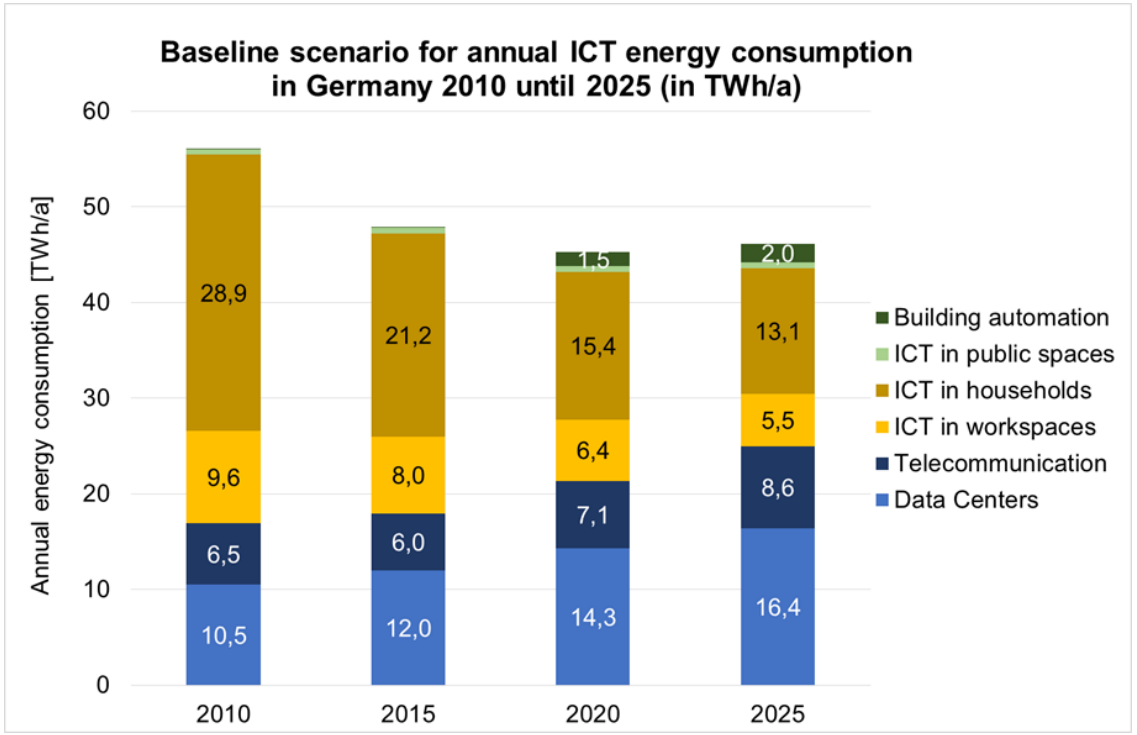
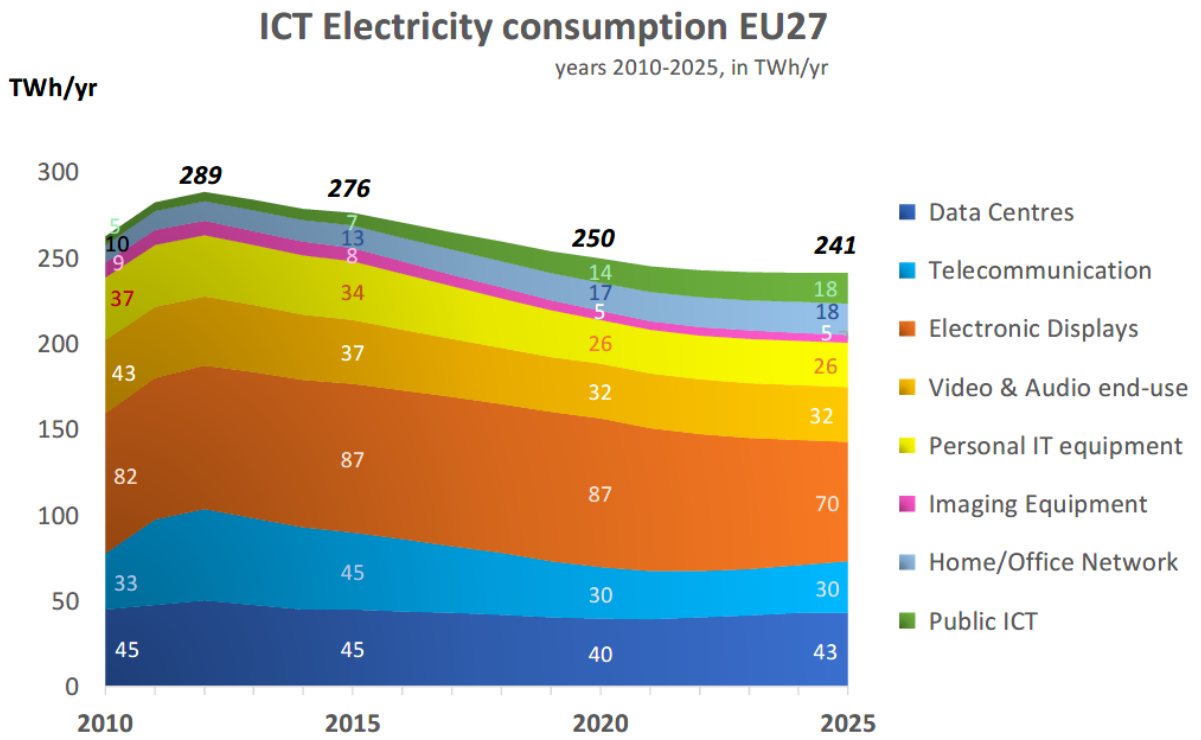
Green ICT @ FMD
New German Competence Centre
within the
Research Fab Microelectronics Germany (FMD)

