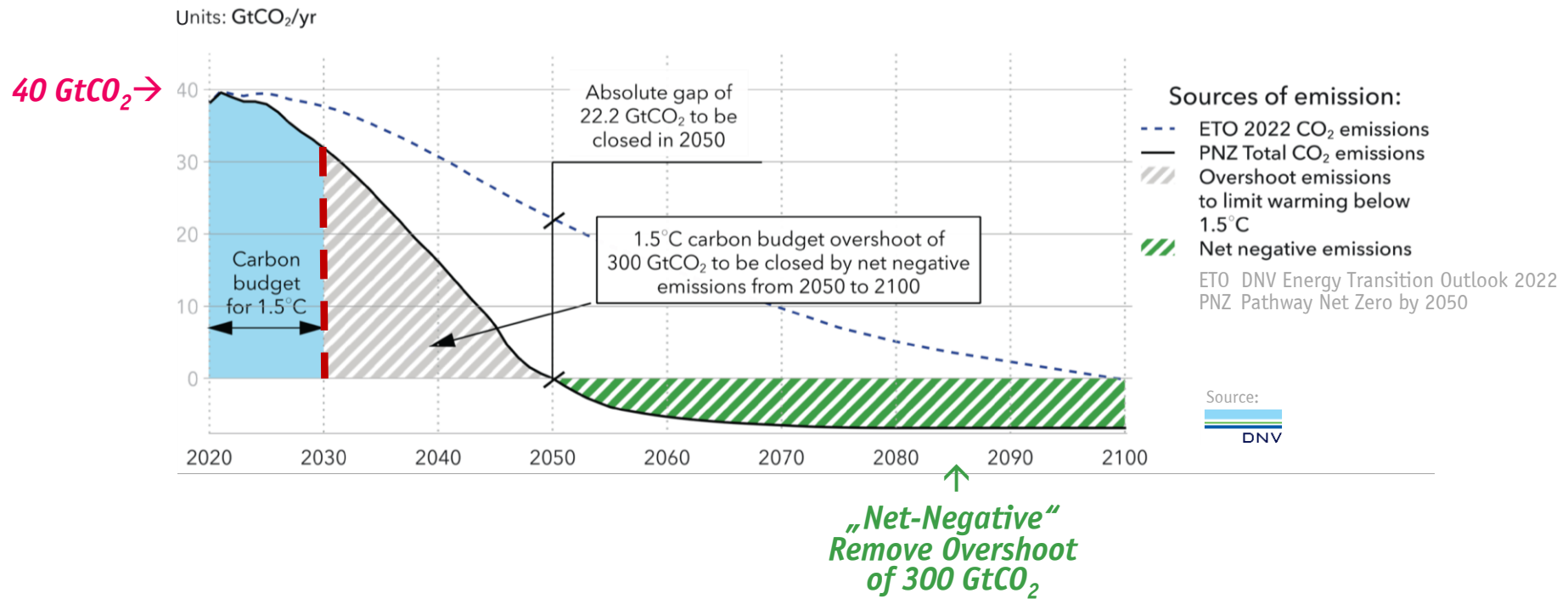


Outline

- ▶ *The Challenge*
- ▶ *The Solution*
- ▶ *The Elephant*
- ▶ *The New Paradigm*

The Pathway

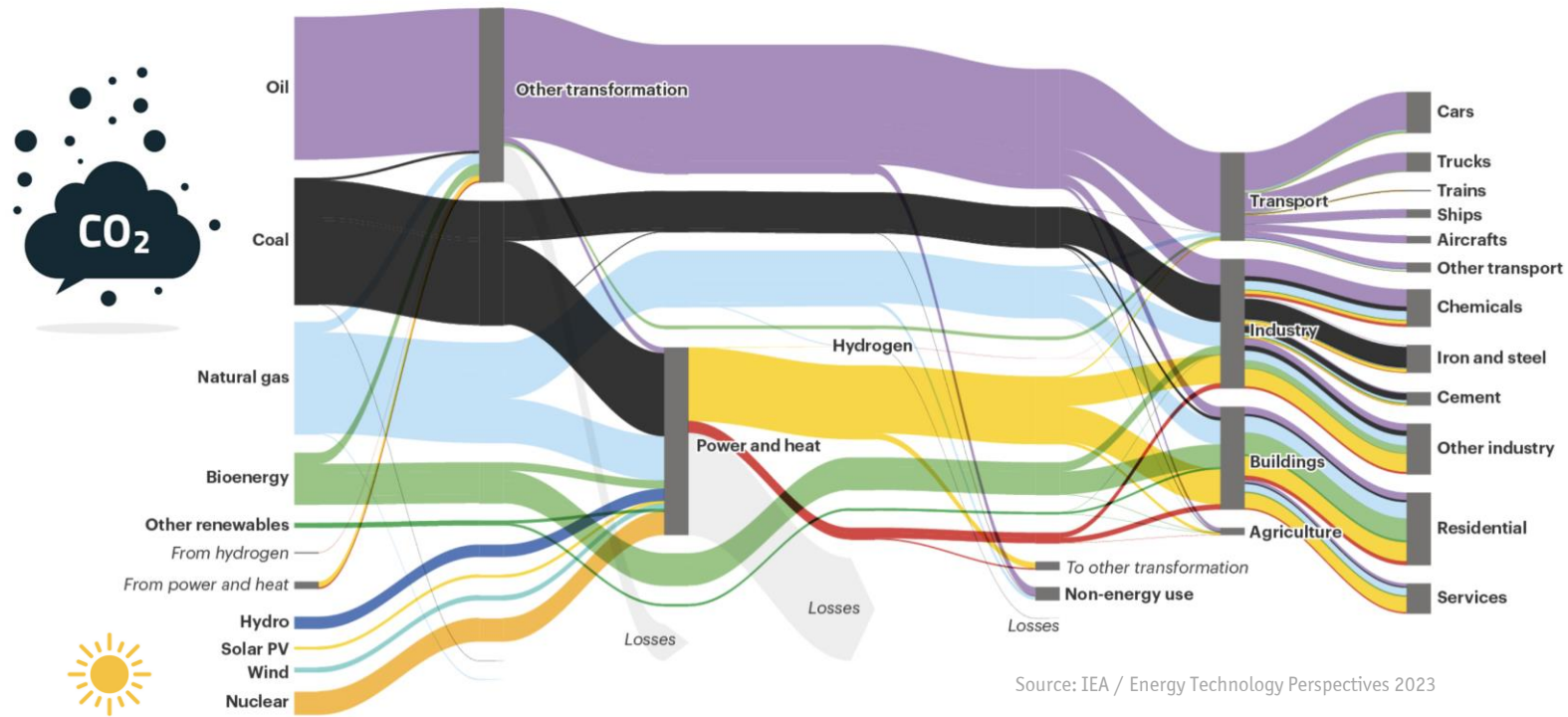
■ **“Net-Zero” Emissions by 2050 & Gap to be Closed**



■ **50 GtCO_{2eq} Global Greenhouse Gas Emissions / Year → 280 GtCO₂ Budget Left for 1.5°C Limit**

