

LUMI



22.11.2021

DATA CENTER FOR SUPERCOMPUTING



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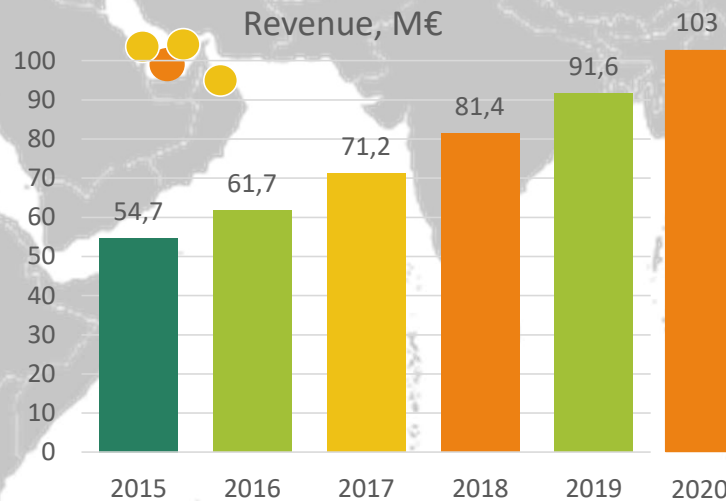
Granlund Group

Founded 1960

Design | Consulting | Software

- Granlund Offices
- Partners

Over 1200 experts



Leader in
Datacenter
design and
consultancy
in Nordics



Building on Innovation

DATA CENTER LOCATION



10 MW

Extended up
to 50 MW

Brownfield
+50 000 m²

3 Greenfield options
+200 ha

Existing reference projects

4 data centers with
30 MW allocated

on time and on budget

Ready electric infrastructure

200 MW

reduced capex and
time-to-market



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C S C



Responsible body for the whole construction and DC - operations



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Design



Construction

- Architect Structural Mechanical
- Electical Automation Fire suppression
- Acoustic Noise CIVIL

- Procurement Cost management
- Construction management Commissioning
- Hand over Warranty period



Project Summary

- LUMI project's key objectives were reasonable capital expenses and low total cost of ownership.
- One of the biggest challenges in the project design was the fact that the final technical requirements of the HPC was available only at the midpoint of the building phase.
- In order to reach the lowest total cost of ownership the primary cooling solution was designed to be the heat recovery and dry air cooling as a backup
- Electrical energy is provided with six independent feeds to on-site substation. Surplus of green energy production in the region, including three nearby hydro power plants and wind farms.
 - One outage during the last 39 years
- LUMI uses 100% certificated hydro power (with a close to zero carbon usage effectiveness) in all its data center production and office environments.





Global Awards / #DCDAwards

8 December 2021 / Park Plaza Westminster



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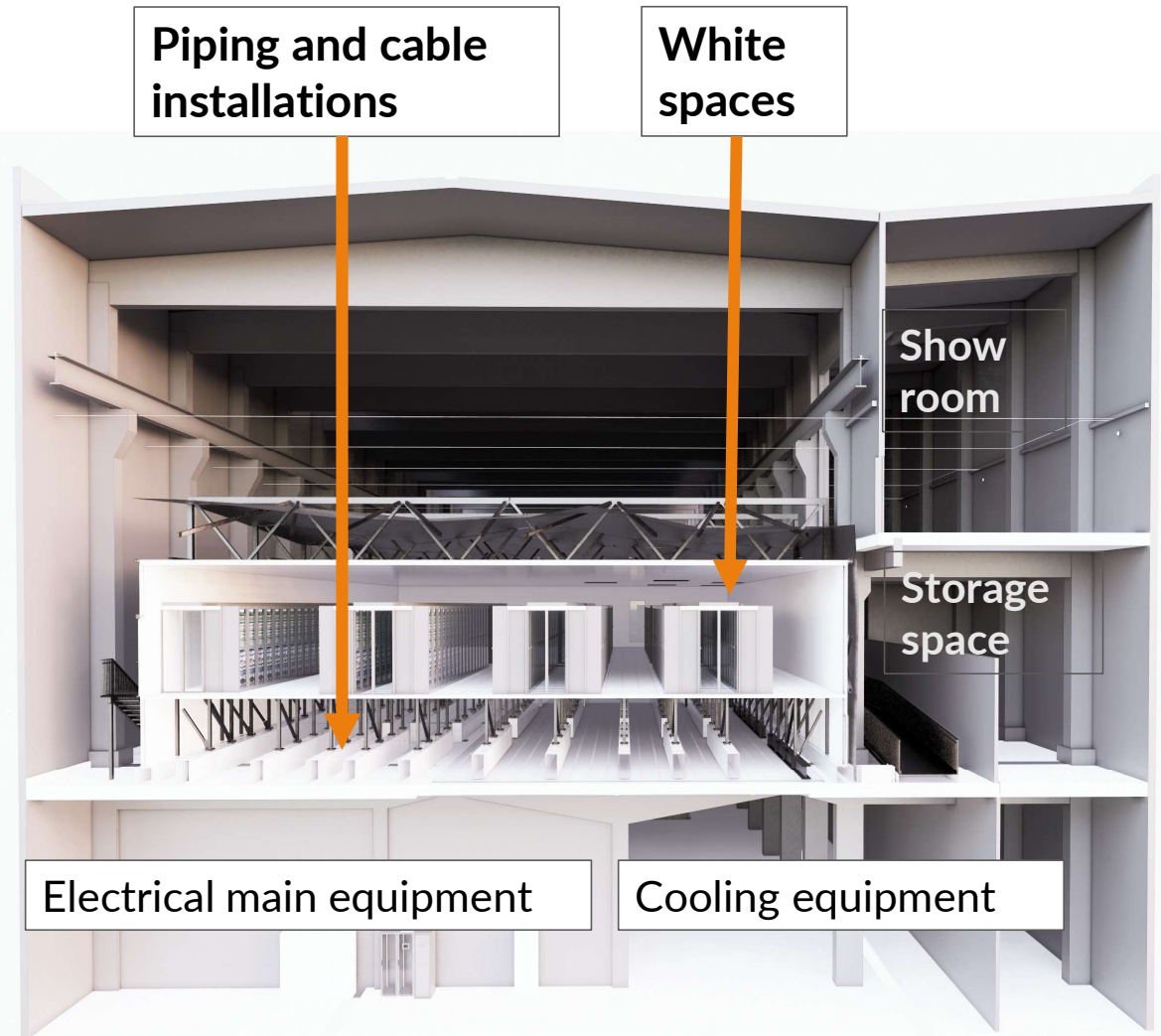
THE MOST INNOVATIVE DESIGN IN DATACENTER INDUSTRY IN 2021