A cooperation of

European ICT Trend

BMWi / IZM (2014): ICT energy consumption in Germany





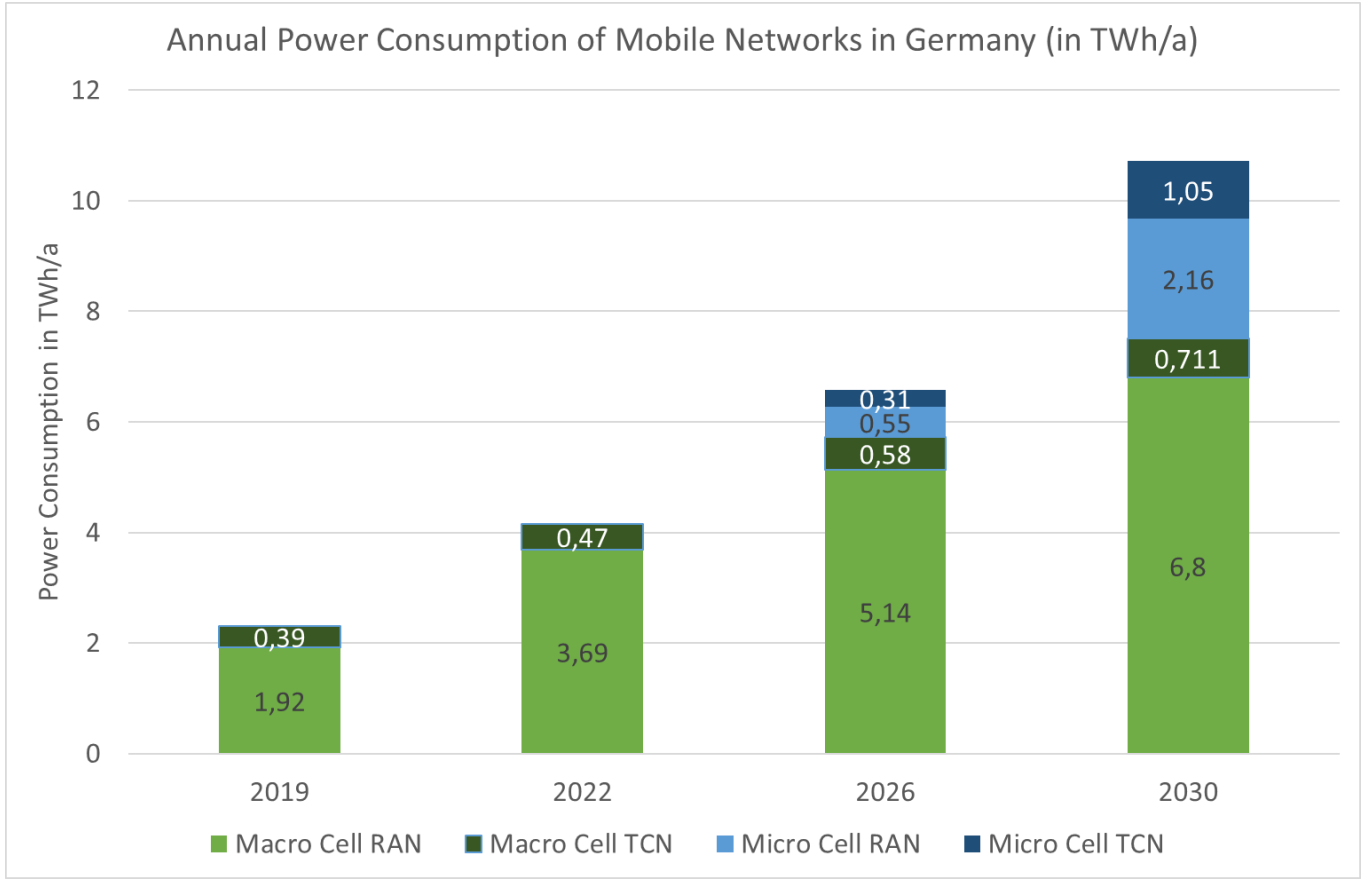
VHK and Viegand Maagoe (2020): ICT Impact Study