The Challenge

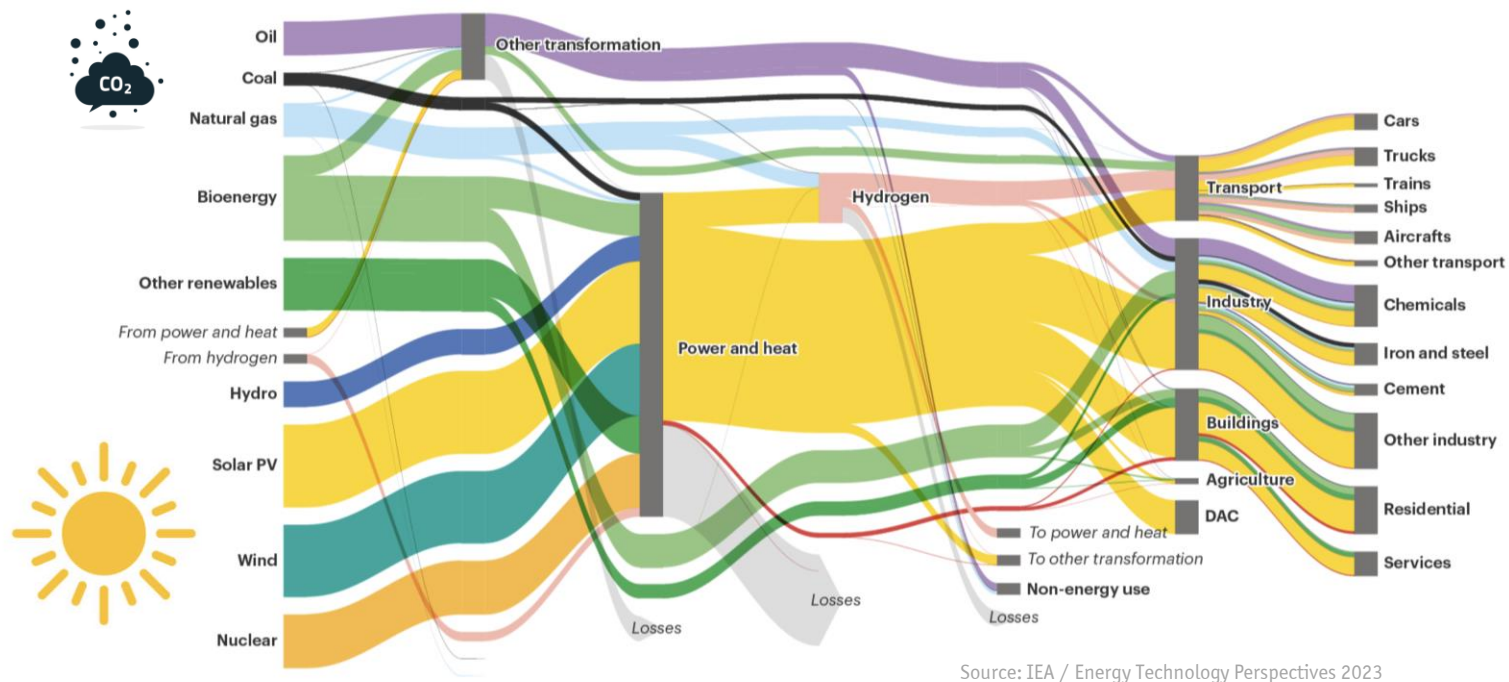
■ Global Energy Flows — 2021



■ Large Share of Fossil Fuels (!)

