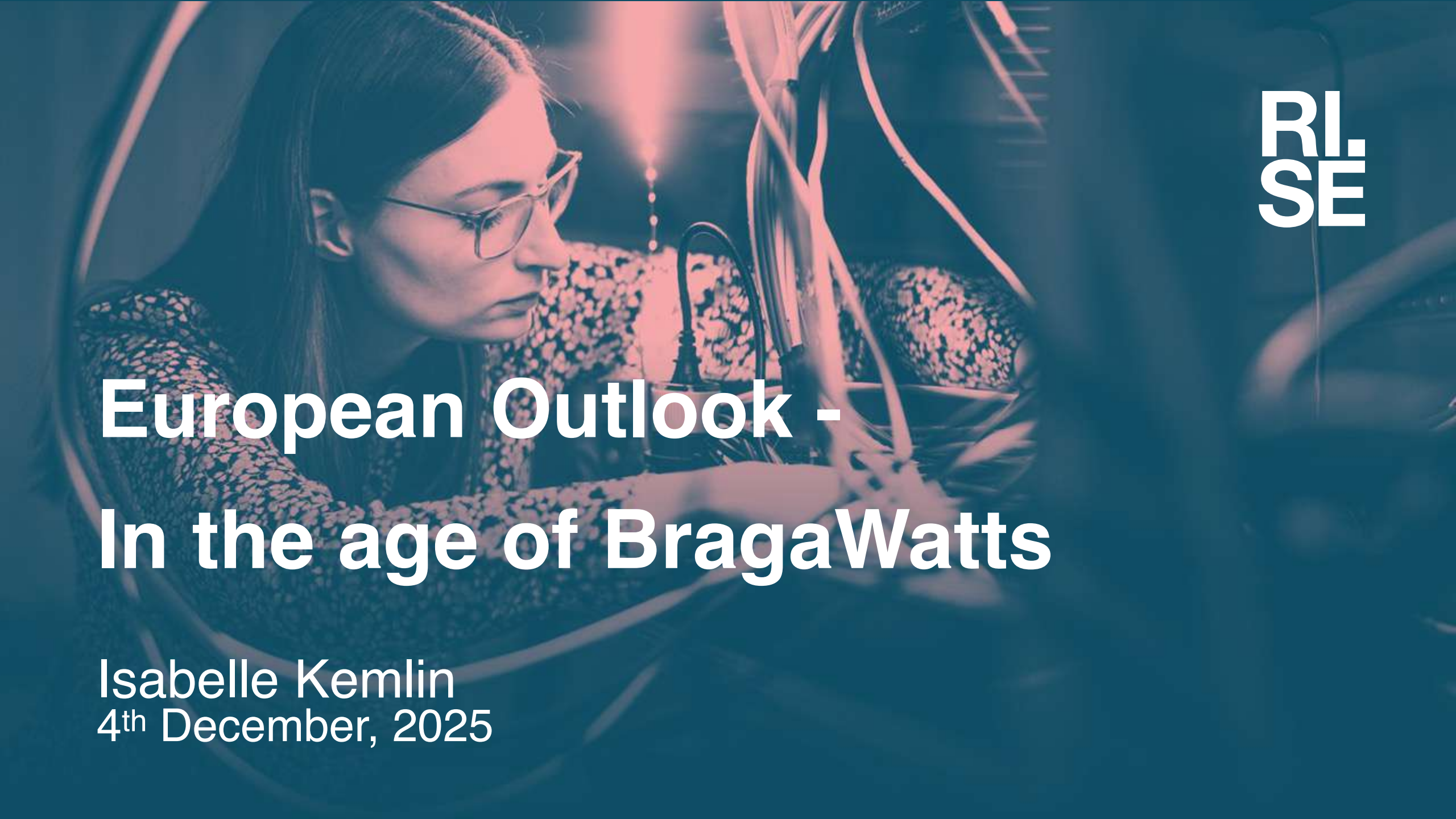


European Outlook - In the age of BragaWatts

Isabelle Kemlin

4th December, 2025

RISE ICE Data Center

A full-scale research datacenter and test environment with the objective to increase knowledge and strengthen the global AI & Data Center ecosystems

- 40+ projects, from the ground to the cloud
- 30+ employees
- 4+ MEUR turnover
- Established 2016
- 100+ project partners

2018 - 2022 BDV GOLD

2023 BDV i-Space PLATINUM

016, 201 BDV i-Space SILVER

DATACLOUD GLOBAL AWARDS 2019

Management Excellence

2017, 2019 Best Data Center Initiative of the Year with RISE SICE North Research Data Center

EARTO Innovation Awards 2022

Holistic Cooling

Current Official Partners in the Partner Program

Premium partners:

ERICSSON VATTENFALL Meta ABB VERTIV

Castrol ALFA LAVAL GRUNDFOS Google

Collaborators:

intel Telia submer Datacenters that make sense

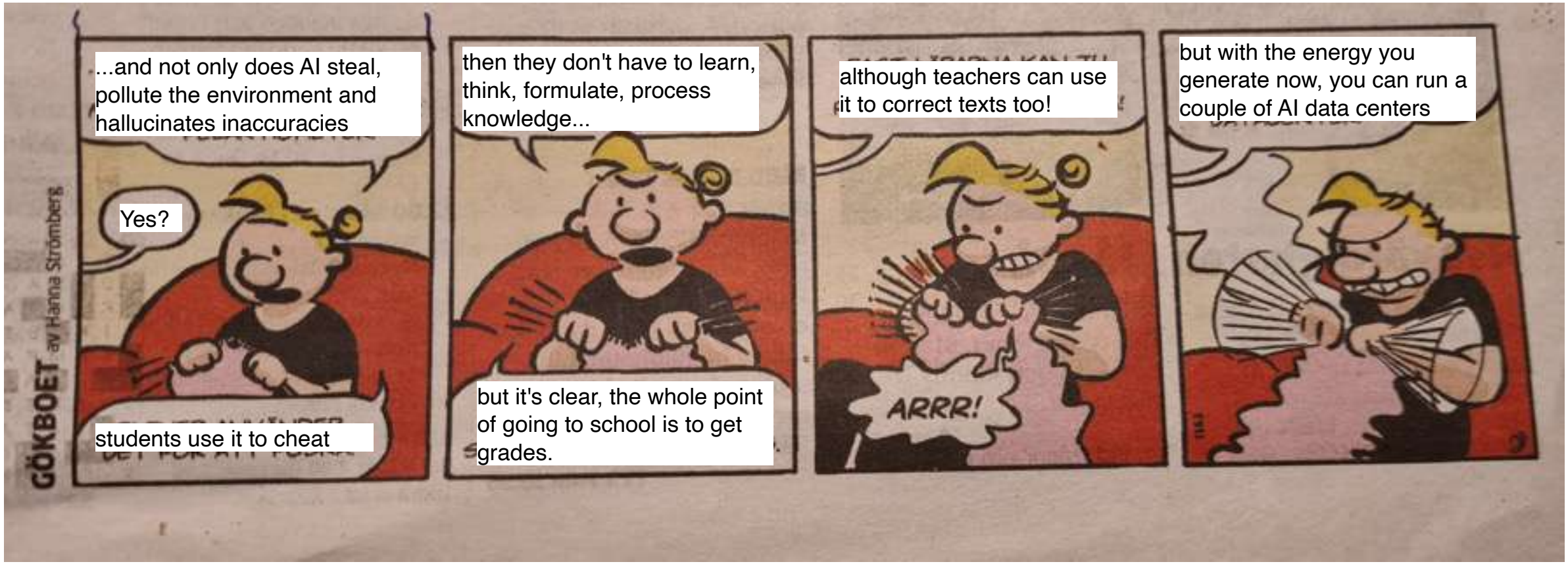
Academic:

LULEÅ TEKNISKA UNIVERSITET Åbo Akademi ktl NUS National University of Singapore

Agenda

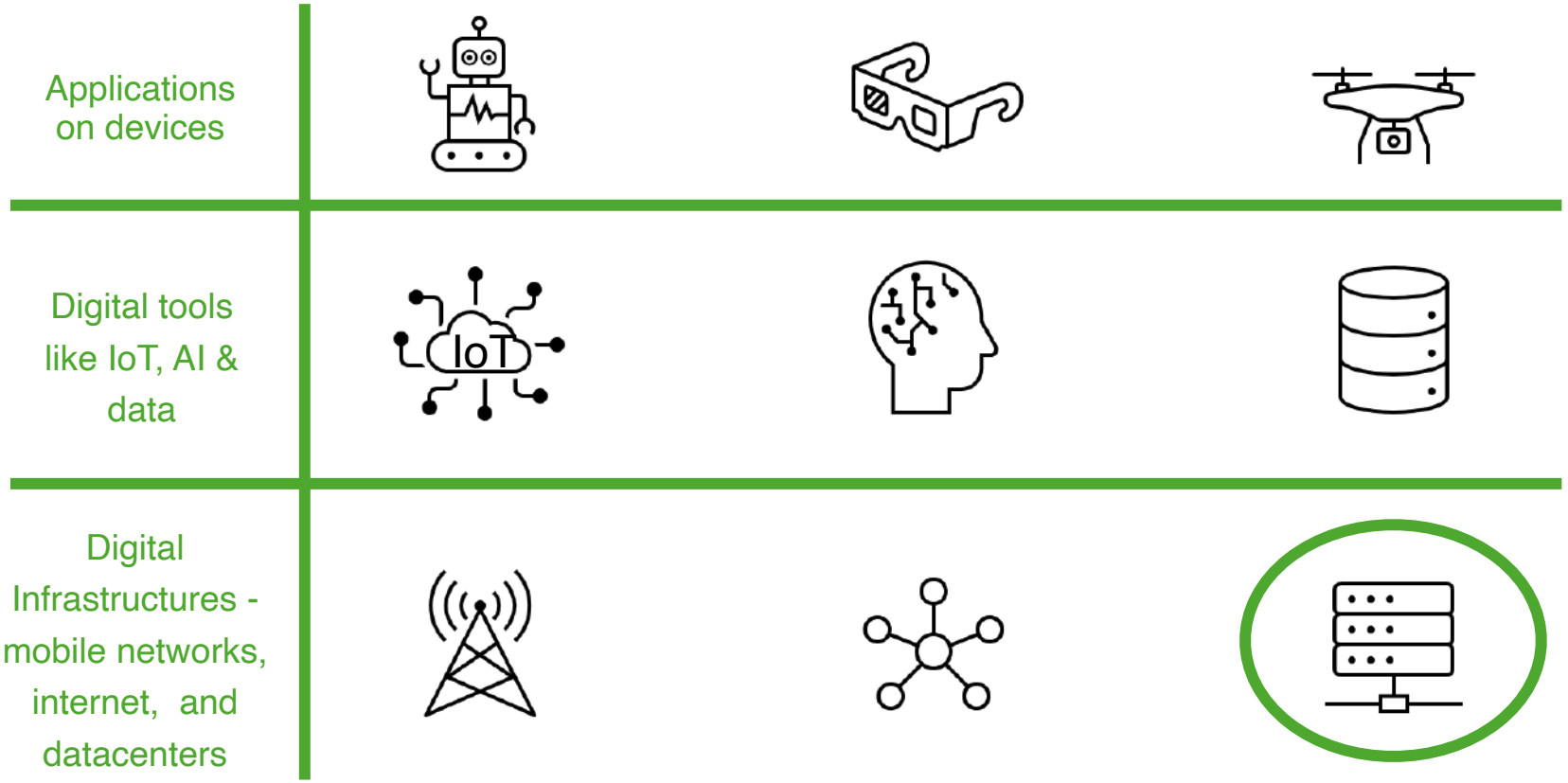
01	Background to ‘BragaWatts’
02	EUDCA ongoing work and future outlook
03	Nordic role?