- Positive decrease of ICT power consumption in Europe
- Based on our projection (Germany) ICT infrastructure is increasing
- Note: Manufacturing footprint not included

Newer Data on Mobile Networks

Source: Project Utamo, Fraunhofer IZM for: Umwelt Bundes Amt – Für Mensch und Umwelt

- **Macro Cells (cm-wave):**
  - Outdoor antenna sites (DTAG, Vodafone, Telefonica)
  - Existing spectrum 700 MHz – 3,6 GHz (2G – 5G)
  - Increase from 85.000 to 120.000 antenna sites
  - 100% area coverage (357.386 km²)
- **Micro Cells (mm-wave):**
  - Outdoor use in public spaces (eMMB / Hotspot)
  - New spectrum 26 – 28 GHz (5G) with average range of around 150 meters
  - 245,000 sites with two 60° sectors
  - 1% area coverage (3.573 km²)

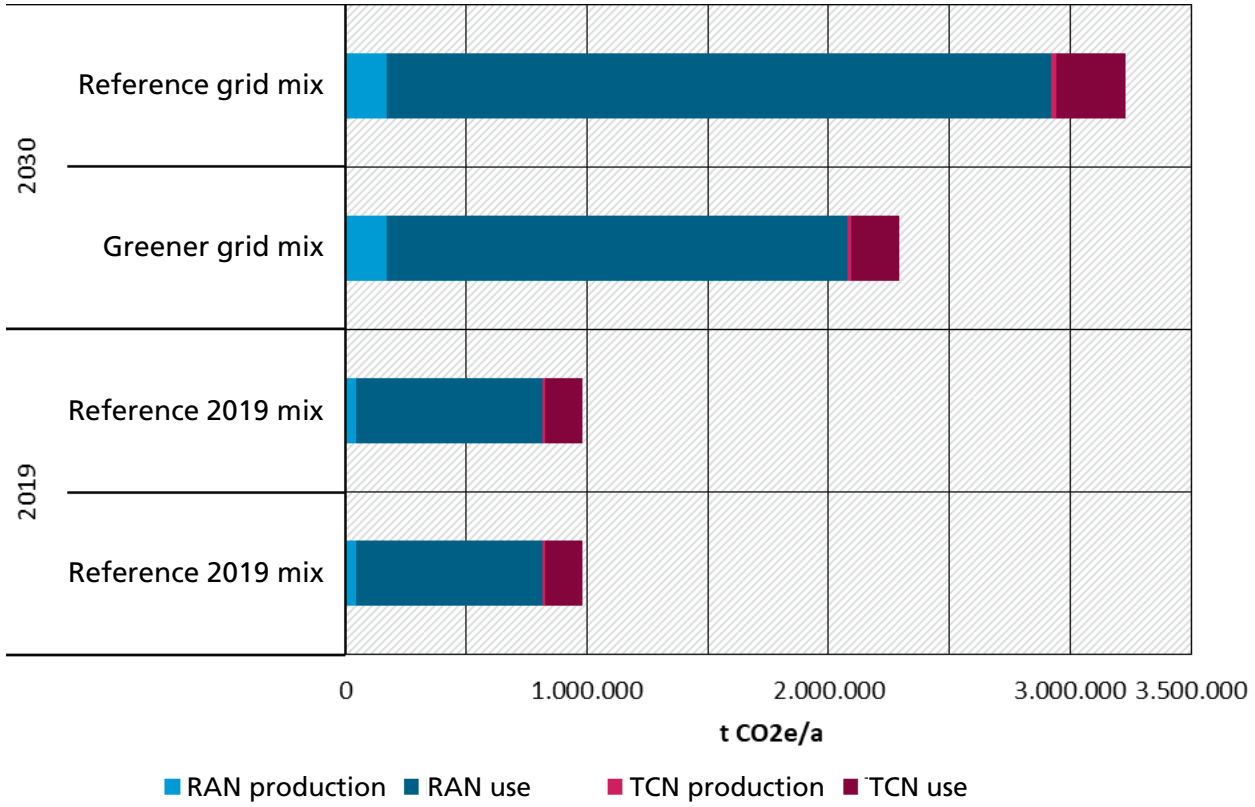


RAN (Radio Access Network) TCN (Transport Core Network)

Production Footprint and Renewable Energy

Source: Project Utamo, Fraunhofer IZM for: Umwelt Bundes Amt – Für Mensch und Umwelt

- Adding manufacturing footprint and two energy transition scenarios
  - Note: 2030 scenario provides factor 45 higher performance
- Two energy mixes for 2030 in Germany (0,4 kg/CO2e and 0,28 kg/CO2e)
- For the network, manufacturing is <10% of carbon footprint
- Efficient components and better load management important