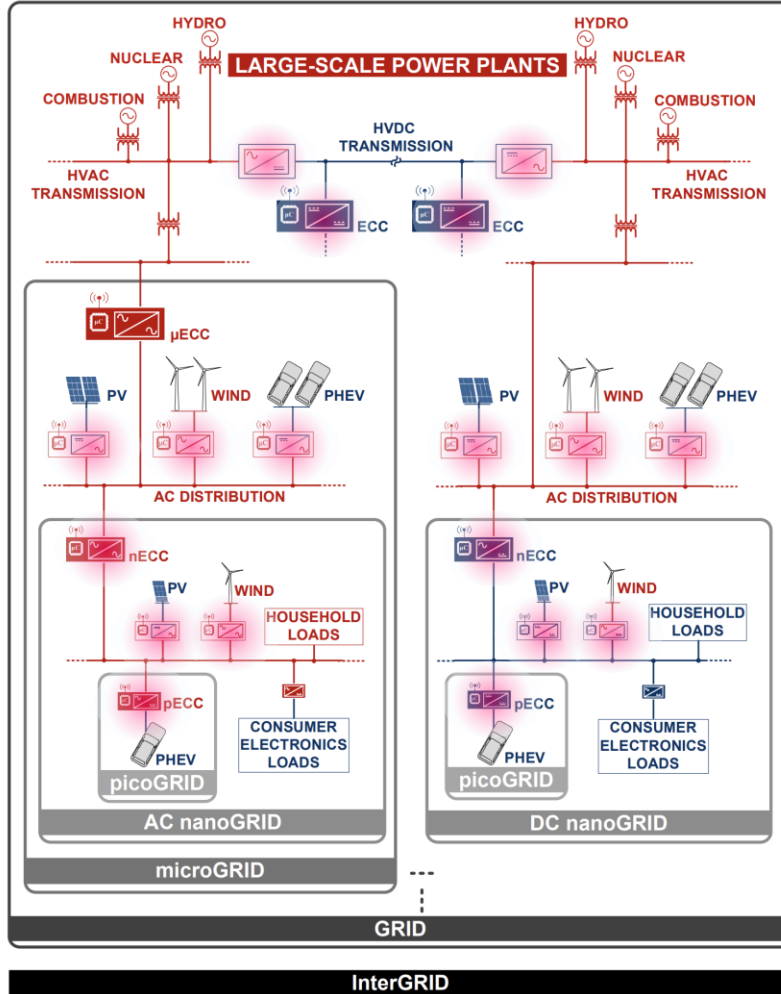
The Solution

■ Global Energy Flows — 2050 / Net-Zero Scenario



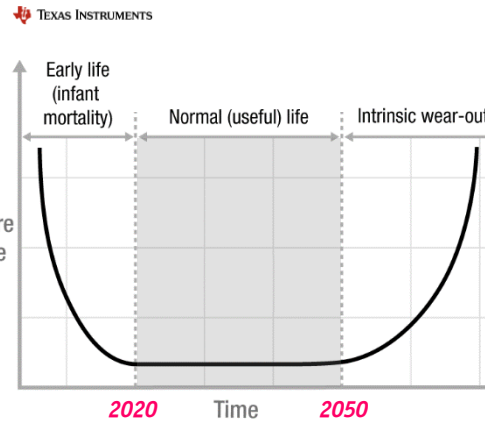
■ Dominant Share of Electric Energy — Power Electronics as Key Technology (!)

Source: D. Boroyevich (2010)



The Elephant in the Room — 2050

- 25'000 GW of Installed Renewable Gen. & 15'000 GWh Batt. Storage
- 4x Power Electronics Conversion Stages btw Generation → Load
- 100'000 GW of Installed Converter Power
- 20 Years of Useful Life
- 5'000 GW_{eq} = 5'000'000'000 kW_{eq} of Electronic Waste / Year (!)

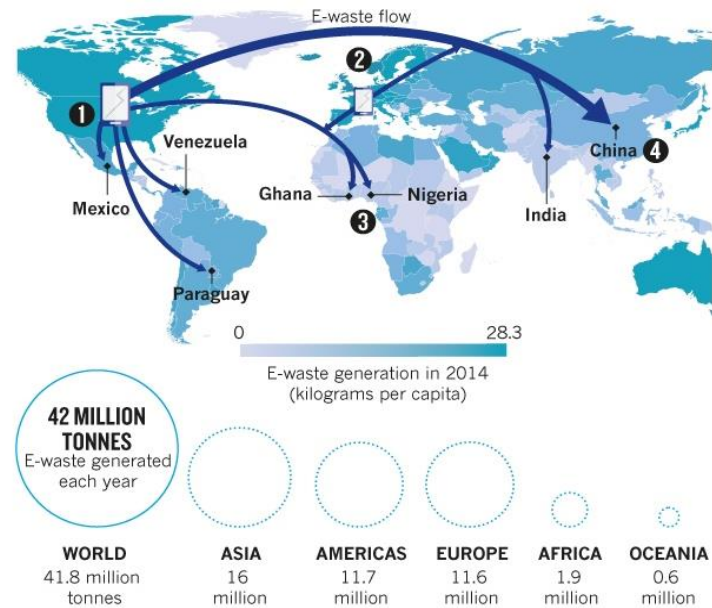


Source: www.e-waste-recyclers.co.in

The Global E-Waste Problem

- 53'000'000 Tons of Electronic Waste Produced Worldwide in 2019 → 74'000'000 Tons in 2030
- Increasingly Complex Constructions → No Repair or Recycling