Comic strip about energy & AI data centers



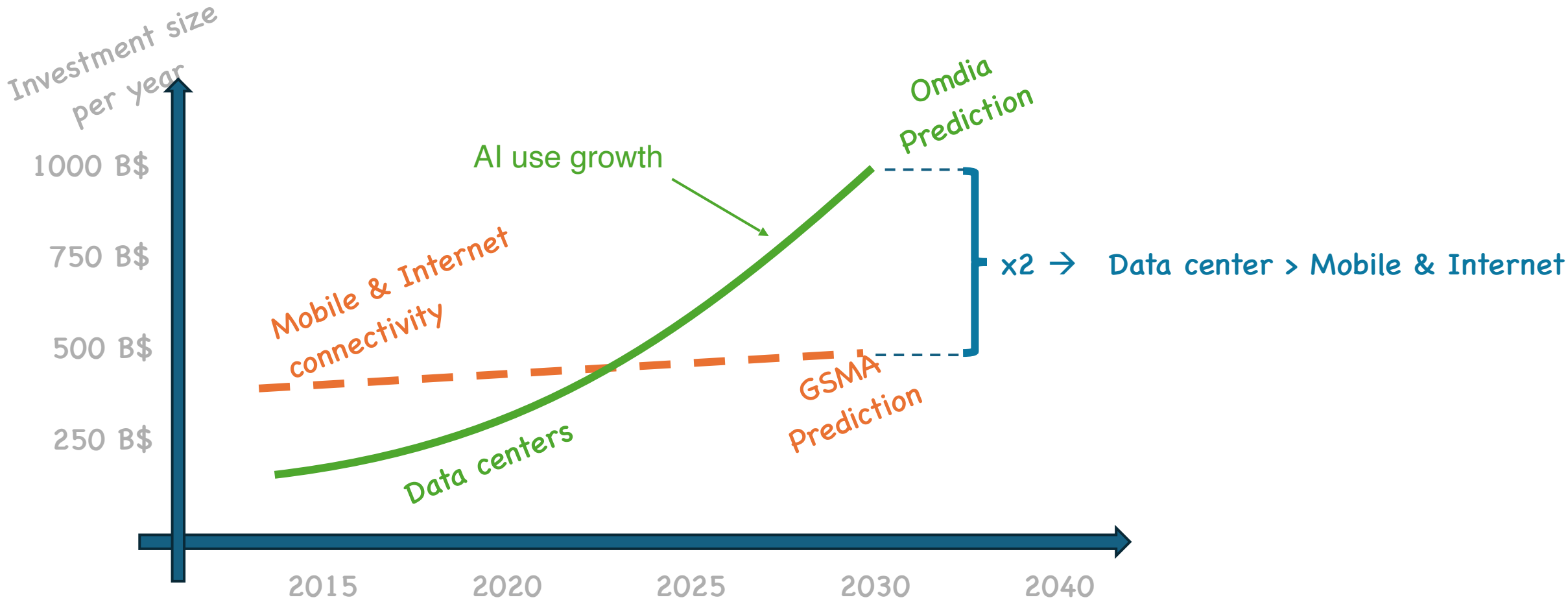
Sources: RISE 2025

Digital infrastructure – including data centers
– is the foundation for AI



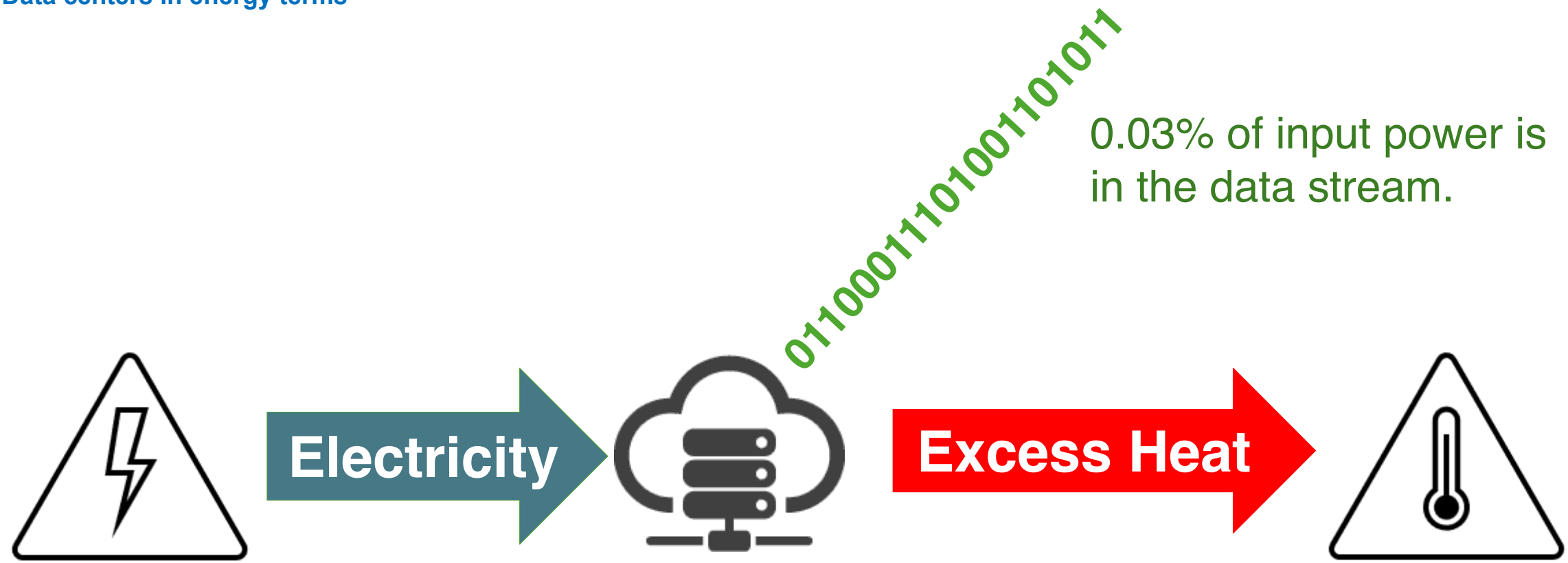
Sources: RISE 2025

Data centers vs connectivity investment sizes



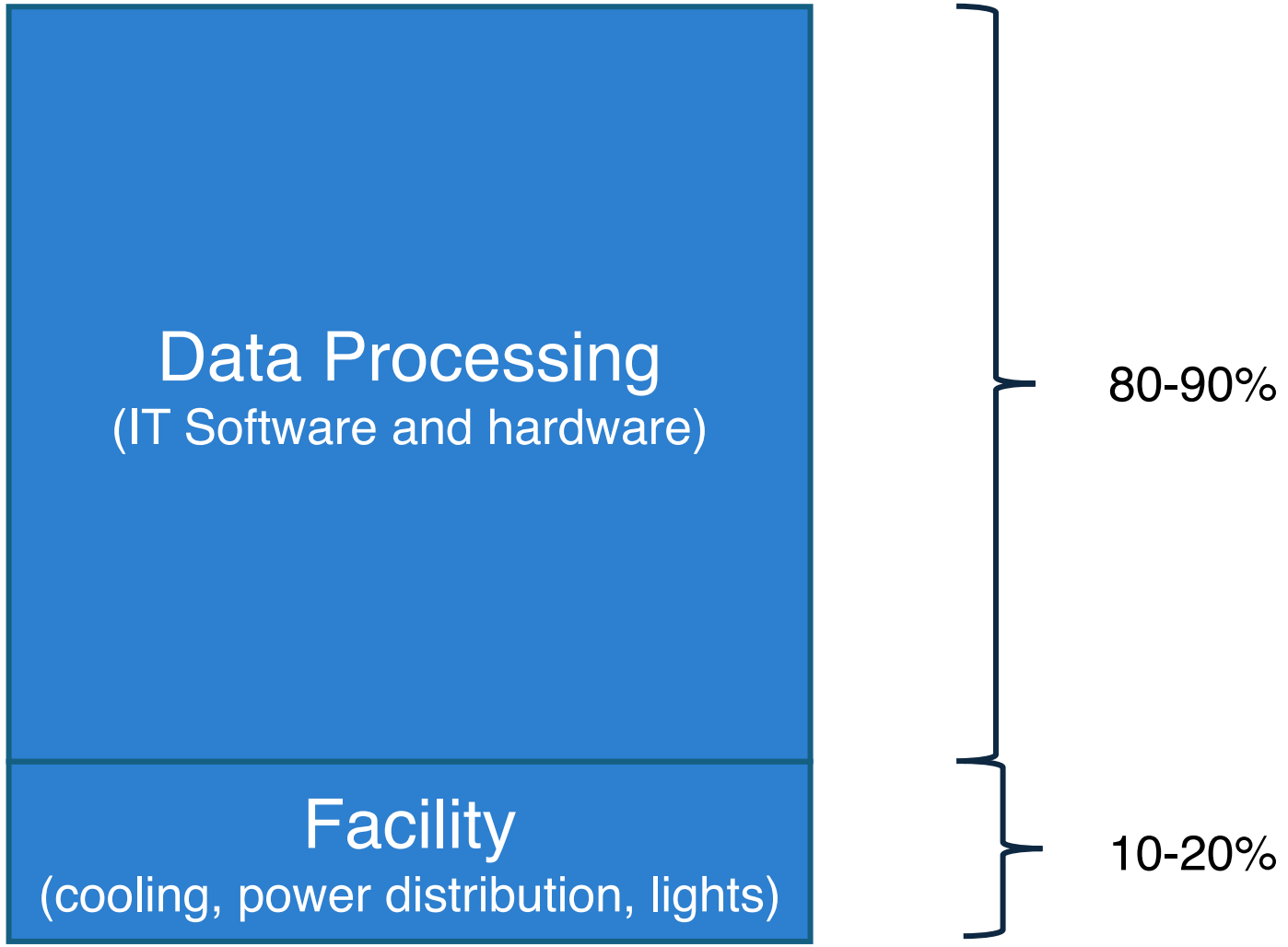
Source: Omdia Analyst Summit 2025 and Mobile Infrastructure Investment Landscape, GSMA, 2025

Data centers in energy terms



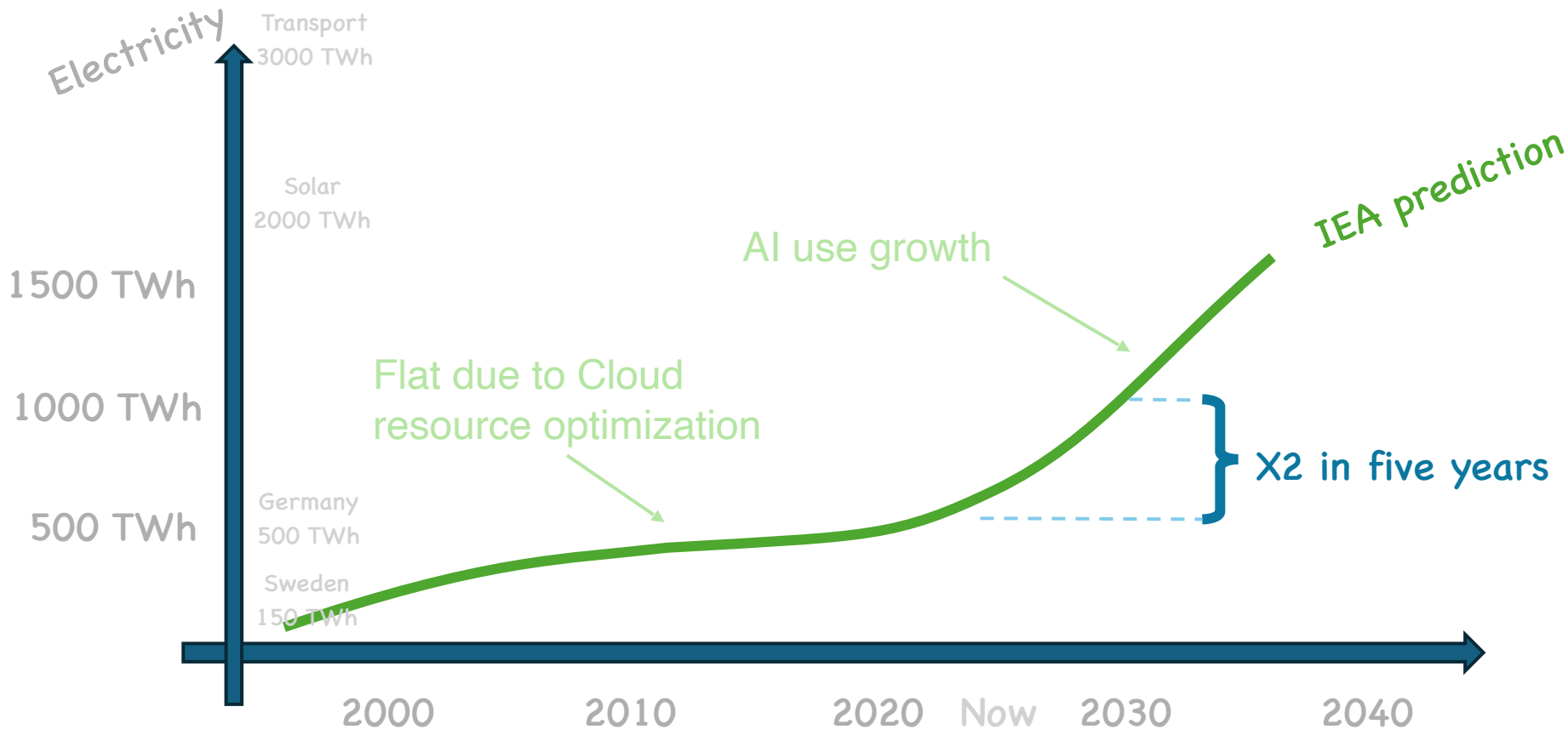
Based on: Rolf Landauer, “Irreversibility and Heat Generation in the Computing Process,” IBM J Res. Dev. 5, 183 (1961).

Where do the energy go? 99,97% becomes heat
(illustration)



