

Sustainability in CSC's Kajaani Datacenters

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CSC in a nutshell



Our special expertise includes for instance research infrastructures, interoperability, and digital transformation



Business volume in 2025 was **98** million euros



Non-profit state enterprise with special tasks owned by the state of Finland **70%** and Finnish higher education institutions **30%**



One of the world's most eco-efficient datacenters in Kajaani



Over **700** employees in 2025



About **90** RDI projects in 2025



Providing IT services for science since 1971



Environmental sustainability at CSC



CSC's services enabling climate and environmental research

- For example Destination Earth and digital twins
- Services for research



Shared service provision saves resources

- Energy efficient, shared and correctly dimensioned services and systems
- Data management, scientific computing and education solutions for researchers, learners and businesses



We calculate our greenhouse gas emissions

- Our scope 1 and 2 emissions are close to zero
- Our biggest emissions are scope 3 and come from purchased goods and services, business travel and energy



Sustainable data center in Kajaani

- 100% renewable electricity
- Excess heat reuse
- Energy efficiency
- Brownfield construction



Environmental criteria in procurement

- Own environmental criteria in use for ICT consulting and data center services
- Procurements through Hansel take into account environmental aspects

Scope 1

Direct emissions

Scope 2

Indirect emissions from purchased energy

Scope 3

Other emissions associated with CSC's activities

Data Centers and Ecoefficiency

Lifecycle ecoefficiency

- **Design choices** and **location**
- Datacenter construction
- IT hardware manufacturing (materials)
- **Operation** (electricity, heat mgmt.)

Energy oriented metrics

- PUE, ERE/ERF etc.

Application oriented metrics

- Performance per watt
- "Science per watt"



LUMI datacenter in Kajaani, Finland

Timeline of CSC Datacenter(s) in Kajaani, Finland

- 2010: CSC selects Kajaani (for national supercomputers)
- 2012: 2MW data center starts, free cooling
- 2014: Modular extensions
- 2019: Decision on LUMI, planning starts (10MW IT power)
- 2022: LUMI starts operations, heat recovery
- 2024: LUMI AI Factory decision
- 2025: LUMI AI Factory DC planning ("~2 x LUMI")
- 2026: LUMI AI Factory DC construction; procurements
- 2027: LUMI-AI & LUMI-IQ start of operation
- 2028: LUMI EoL (?); dismantling of oldest facilities



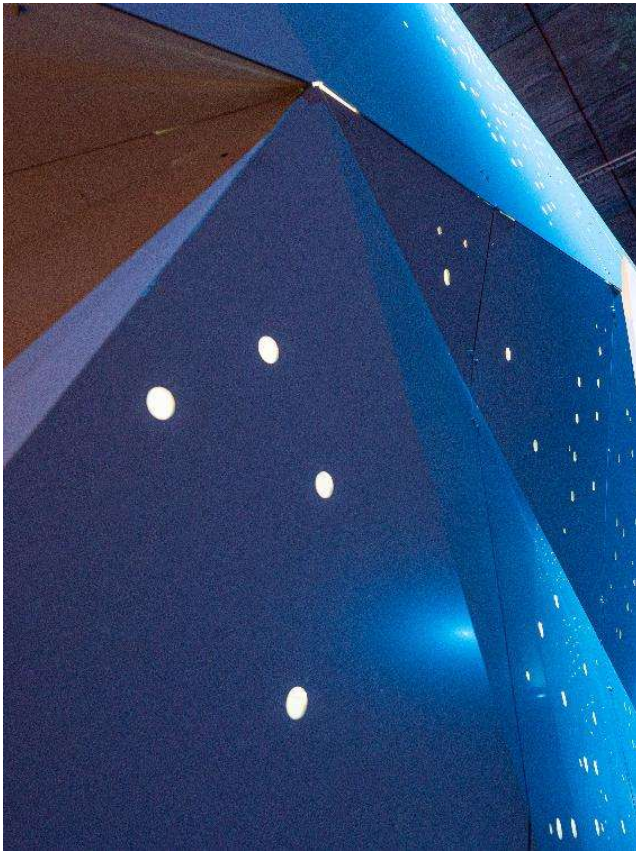
Design Principles for LUMI Datacenter

- Old papermill site with existing electricity etc. infrastructure
- Brownfield implementation, building-in-building
- Heat reuse as primary cooling solution
 - Free cooling as backup
- Certified carbon-free electricity
- Minimal water footprint