Source:
Green IT Solution 



Source: nature

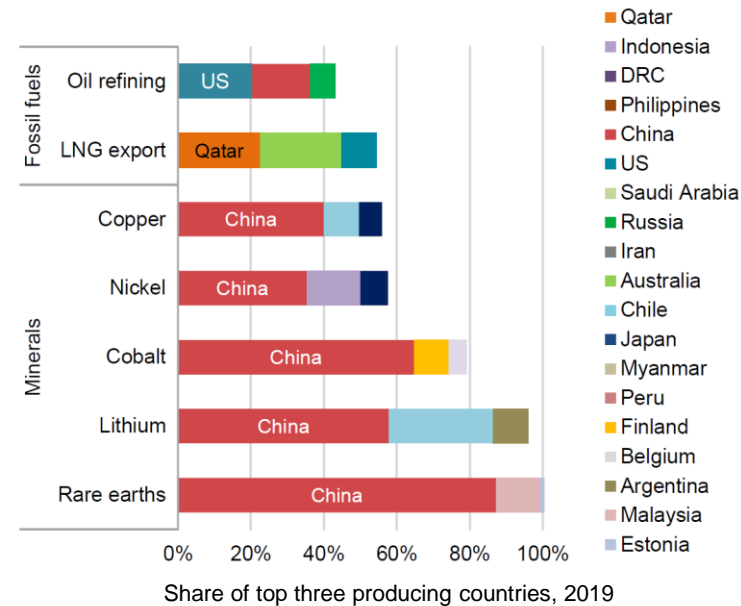
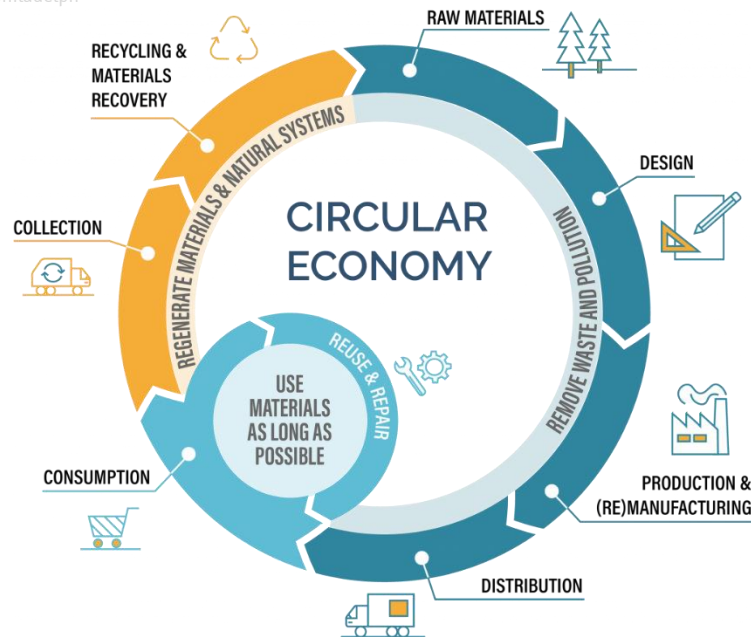


- Growing Global E-Waste Streams → Regulations Mandatory (!)

The Paradigm Shift

- **“Linear” Economy / Take-Make-Dispose** → **“Circular” Economy / Perpetual Flow of Resources**
- **Resources Returned into the Product Cycle at the End of Use**

Source: <https://circularphiladelphia.org>



Source: IEA / The Role of Critical Minerals in Clean Energy Transitions (2021)

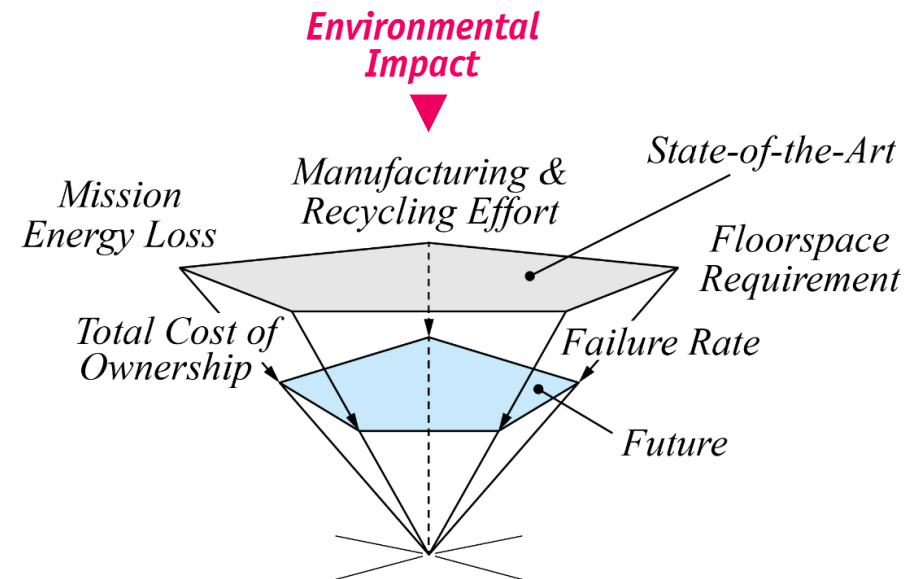
- **Geographically Concentrated Production of Many Energy Transition Critical Minerals**

The Future

- Assuming 20+ Years Lifetime → Systems Installed Today Reach End-of-Life in 2050 (!)
- Life-Cycle Analysis (LCA) Mandatory for All Future System Designs