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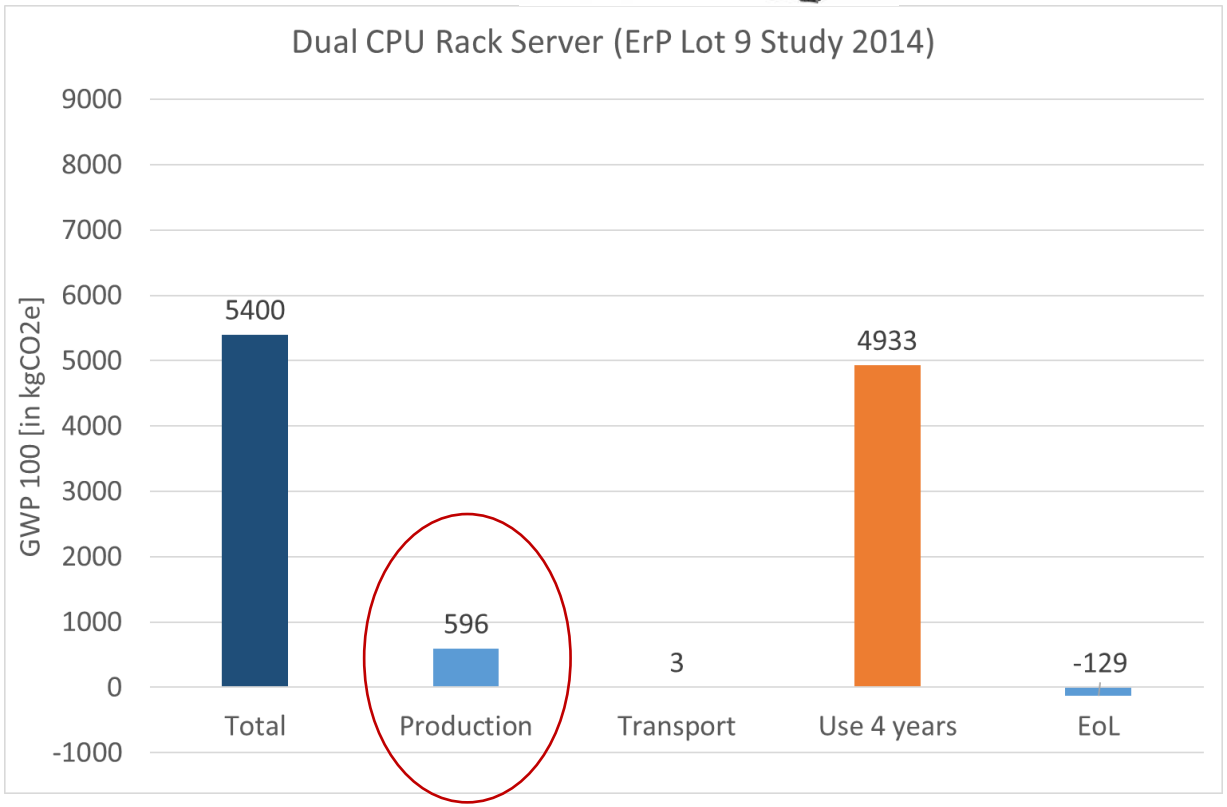