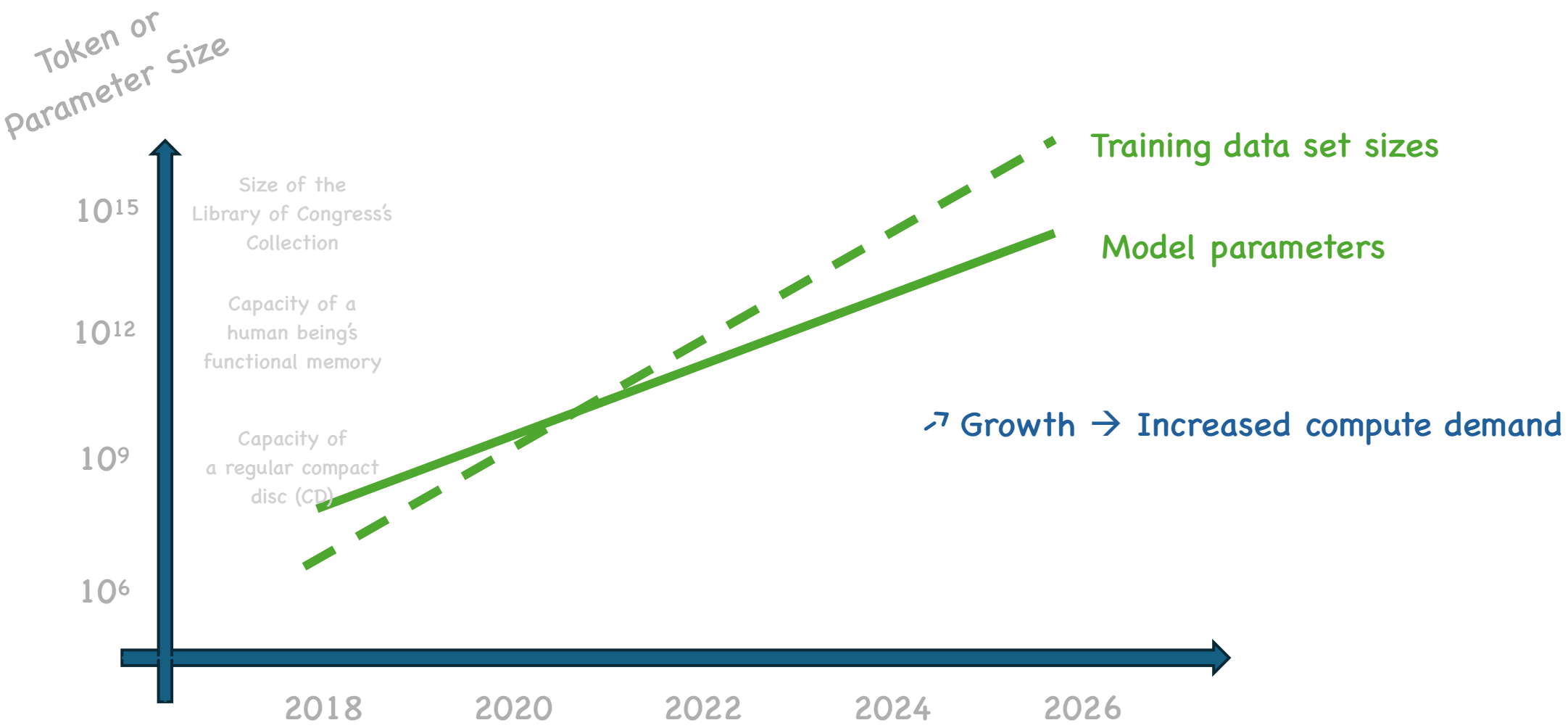
Sources: RISE 2025

Global electricity demand in data centers



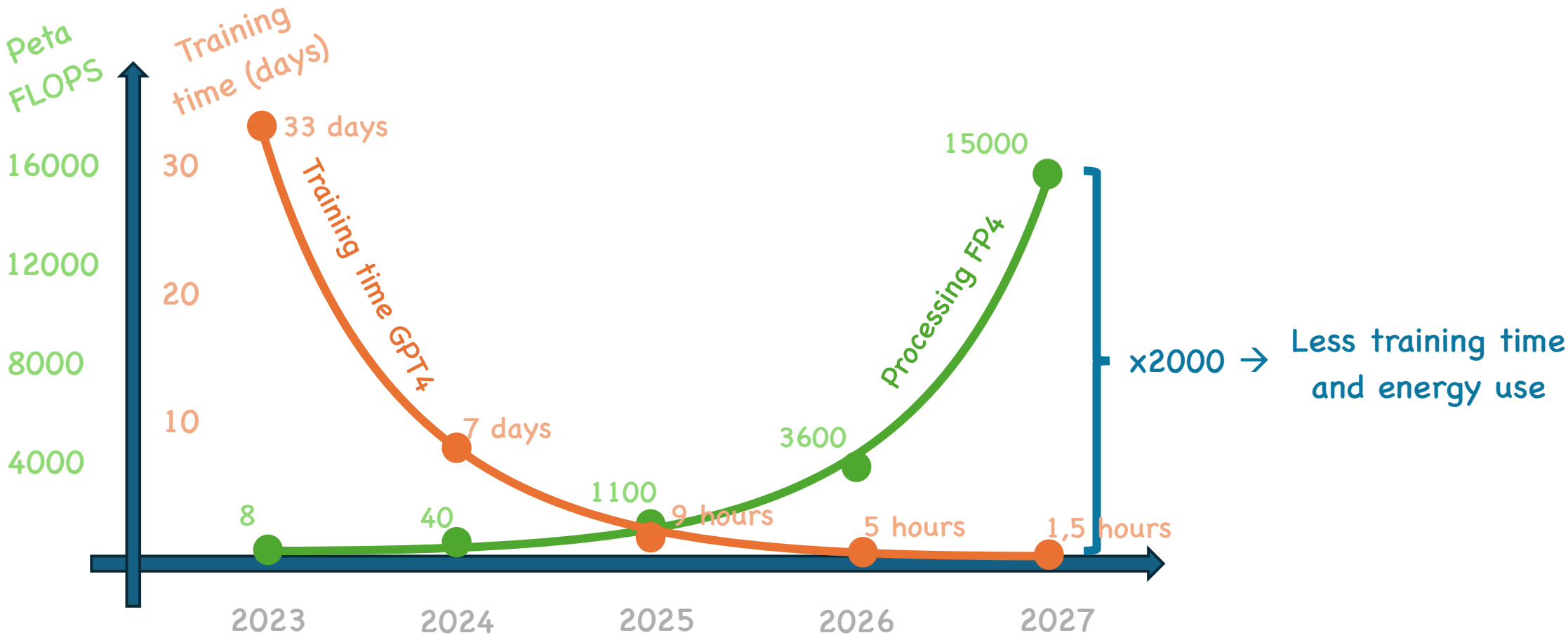
Sources: Electricity 2024 Global trends- Analysis and forecast to 2026, IEA 2024 - EPRI, Powering Intelligence, White Paper, May 2024 - Global Data Center Demand Forecast (McKinsey), 2024

Size of AI models and training data used



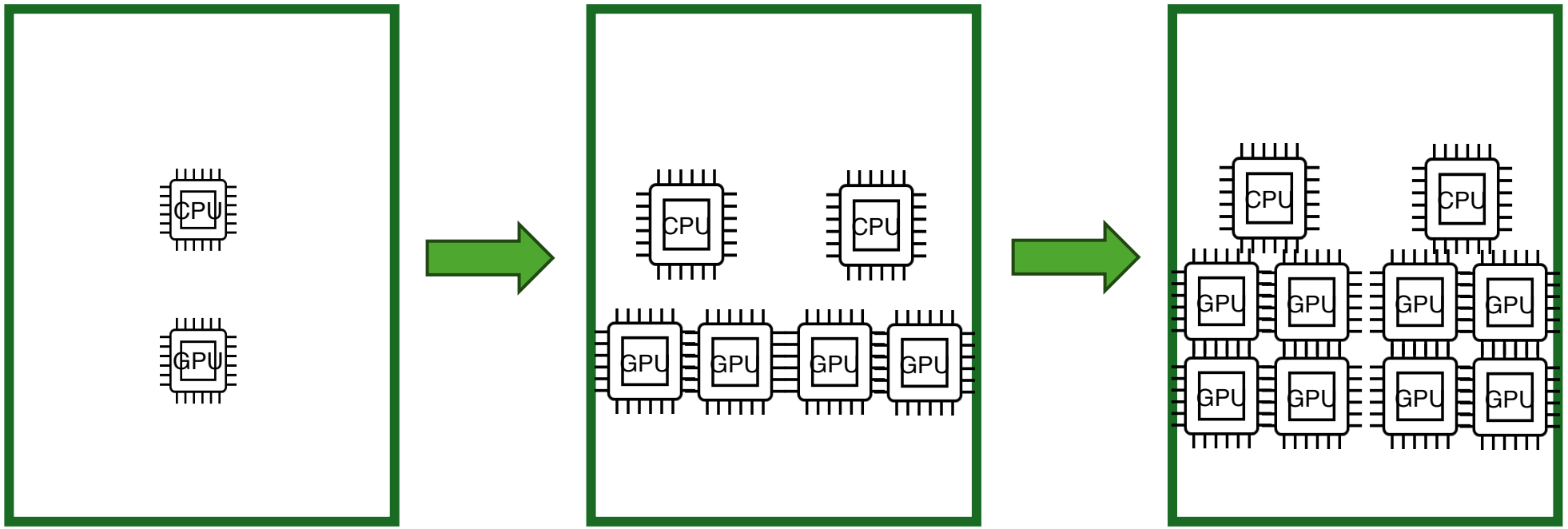
Sources: Trends in Training Dataset Sizes, Epoch AI, Sep 20, 2022

