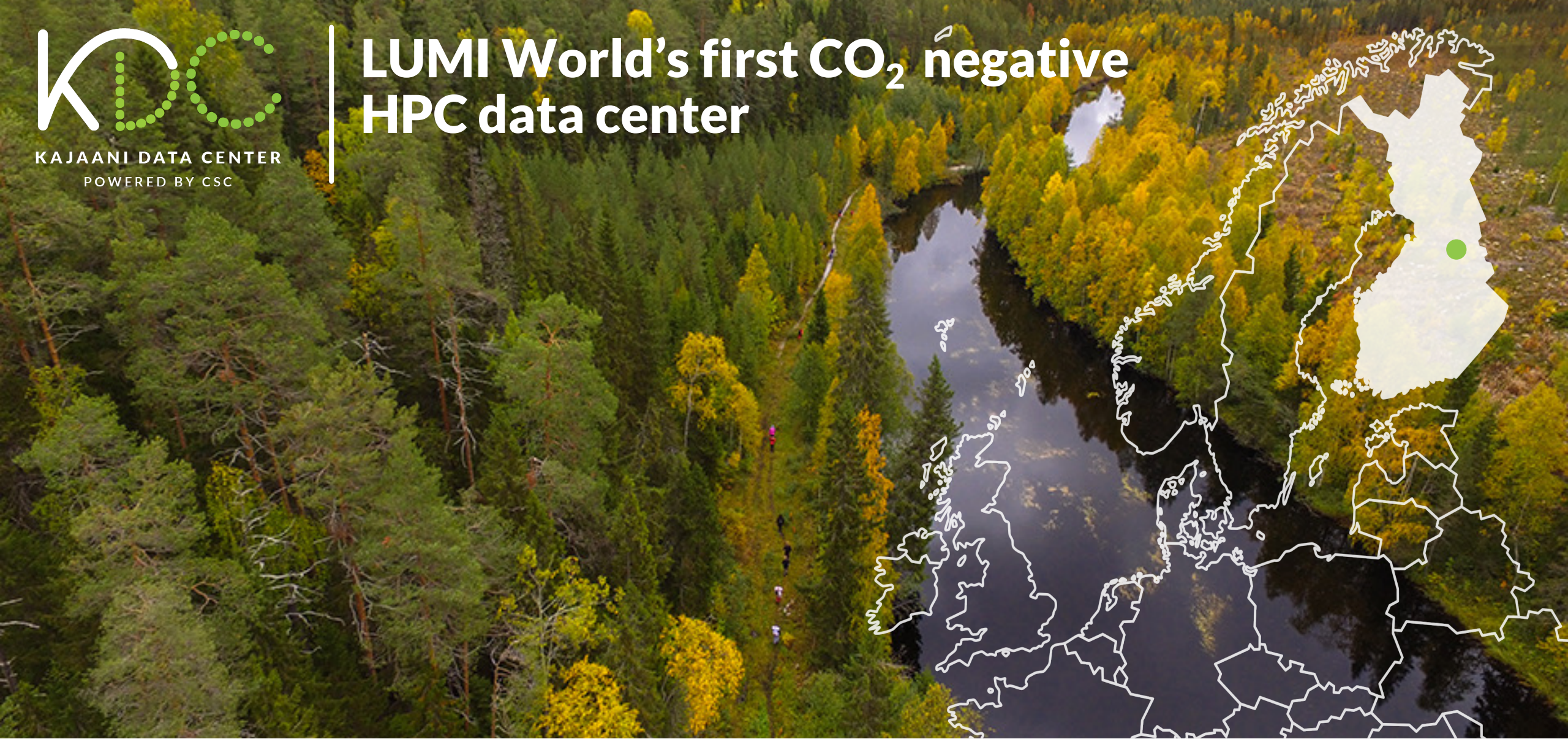


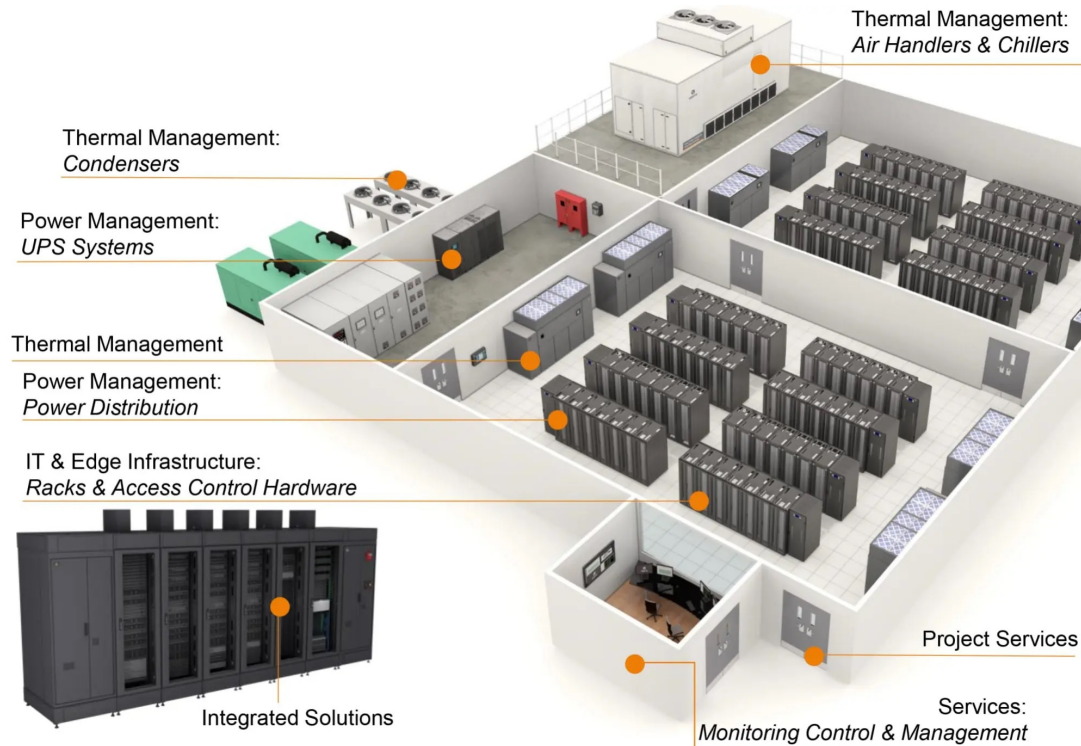


KAJAANI DATA CENTER  
POWERED BY CSC

# LUMI World's first CO<sub>2</sub> negative HPC data center



# HPC Data Center operation simplified



Source: Vertiv.

- Electricity in to run the hardware and supporting infrastructure
- Majority of the electricity used to compute will be transformed into heat, that needs to be cooled down one way or another (liquid or air-cooled devices)
  - Cool climate enables use of “free cooling”, meaning use of outside-air. No compressors or cooling liquids
  - Once the heat has been taken away from the hardware it needs to be transformed out of the facility
    - Liquid is much more efficient way to transport heat than air and enables more dense power distribution per m<sup>2</sup>
- Basically you have two options:
  1. Release the heat out of the building
  2. Find suitable use-cases that would utilise excess heat from data center

# HPC data center's carbon footprint



- Building phase
  - Greenfield vs. Brownfield
- Operations
  - Design & Efficiency (PUE)
  - Consumed electricity
  - Waste Heat utilisation (ERF)
  - Hardware "Science per watt"

$$\text{PUE} = \frac{\text{Total Facility Power (Cooling+Power+Lightning+IT)}}{\text{IT Equipment Power}}$$

$$\text{ERF} = \frac{E_{\text{Reuse}}}{E_{\text{DC}}}$$



# LUMI: Excess Heat Utilization Process Overview



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. Maximum heat output ~9,6 MW.

3x heat pumps that use renewable energy & COP ~4,6. Infrastructure payback time ~16 months.



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).