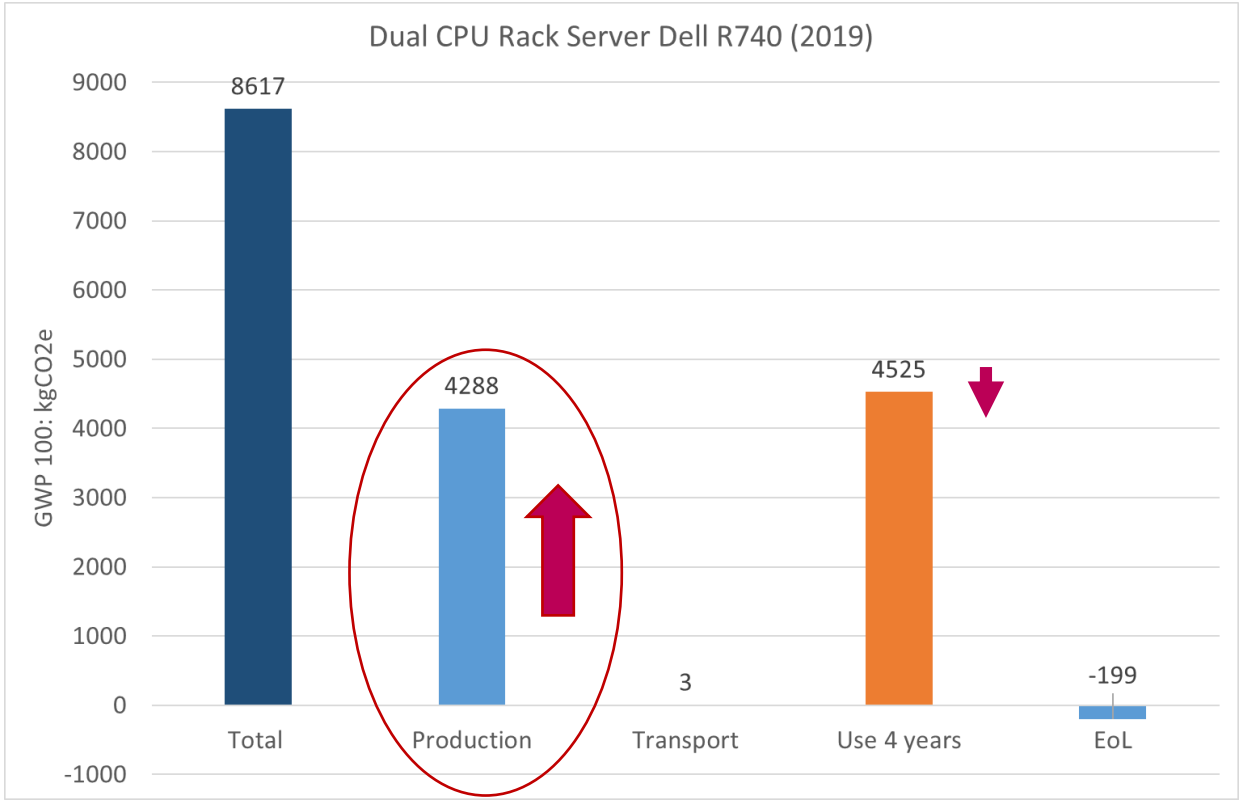
Servers (Small and Co-location Data Centres)