Development of compute performance in Nvidia GPUs



Sources: GTC 2025 Keynote, Jensen Huang, Founder and CEO, NVIDIA, 2025

Increased density in rack & server design



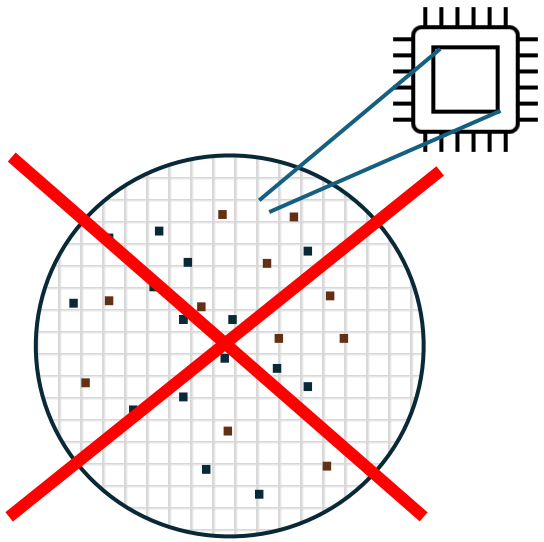
Old server

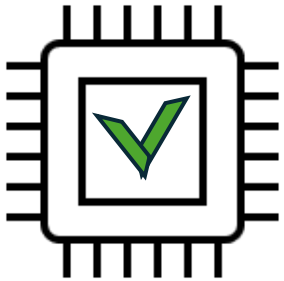
Server now

Future server

Sources: GTC 2025 Keynote, Jensen Huang, Founder and CEO, NVIDIA, 2025

Chip design is limited by the physics



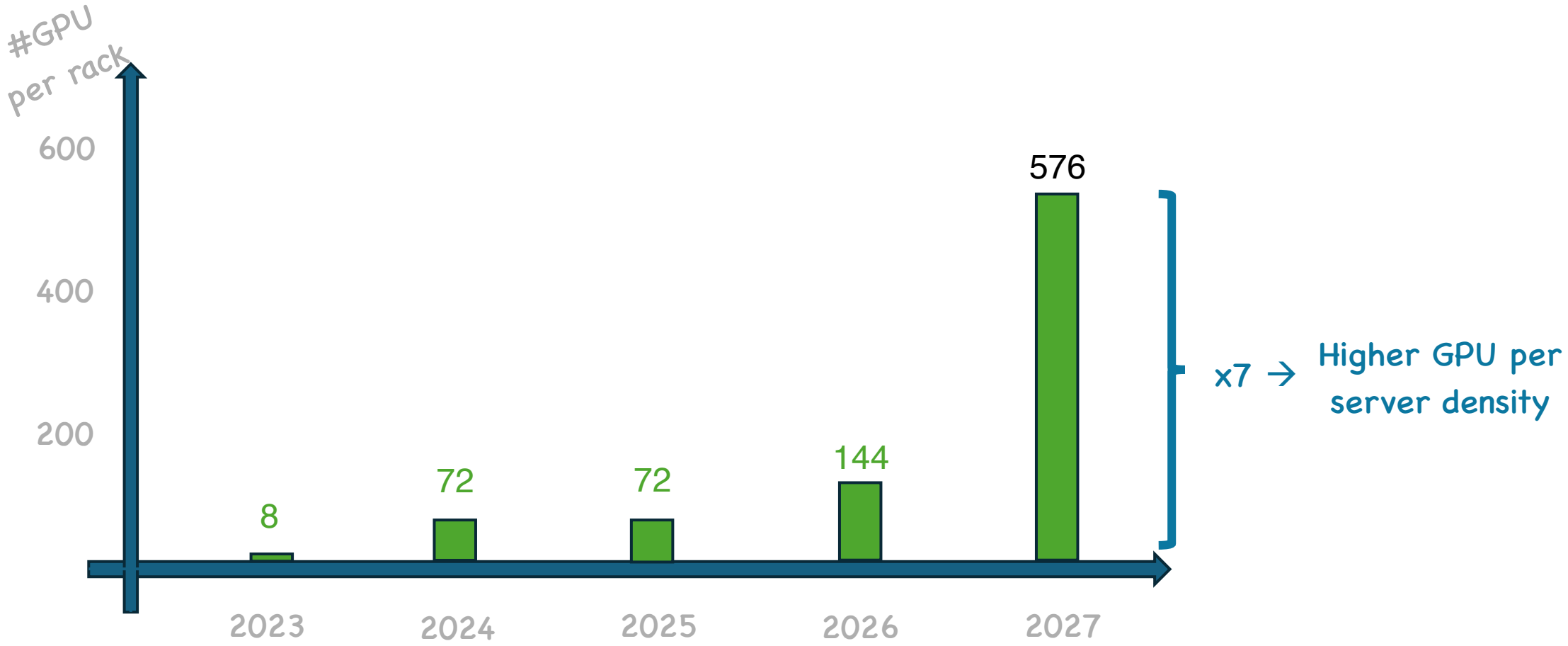


Utopia: One super chip
+ Could enable fast RAM/COM
- Faulty parts of the silicon
- Difficult to power and cool
- Difficult to package

Solution: Several large chips
- Need fast communication
+ Possible to make fault-free
+ Possible to power and cool
+ Possible to package

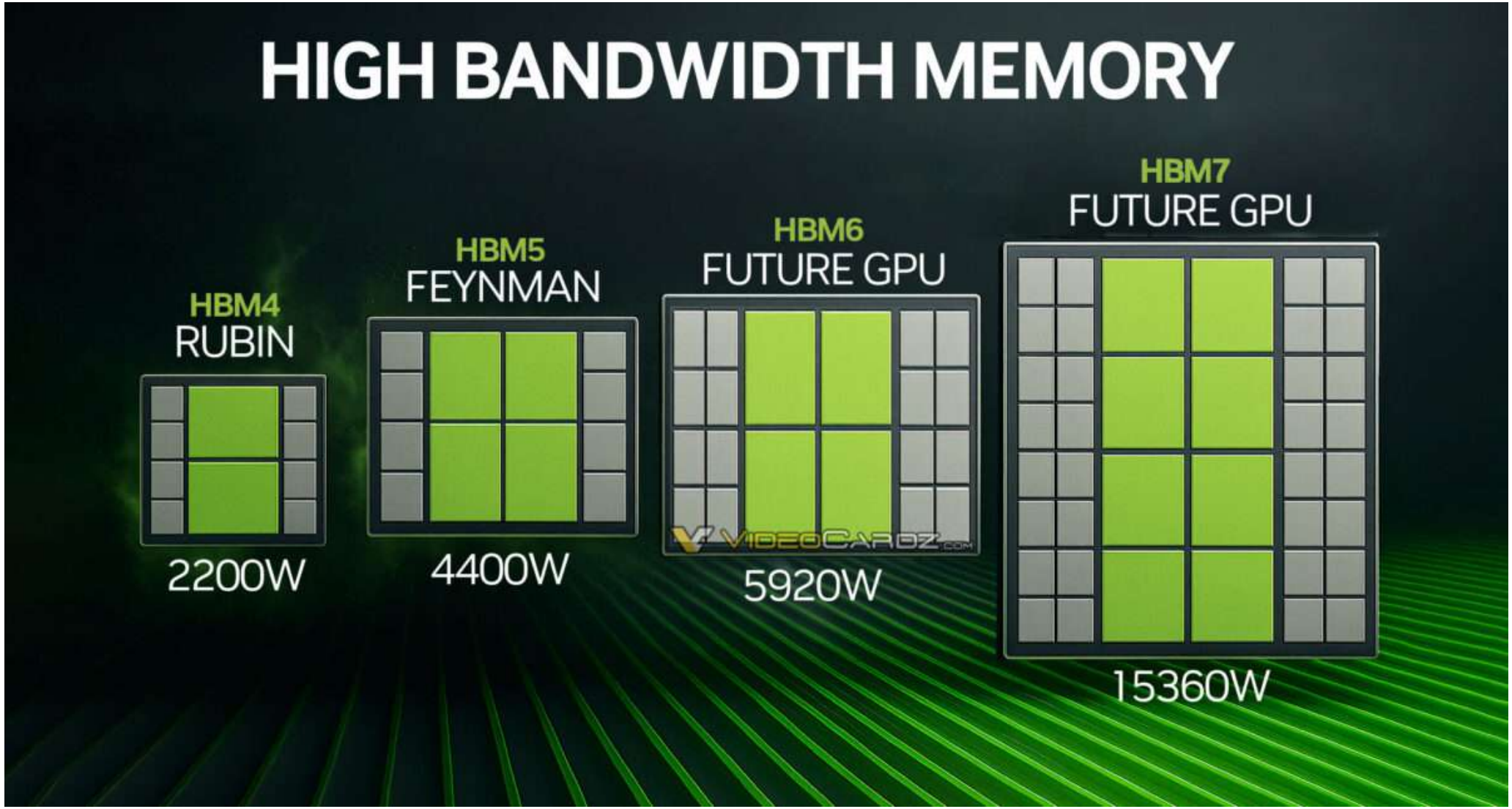
Sources: GTC 2025 Keynote, Jensen Huang, Founder and CEO, NVIDIA, 2025