# Targets and indicators



## 13 CLIMATE ACTION



- **13.1** Strengthen resilience and adaptive capacity to climate-related hazards and natural disasters in all countries
- **13.2** Integrate climate change measures into national policies, strategies and planning
- **13.3** Improve education, awareness-raising and human and institutional capacity on climate change mitigation, adaptation, impact reduction and early warning
- **13.A** Implement the commitment undertaken by developed-country parties to the United Nations Framework Convention on Climate Change to a goal of mobilizing jointly \$100 billion annually by 2020 from all sources to address the needs of developing countries in the context of meaningful mitigation actions and transparency on implementation and fully operationalize the Green Climate Fund through its capitalization as soon as possible
- **13.B** Promote mechanisms for raising capacity for effective climate change-related planning and management in least developed countries and small island developing States, including focusing on women, youth and local and marginalized communities

# Communication & Promotion: “Things to consider”

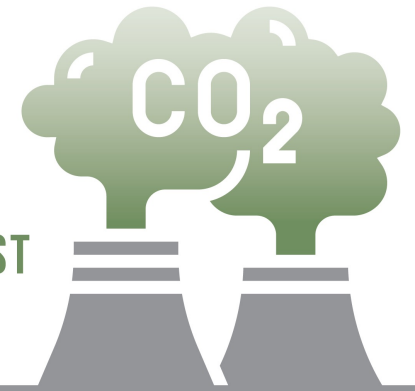


- **Use of renewable energy in HPC operations**
  - Certification, PPA, own solar panel energy production
  - National vs. local energy production portfolio
  - Making people aware that the HPC center can reduce global CO<sub>2</sub> -emissions in multiple ways
- **Enabling new renewable power production (wind+solar)**
  - Data centers can connect UPS -system to FFR -service, this enables addition of more in-frequent power production
  - HPC site's have the ability to cut-off power in the peak demand hours
- **HPC data center PUE -value**
  - Better PUE compared to enterprise data centers
  - 10 MW data center 5% PUE increase saves < 4000 MWh or equal to annual consumption of ~3 000 houses
- **Utilisation of waste heat / excess heat utilisation**
  - Ability to reduce overall CO<sub>2</sub> -emissions when you know the secondary process emission rate

ENERGY-RELATED  
CO<sub>2</sub> EMISSIONS  
INCREASED

6% IN 2021

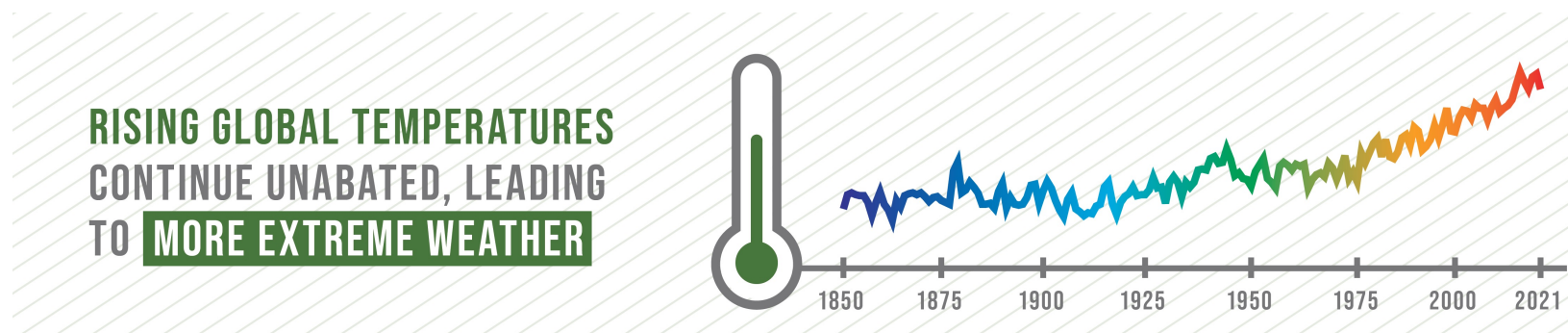
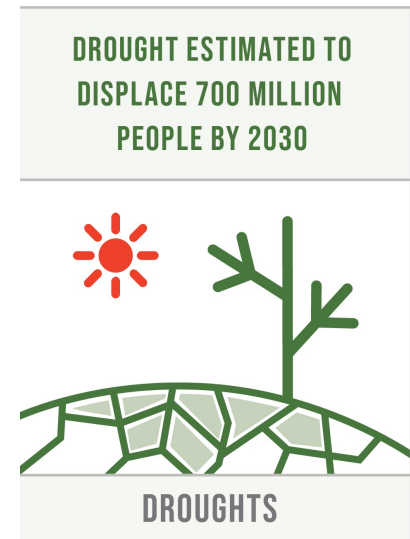
REACHING HIGHEST  
LEVEL EVER