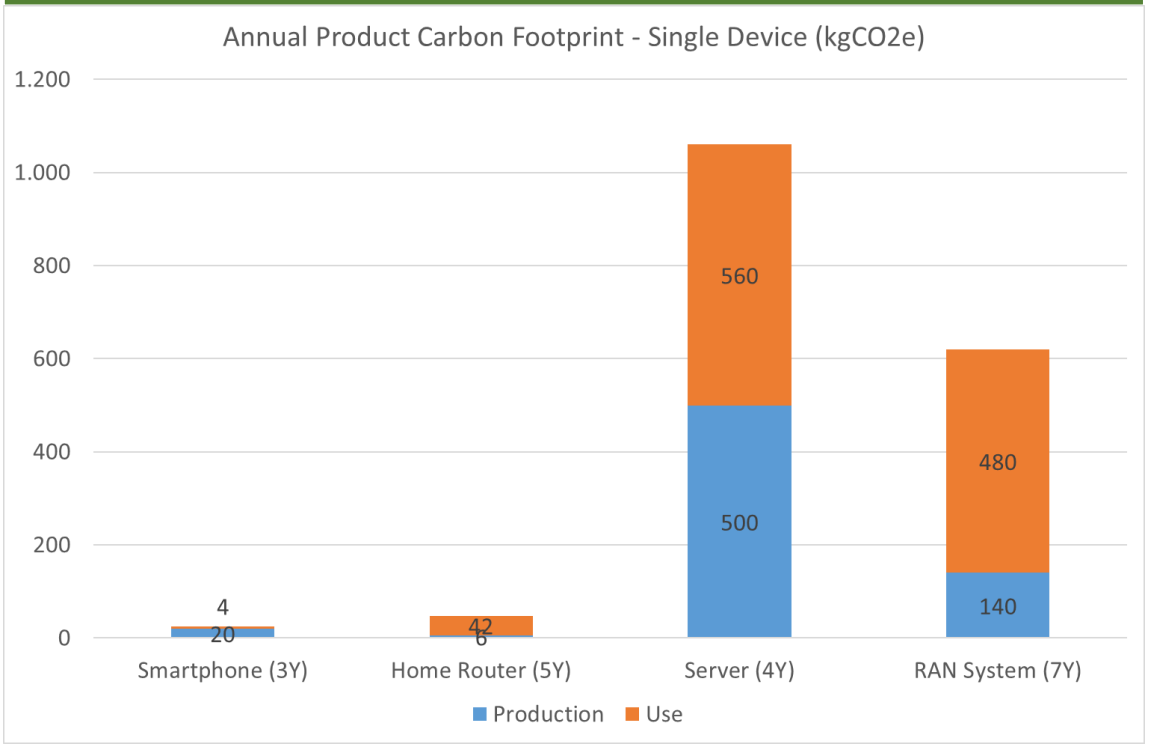




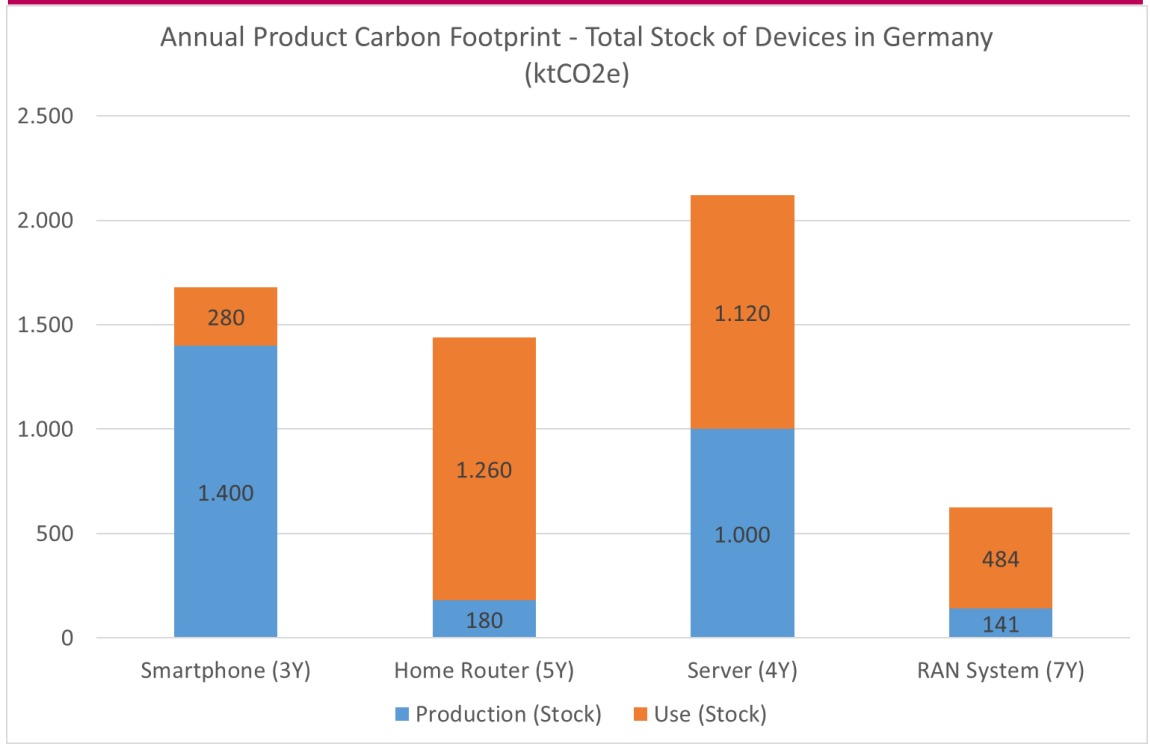
- for memory heavy (AI-optimized) servers: carbon footprint of production is higher than for 4 years of use

Absolute and Relative Impact

relative environmental impact (kgCO2e)



absolute environmental impact (ktCO2e)



- Relative: single product annual carbon footprint
- Absolute: product stock annual carbon footprint

- Absolute impact reduction needed

Stock Germany	Devices
70.000.000	Smartphone (3Y)
30.000.000	Home Router (5Y)
2.000.000	Server (4Y)
1.008.000	RAN System (7Y)