Development of number of Nvidia GPUs in one rack

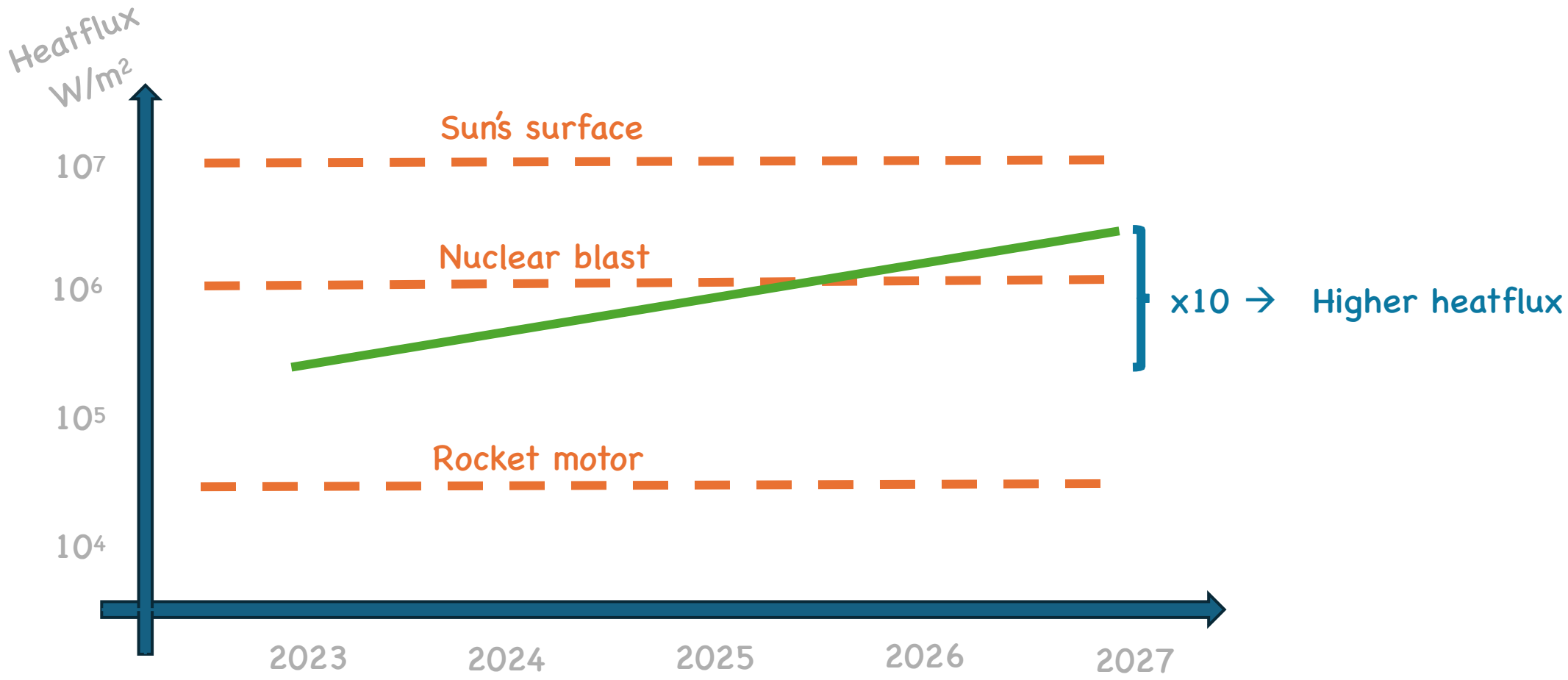


Sources: GTC 2025 Keynote, Jensen Huang, Founder and CEO, NVIDIA, 2025

Development of power for Nvidia GPUs

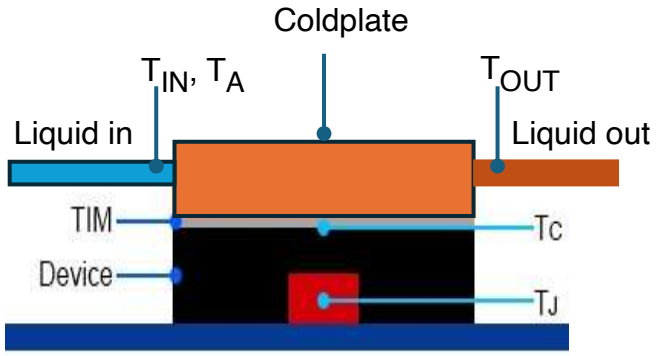


CPU/GPU heat flux (power per area)



Sources: Oktay, Sevgin, Robert Hannemann, and Avram Bar-Cohen. "High heat from a small package." Mech. Eng.;(United States) 108, no. 3 (1986).

Challenges with higher heatflux



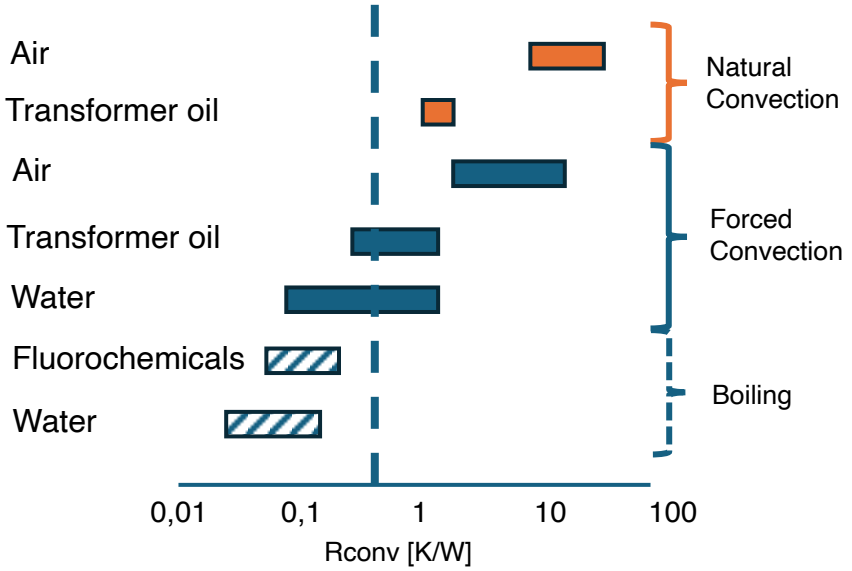
T_{IN}, T_A = Ambient temperature

T_C = Case temperature

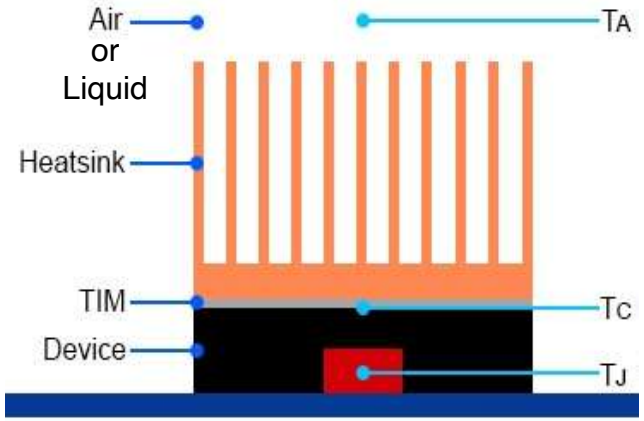
T_J = Junction temperature

TIM = Thermal Interface Material

On-chip



Server now



Immersion

Sources: Ahmed El-Neama based on Tummala, R.R. 2001. Fundamentals of Microsystems Packaging. McGraw-Hill.