Finalists:

- CSC LUMI Supercomputer, Kajaani, Finland in collaboration with Granlund & Synopsis
- Nautilus Data Technologies, Stockton 1 Data Center, California
- NTT Silicon Valley SV1, Santa Clara, California in collaboration with Gensler & DPR Construction
- RiCloud Data Center, San Jose, California in collaboration with Corgan & Syska Hennessey Group

Design innovations

- Heat recovery for the IT- load
- UPS- devices connected to the demand respond market
- Three floor arrangement:
 - Ground floor for the main equipment
 - 1st floor for the piping and cable distribution
 - 2nd floor for the DC- equipment only!
- Availability is calculated equivalent to TIER-3 level
- Unique shape of the DC > demonstrate snow
- Cooling production is simulated with native digital twin



Benefits of the brownfield solution

- We assume having **reduced the CO2 footprint of LUMI data center construction by over 80%** when comparing the brownfield solution vs. constructing an all-new building for LUMI
 - ~1000 tons
- Without the utilization of brownfield solution, we couldn't have secured the project timeline

| Materials - building shell 5,700 ft ² (530 m ²) office facility | Tonnes of CO ₂ | Percentage of total |
|---|---------------------------|---------------------|
| Foundation (concrete) | 4.7 | 4% |
| Flooring (concrete slab, insulation) | 39.9 | 31% |
| Ceilings (plaster board) | 2.3 | 2% |
| Structure (steel beams) | 15.4 | 12% |
| External walls (brick, insulation) | 32.1 | 25% |
| Internal walls (wood frame and plasterboard) | 8.7 | 7% |
| Stairs (concrete) | 1.1 | 1% |
| Windows (glass and frame) | 0.59 | 0.4% |
| Internal doors (particle board)* | -0.4 | -0.3% |
| External doors (plastic) | 0.6 | 0.5% |
| Roof (wood, concrete, insulation) | 23.4 | 18% |
| TOTAL | 128.3 | 100% |

Source: Schneider-Electric white paper 66



LUMI: Excess Heat Utilization Process Overview

Annual CO₂ savings 12 400 tonnes



DRY AIR COOLING
FOR BACK UP
~ 10 MW

DISTRICT HEATING
NETWORKS ~ 10 MW
-Renforsin Ranta Business Park
-CITY of Kajaani