# Communication & Promotion: “Things to consider”



- **Water usage in cooling process (WUE water usage effectiveness)**
  - Average Google data center uses 622 million litres of water annually\*
  - Google in Hamina uses annually 80 million m<sup>3</sup> of sea-water and releases the heated water back to the sea
  - In Nordics the use of water in cooling is marginal, not so common in Europe either?
    - If your facility doesn't use water in the cooling process this should be promoted
- **Utilisation of waste heat / excess heat utilisation**
  - Are you releasing your heat to atmosphere or using it somewhere else
  - Contributing to the local community



# Communication & Promotion

Note the variety of research activities that HPC is supporting

- HPC use is key to study and simulate the climate change
- Much more noble than looking newest social media updates or latest episode on streaming services
- **EU's Corporate Sustainability Reporting Directive**
  - Reporting duty will start next year
  - Includes all European data center operators also HPC centers
  - Comparability easier once everyone reports the same metrics
- **Use of existing buildings to retrofit data centers**
  - Building time CO<sub>2</sub> -emission savings
  - Good examples of circular economy

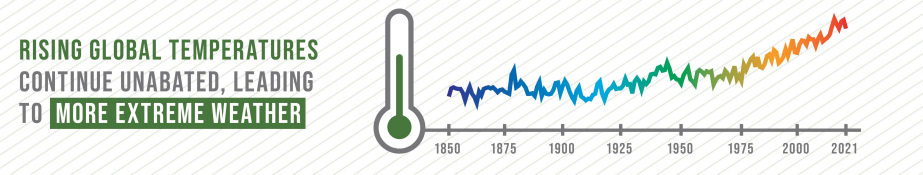
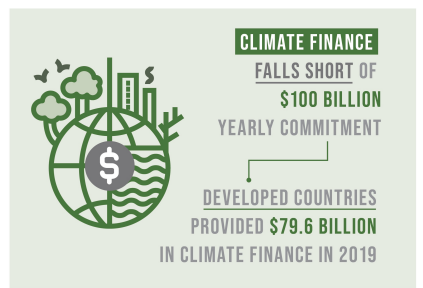
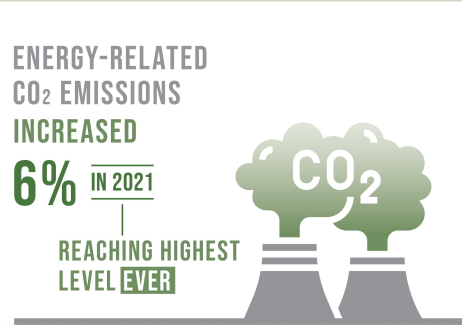
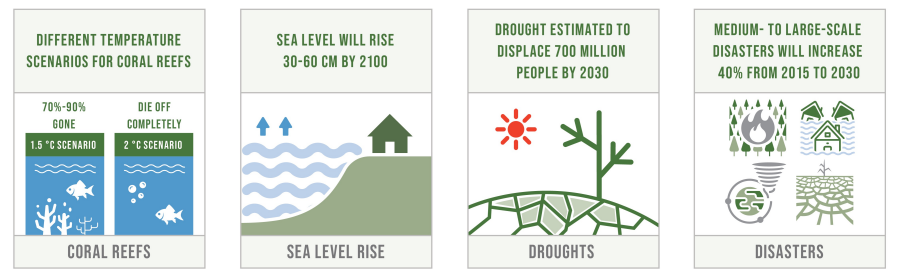
13 CLIMATE ACTION