Challenges with higher GPU density per rack

Power in 500kW-1MW at 800 VDC

Cool air in 60-120 cmm

Communication in & out

Hot coolant out 1000-2000 lpm

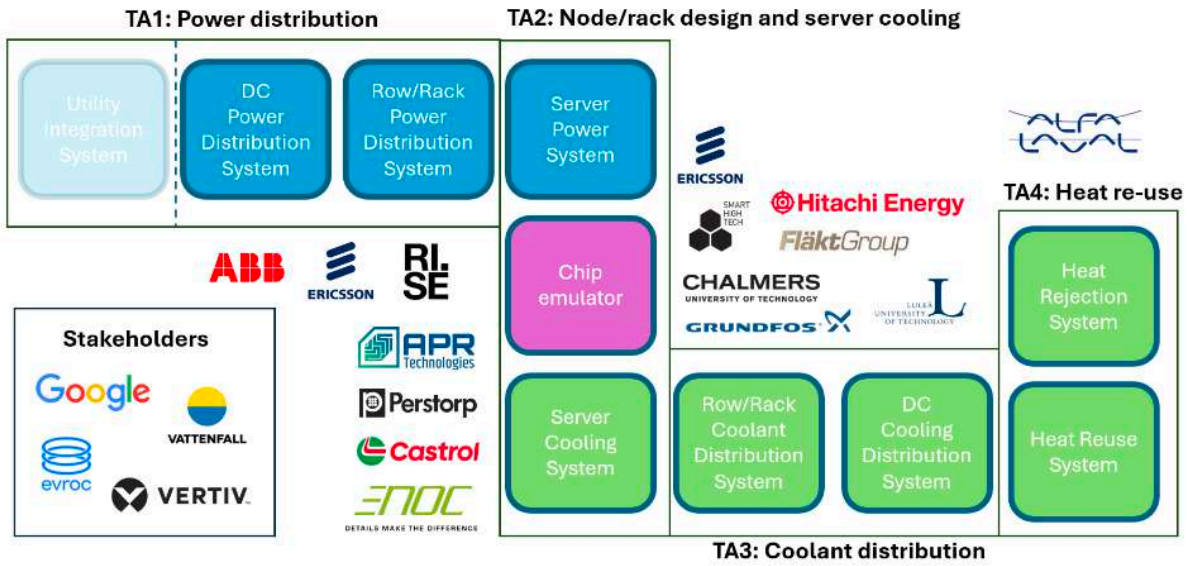
Warm air out 60-120 cmm

Lukewarm coolant in 1000-2000 lpm

Future racks

Sources: RISE 2025

Needed development in the industry

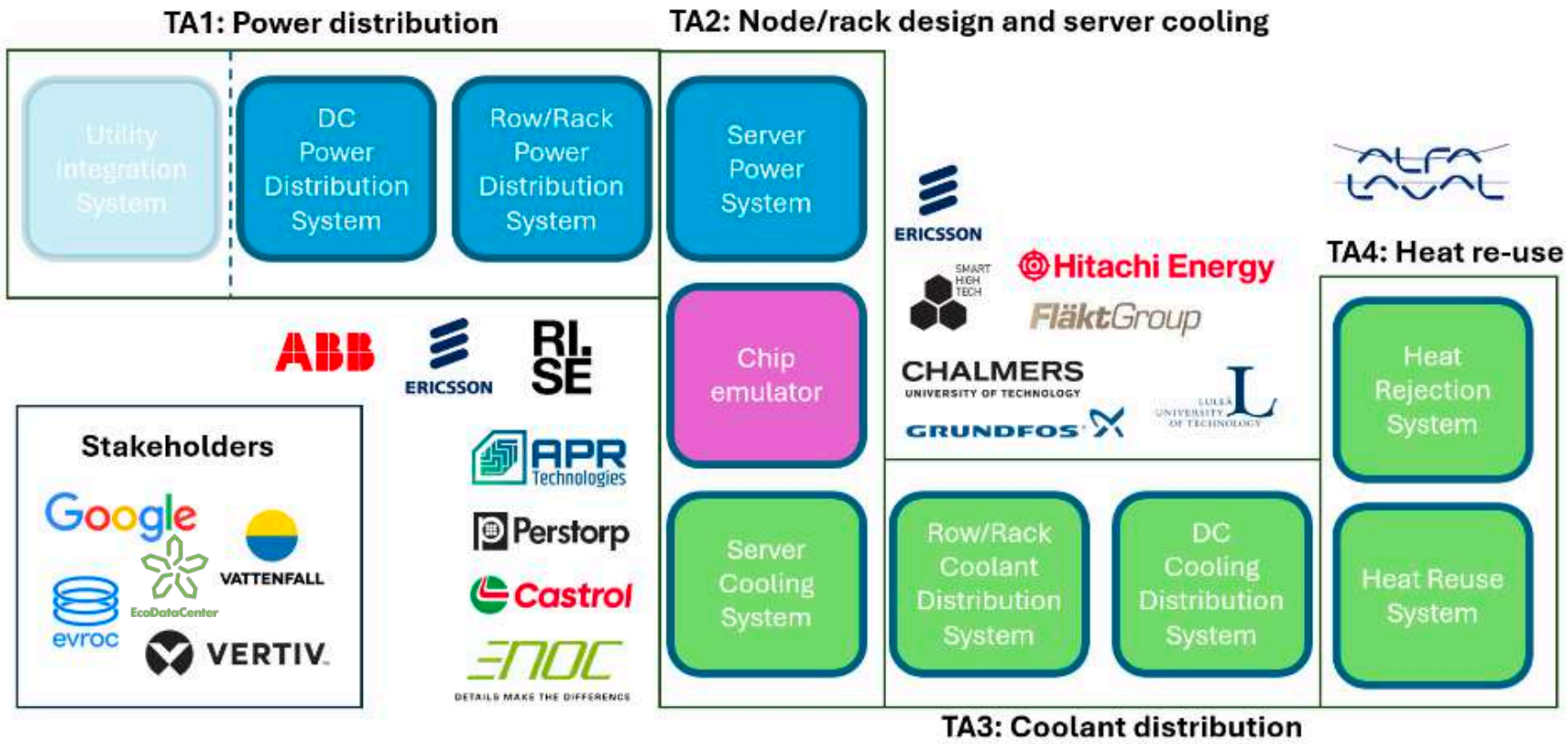


- Power Distribution
  The entire power delivery chain—from high-voltage input to rack-level busbars—must be redesigned to minimize energy losses and maximize flexibility in handling dynamic loads.
- Energy Storage
  Emerging technologies such as supercapacitors, hydrogen fuel systems, and advanced battery chemistries should be considered to manage power spikes, enhance sustainability, and support grid flexibility.

- Power Electronics
  Efficient and reliable power conversion is essential from rack-level distribution down to the chip, requiring innovations in voltage regulation and energy management.
- Coolant Distribution
  Liquid cooling systems must be optimized for low-loss thermal transport and balanced flow across the facility to ensure consistent and efficient heat removal.
- Chip Heat Transfer
  Minimizing thermal resistance in the cooling loop—from the chip to the first heat exchanger—is critical. This includes optimizing thermal interface materials (TIM), cold plates, liquid flow, pumps, valves, and manifolds.
- Hybrid Cooling Design
  Future racks will require hybrid cooling approaches, combining liquid cooling for high-performance GPUs with air cooling for supporting electronics to maintain overall system efficiency.
- Heat Rejection
  Heat rejection systems must operate efficiently at the highest possible temperatures and adapt to diverse climate conditions to ensure sustainable thermal management.

Sources: RISE 2025

How the industry is coming together - The H-DINI project

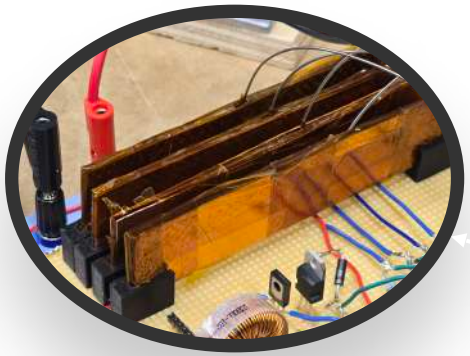


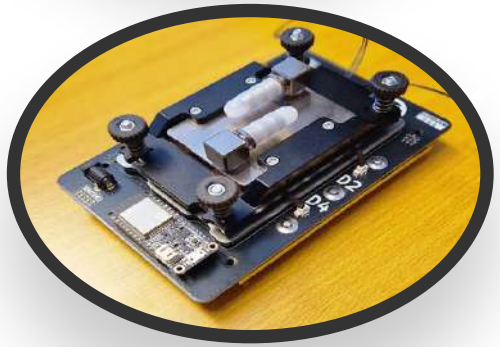
Goals

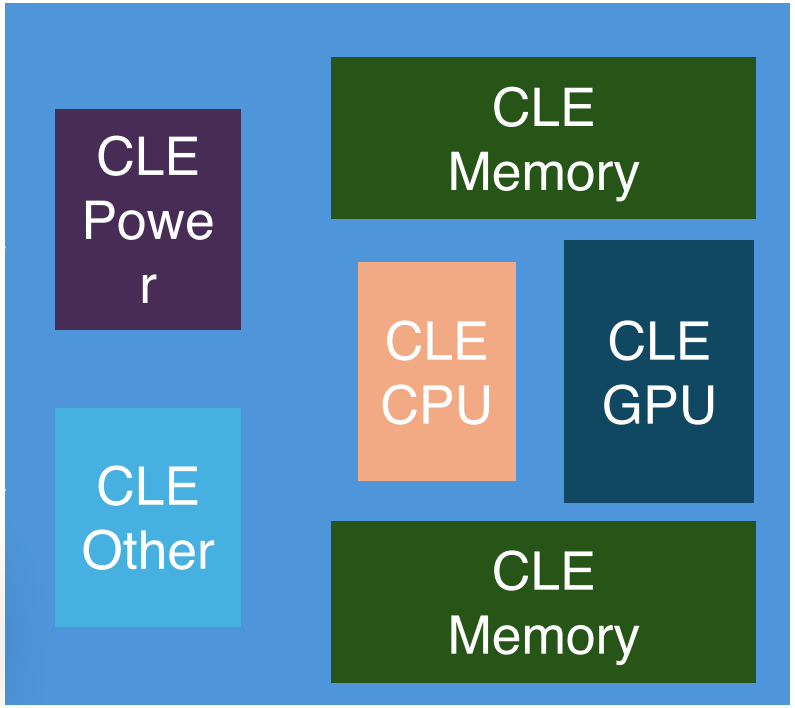
- The project goal is to develop technologies and systems for power-dense AI compute with efficient power delivery and thermal performance.
- Demonstrate system solutions for selected technology areas
- Total budget €6M

Sources: RISE 2025

What if we can use a Server Emulator?





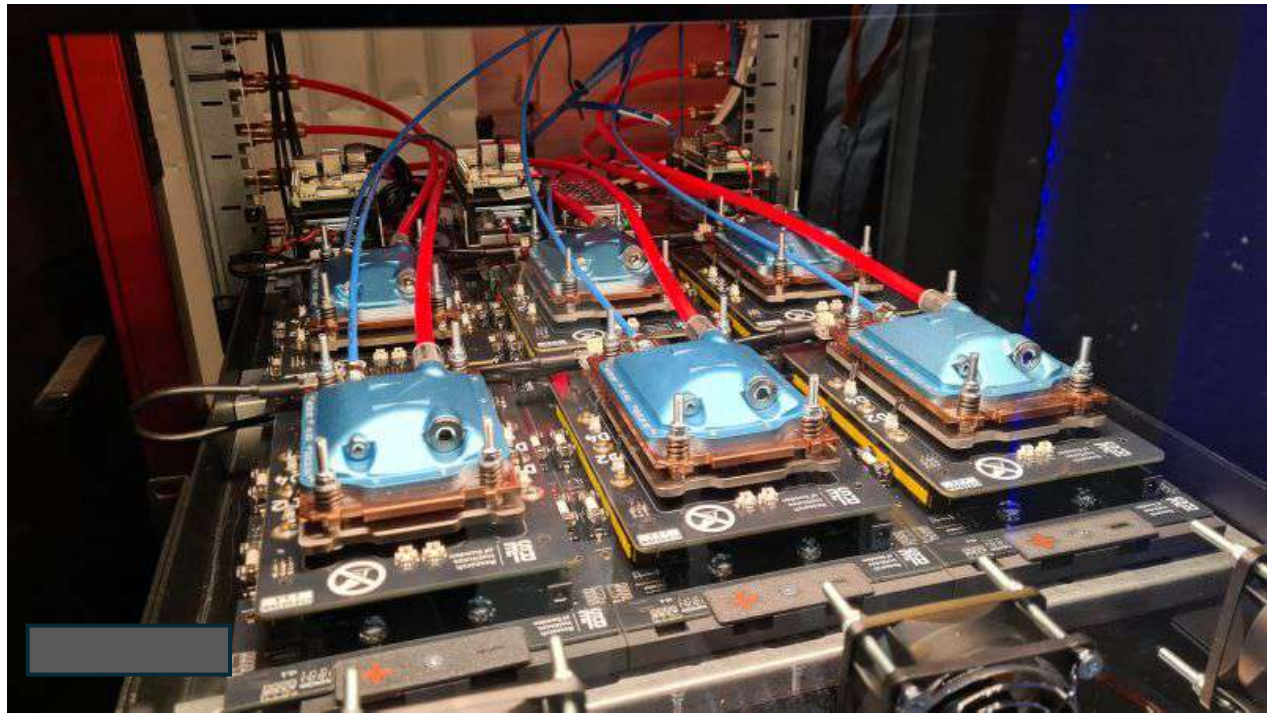


- Look like a server
- Accurately emulating real chip
- High Power Density
- Compatible with different cooling technologies
- Modular server design
- Can meet future standards

A server emulator consists of one or more CLE, Chip Load Emulators

Sources: RISE 2025

RISE 2U Server Emulator single unit



- Power (0-12000W)
- Temperature (0-100°C)
- Integrated control
- Monitoring of CLEs