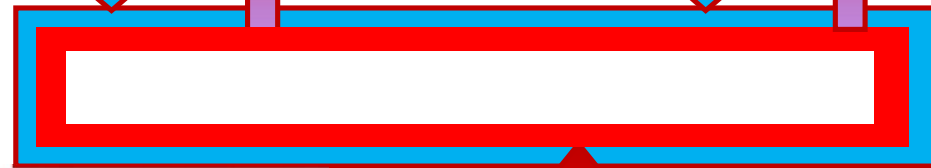
HEAT EXCHANGERS



HEAT PUMPS

Service demarcation point for the excess heat utilization

Heat pumps use renewable energy



HPC load

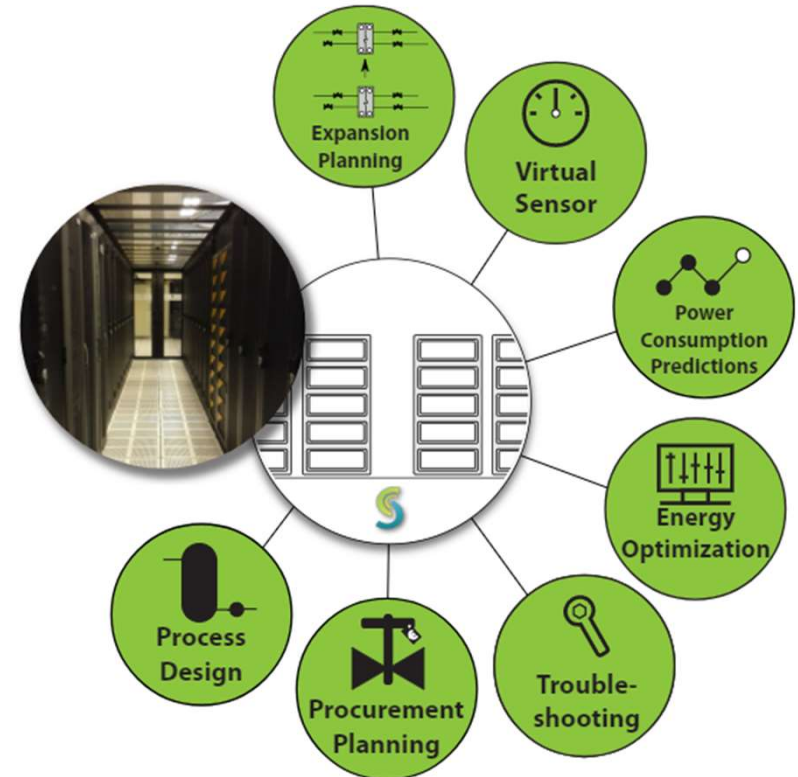
In addition of Direct Liquid Cooling there is approximately 1 MW of capacity for the air-cooled servers (e.g. storage and management servers). This load is free-cooled.



DIGITAL TWIN FOR COOLING

Semantum and Granlund have developed the Digital Twin of the cooling system of the LUMI high-performance computer. This application is a digital replica of the entire cooling system and computer racks. The underlying simulation model includes the entire cooling system, computer racks, as well as the automation system that monitors and controls the LUMI's cooling system. The simulation model is used to obtain information about the dynamics of this system. It also includes the connection between LUMI's cooling system and the district heating network. This is highly important to predict energy consumption of the system based on expected weather forecast and heating production of the high-performance computer.

Link to VIDEO



LUMI sustainability

- Immediate ability to utilize excess heat, process developed together with local district heat operator
 - Reduces annual CO2 emissions equivalent to 6.8 M kilograms of burned coal
- CSC data centers in Kajaani are designed and operated to reduce global CO2 emissions.
 - Designed PUE 1.05 / 1.24 and ERE ~0.20
- Existing building is transformed to the data center
- UPS- devices connected to the demand respond market
- Surplus of local green renewable energy sources available (wind & hydro)
 - BEING GREEN instead of BUYING GREEN



Data Center Total Cost of Ownership in Kajaani



- Low excess heat investment costs and excellent efficiency due to close proximity
- Extra cost savings offered by the existing infrastructure and private electricity network
- Surplus of renewable local energy enables low-cost operations in the years to come
- Availability for long PPA contracts to secure stable electricity pricing