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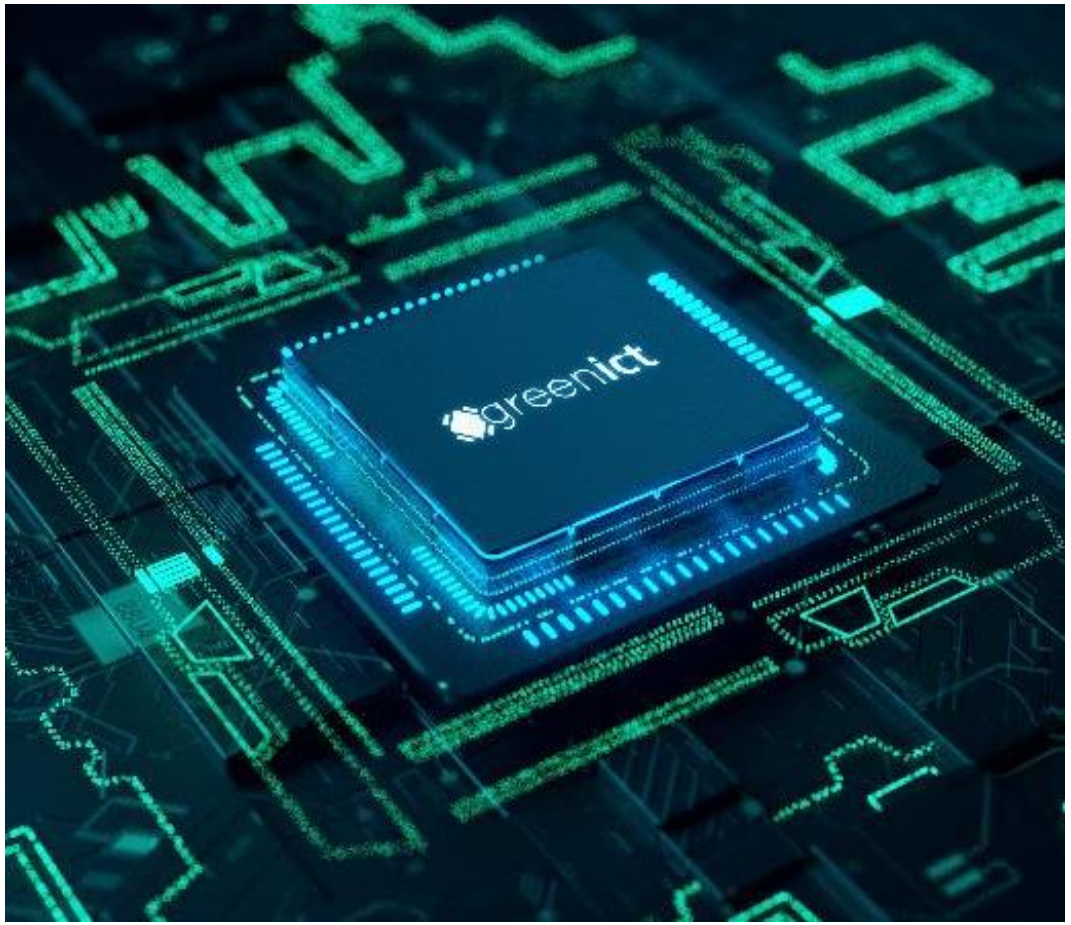
Green ICT and Green-by-ICT

- We need an ecosystem of R&D to develop, evaluate and roll out validated Green ICT solutions
- Focus on leverage of the German market, but many components and products are sourced globally
- »Green-by-ICT« may increase leverage positively
- but focus must be on **Hardware level improvements** (materials, technologies, components, system integration)



New Competence Centre Green ICT

- Research Fab FMD covers 11 micro-electronics institutes of the Fraunhofer Society plus two institutes of Leibnitz (IHP, Frankfurt Oder, and FBH, Berlin)
- Original FMD coordinated investment in new cleanroom processes and heterogenous system integration
- Competence centre »Green ICT« started in 2022 based on same distributed fab cooperation

»Going Green for ICT Hardware«

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Green ICT Project Structure

- One-stop-shop for green questions
- Three core ICT areas
  - Sensor-Edge-Cloud
  - Communication Networks
  - Resource Efficient Production
- Additional elements
  - Student academy
  - Professional development
  - Green ICT Start-up Collaborations

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Green ICT Hub Production

- Focus of production activities
  - **Front-end (semiconductor) processing** for variety of components, i.e. CMOS, non-CMOS silicon, MEMS, III/V semiconductors
  - **Back-end processes**: heterogenous packaging including wafer level packaging (WLP), panel level packaging (PLP); multi-chip / chiplet and 3D packages
  - **Clean room infrastructure** and operations improvements
  - **Emissions control** and abatement
  - **System integration elements**, including printed circuit boards
  - **Material efficiency** and/or substitutions of critical materials

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Green ICT @ FMD

- Take-away messages …
  … before deeper dive into emissions abatement

- Establishment of German knowledge hub for Green ICT
- **Production and hardware focussed,**
  where the electronics industry must fundamentally reinvent itself
- Partner for small and large enterprises
- Partner along the microelectronics supply chain
- Material efficiency in parallel to carbon reduction

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Any Questions?

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