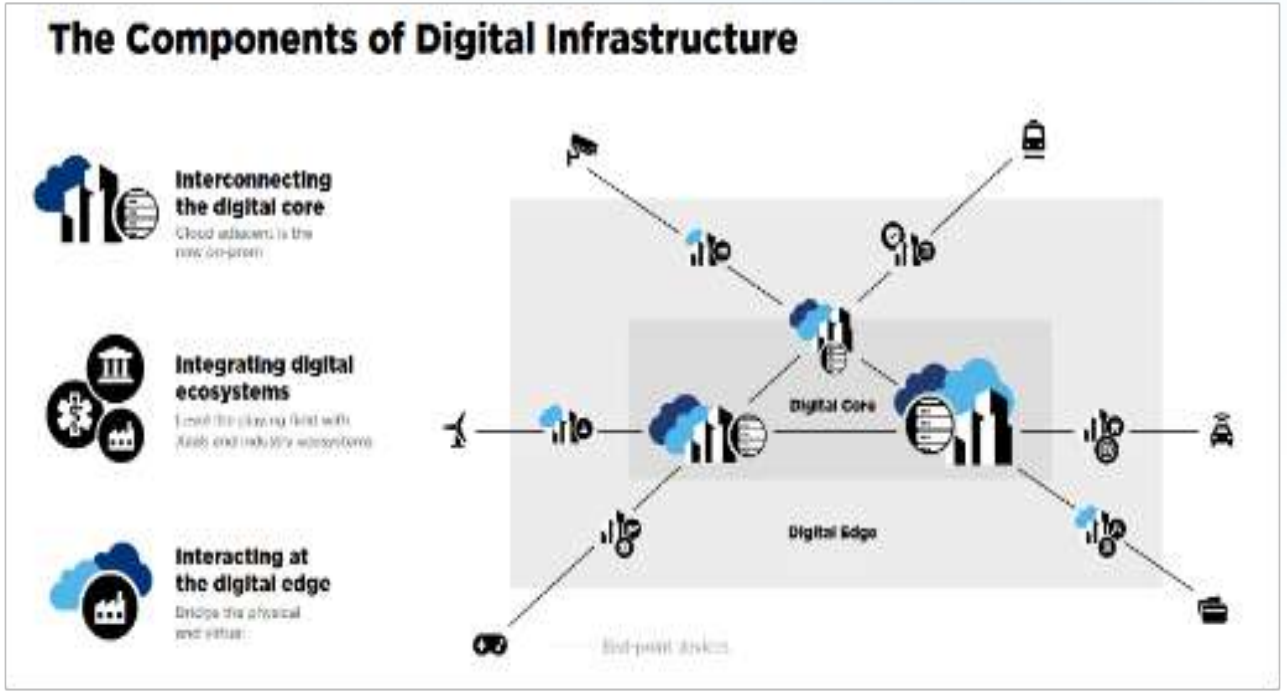
Sources: RISE 2025

EUDCA – ongoing activities and the role of the Nordics

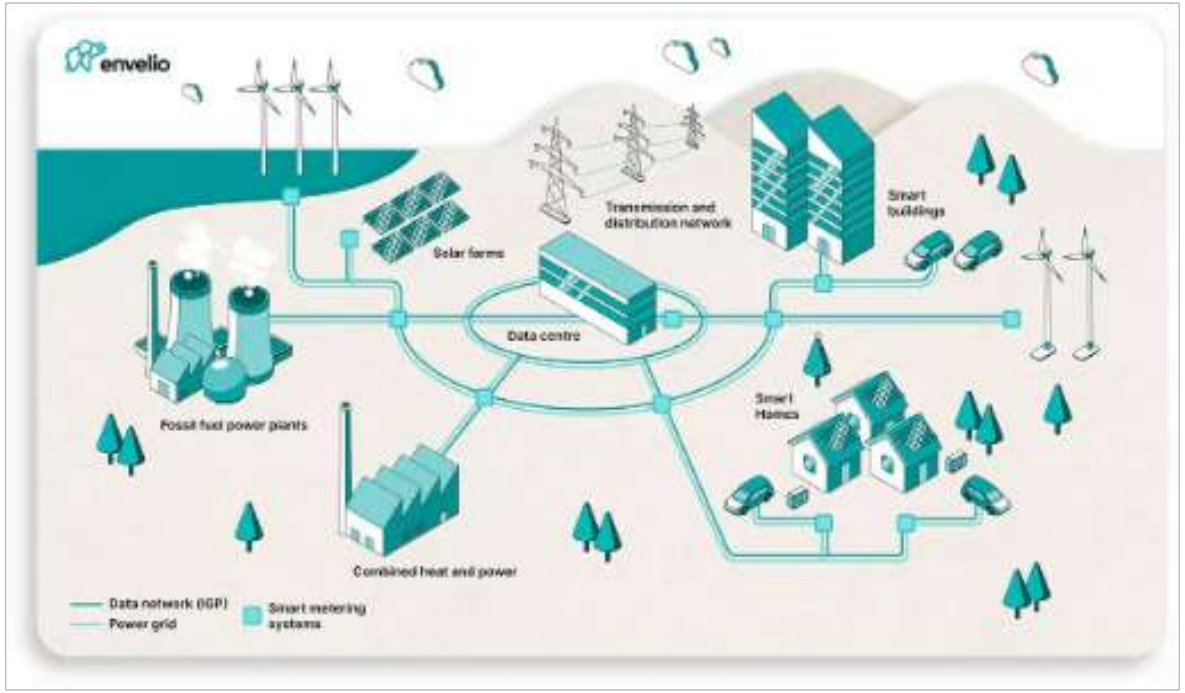
The Role of Data Centres in Europe's Digital Future

- **Invisible Backbone:** The essential foundation for AI, cloud computing, and digital services.
- **Global competitiveness:** Europe's success depends on secure, scalable infrastructure within its
- borders - goal of tripling the capacity.

Strategic Alignment: EUDCA is the voice of the industry to align growth with EU policy and energy goals.



Grid Integration & Energy Access – Collaboration on EU level



- **Key Collaboration:** Co-led by EUDCA and ENTSO-e EU Commission's Grid Integration Roundtable.
- **4 Working Groups:** Planning, Grid Rules, Queue Management, Flexibility.
- **Milestone:** Recommendations due Dec 2025.
- **Grid Partners:** Free up more capacity together, while keeping the electricity grid stable.

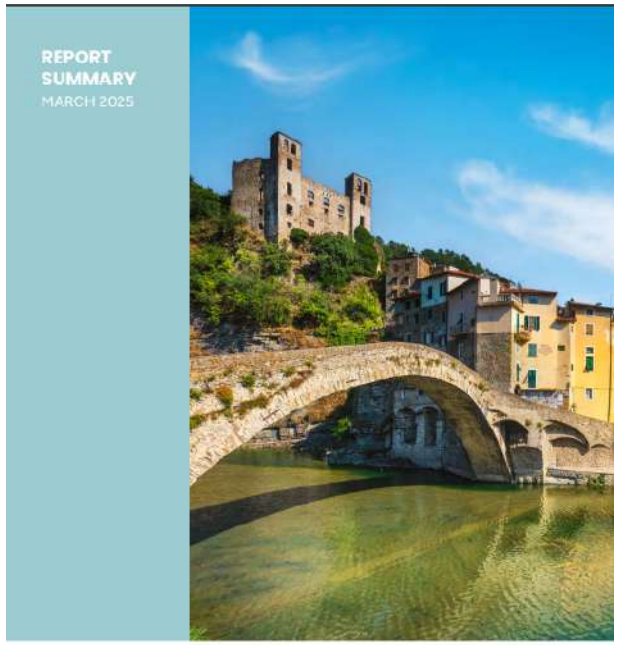
Policy Advocacy & Sovereignty

- **Capacity Growth:** Calling for tripling EU capacity to support AI & sovereignty.
- **Streamlining:** Advocating for faster permitting and grid modernization.
- **Open Approach:** Ensuring sovereignty through openness, not isolation.

EU Policy Landscape

Green Deal & EED	Digital Decade	Reforms	Resilience
Stricter sustainability and reporting requirements.	Tripling data centre capacity by 2030.	Energy market reforms and streamlined permitting.	CER & NIS2 regulations impacting operations.

Market Trends & Investment – EUDCA State of European Data Centres 2025



EUDCA
STATE OF EUROPEAN DATA CENTRES 2025

- **Demand Surge:** Driven by AI, cloud, edge, and digital transformation.
- **Growth:** €100B expected investment; 15% annual power demand growth.
- **New Hubs:** Tier-2 markets (Nordics, Spain, Poland) gaining traction.
- **Power is the biggest challenge:** 76% of the respondents mentioned Access to Power.

EU Engagement & Nordic Leadership

Shaping Policy

- Active in EED, AI Act, Data Act, and CER Directive.
- Harmonizing EU-wide Sustainability Label & Standards.
- Bringing the Nordic perspective to the “European table”.

Nordic Strengths

- Leadership in sustainability – e.g. renewables and heat reuse.
- Close collaboration cross-boarder for energy.
- Model for cross-border innovation and collaboration.

Nordic Opportunity

- **Digital Backbone:** The Nordics as Europe's sustainable hub for digital infrastructure.
- **Leadership:** Leading in energy, innovation, and cross-border collaboration.
- **Export:** Exporting best practices to shape the EU's digital future.

Building the Future Together

- Data centres are critical to Europe’s digital ambitions.
- EUDCA is driving and influencing policies on a European level.
- The Nordics have a unique opportunity to lead by example.

"Let us together build a resilient, sovereign, and green digital future."