Data Center electricity costs

<50 €

MWh

>5 MW data centers

Excess heat utilization ready

**CARBON
NEGATIVITY**

+ ASSETS FOR SALE

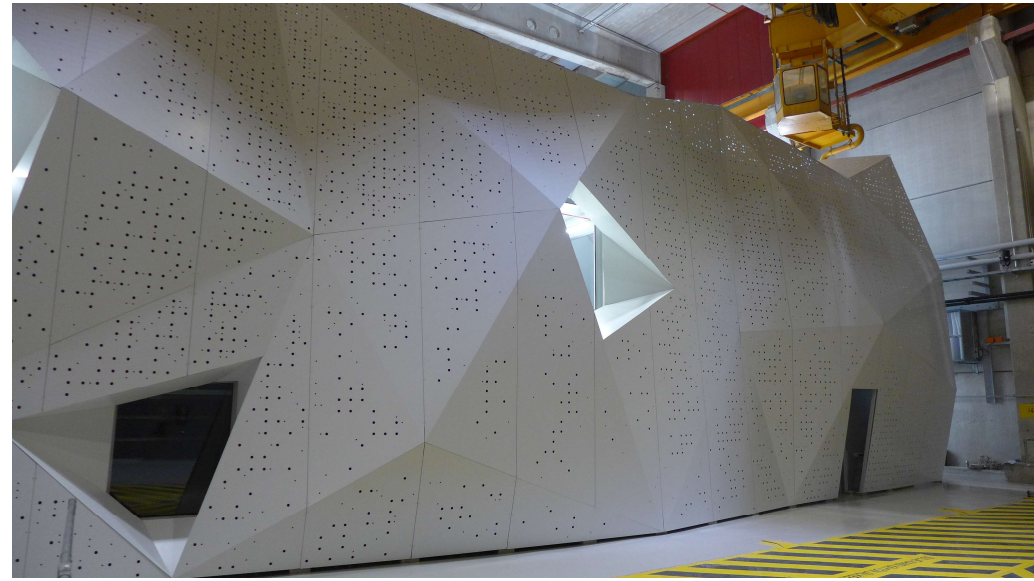
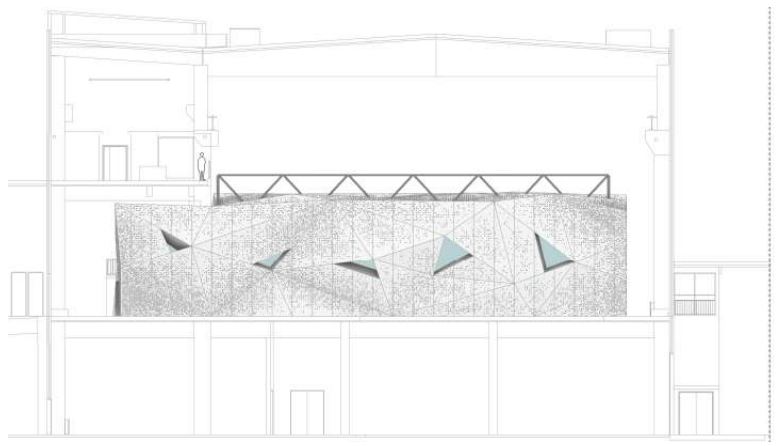
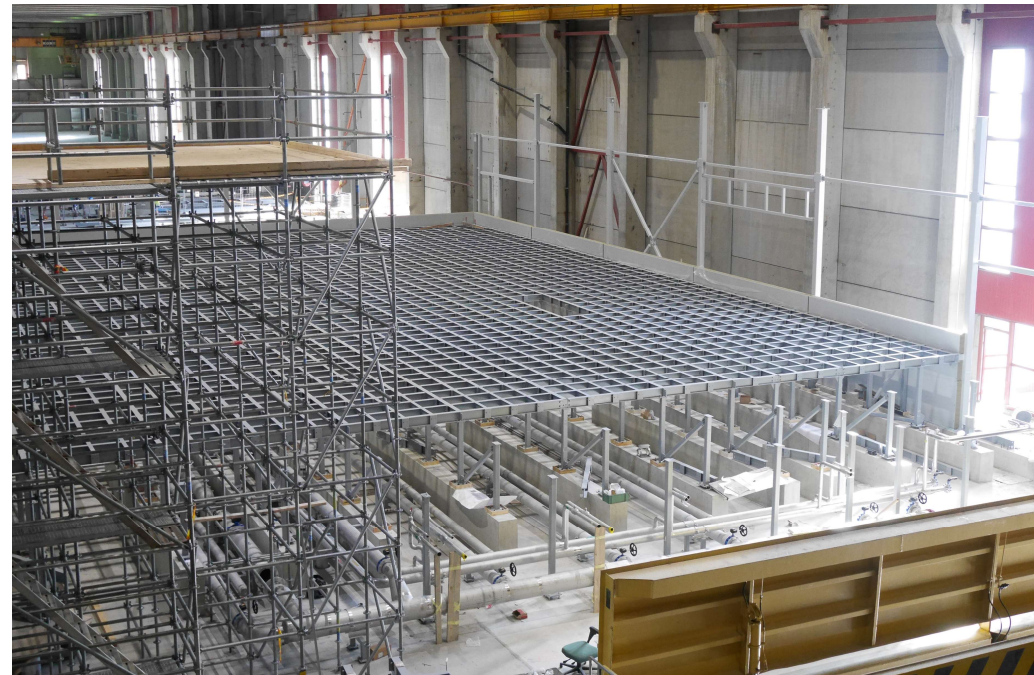
PPA contract lowest 25% in 2020

30 €

MWh

Waste heat impact to total cost of energy

~40 %



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Thank You!

<https://www.granlundgroup.com/finland/solutions/design/mission-critical/>

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