LUMI



Award-winning LUMI Datacenter

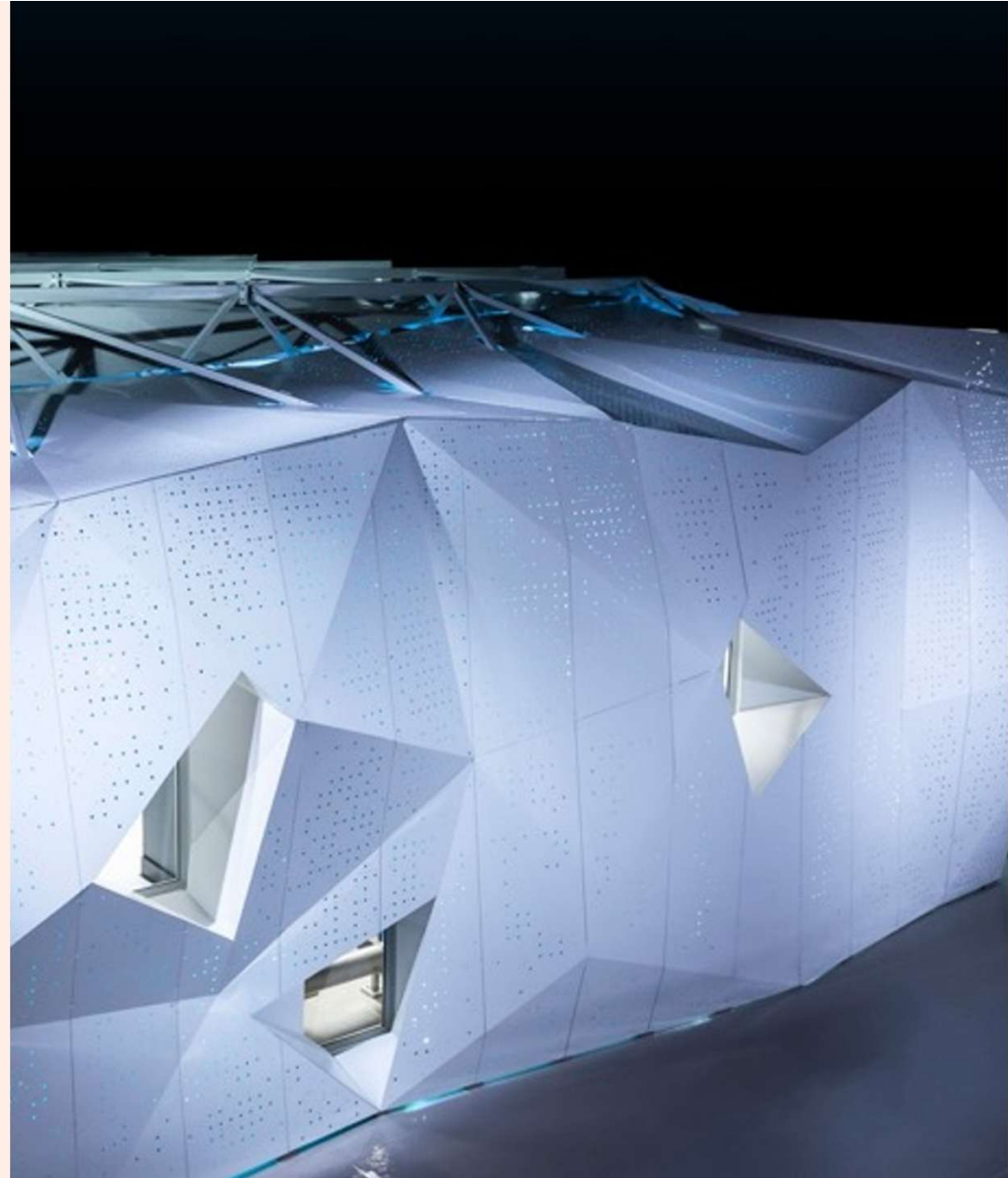


Design Principles for LUMI AI Factory Datacenter

- More or less same as LUMI (some improvements)
 - Old papermill site with existing electricity etc. infrastructure
 - Brownfield implementation, building-in-building
 - Heat reuse as primary cooling solution
 - Free cooling as backup
 - Certified carbon-free electricity
 - Low water footprint
- More emphasis to construction & materials (wood)
- LEED certification (in progress)