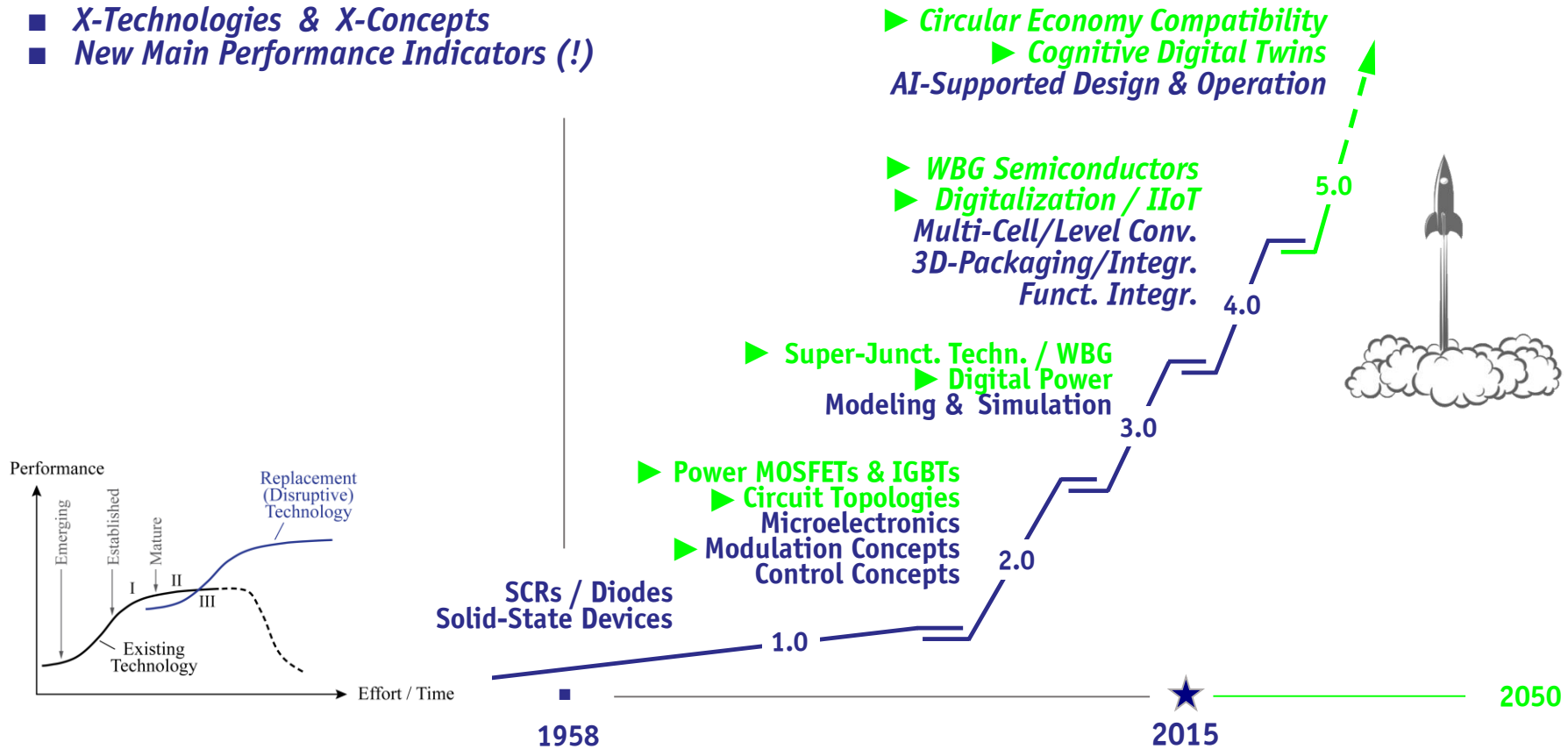
- Complete Set of New Performance Indicators

- Environmental Impact [kgCO₂eq/kW]
- Resource Efficiency [kg_{xx}/kW]
- Embodied Energy [kWh/kW]
- TCO [\$/kW]
- Power Density [kW/m²]
- Mission Efficiency [%]
- Failure Rate [h⁻¹]



Power Electronics 5.0

- Power Electronics 1.0 → Power Electronics 5.0
- X-Technologies & X-Concepts
- New Main Performance Indicators (!)



Thank You !