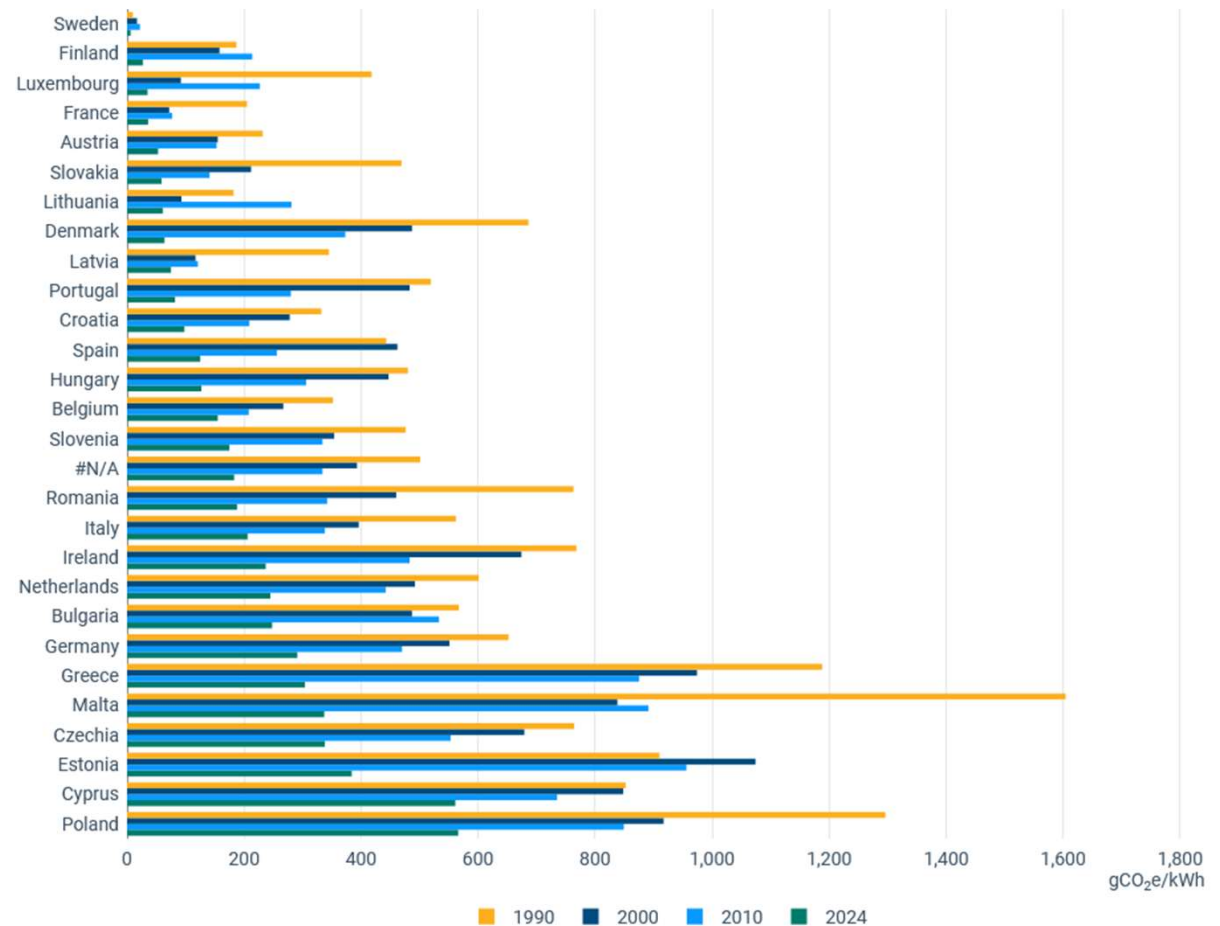


Electricity & Heat



Electricity

- Electricity dominates lifecycle carbon emissions of datacenters
 - Close to 100% in high-carbon areas
 - Substantial also in low-carbon
- Certified carbon-free electricity is still just your average electricity !
 - Market mechanism to direct production to green(er) sources
- Huge differences in carbon footprint of electricity production
 - Substantial improvements seen recently



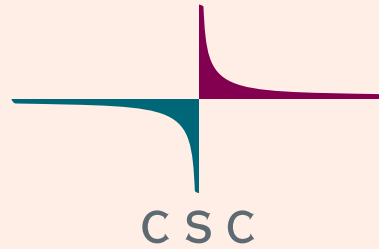
Source: European Environment Agency
<https://www.eea.europa.eu/en/analysis/indicators/greenhouse-gas-emission-intensity-of-1>

Heat Management, Basic Facts

- 100% of electricity consumed by IT turns to heat
 - Computation & other data processing as “side product”
- Heat sink required: atmosphere, body of water, building, industrial process(?), ...
 - Some are more favourable than others
- Free cooling: less electricity used compared to mechanical cooling (better PUE)
- Heat reuse: less energy used (less emissions) in total
- Emission reduction potential of heat reuse depends on carbon-intensivity of alternative heat source
 - Ongoing transition in heat production from burning to green(er) sources (electric boilers, heat pumps, heat storage systems etc.)
 - As heat production is decarbonized, reduction potential (tCO₂ per MWh) goes down ...

Heat Reuse in Kajaani

- HPC systems' direct liquid cooling enables practical heat recovery
- District heating a standard technology in towns in Finland since 1970s
 - Existing infrastructure and customer base (~50% of households in Finland)
 - Demand for heating (almost) year round
- Transition in heat production from burning to electricity
 - Aligns with implementing heat reuse in datacenters (or other low-temperature sources)
- Implementation (operational in LUMI since 2023, to be implemented for LUMI-AI)
 - Warm water (~40 degC) produced by LUMI supercomputer (primary circuit)
 - Higher-temperature (~80degC) secondary circuit towards district heating network
 - Heat transfer from primary to secondary circuit by heat pump
- *Other excess heat reuse methods are subject of active research, or niche implementations*



Thank you!



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