## TAKE URGENT ACTION TO COMBAT CLIMATE CHANGE AND ITS IMPACTS



OUR WINDOW TO AVOID CLIMATE CATASTROPHE IS CLOSING RAPIDLY

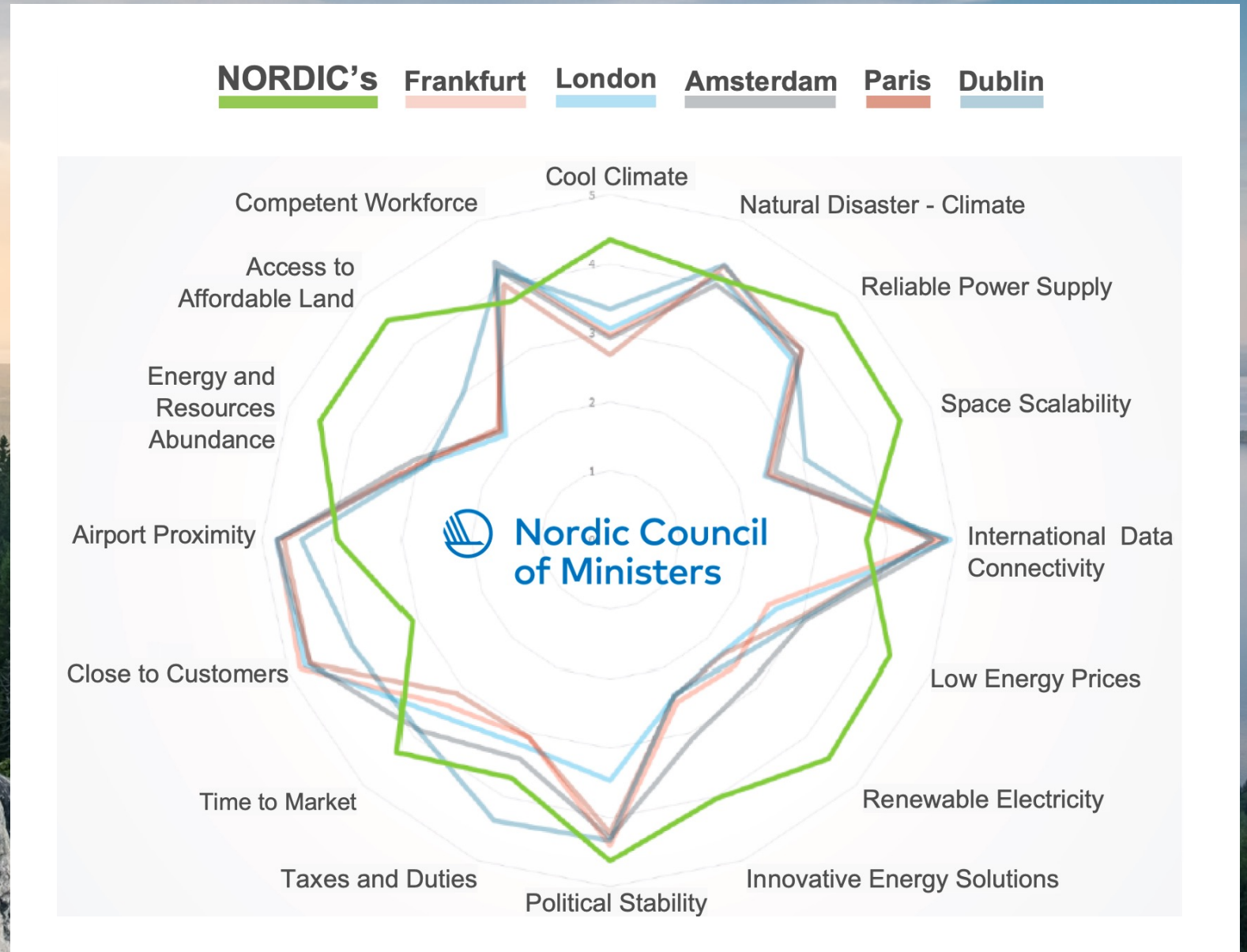




# Nordics value proposition of the Nordic region as a data center location

A score of five (5) indicates “very attractive”

Source: COWI, Analysis of Data Centre Investment Opportunities in the Nordic Countries (2018).  
*Data centre opportunities in the Nordics 31*



# Built-in sustainability for your data center



- CSC data centers in Kajaani are designed and operated to reduce global CO<sub>2</sub> emissions.
- Surplus of local green renewable energy sources available (wind & hydro)
  - **BEING GREEN** instead of **BUYING GREEN**
- Excess heat utilization reduces electricity costs and CO<sub>2</sub> emissions equivalent to 6.8 M kilograms of burned coal
- Reach CO<sub>2</sub> negative operations via excess heat utilisation

Renewable energy

**100%**

Hydro +100 MW | Wind +400 MW



footprint

**-12 400T**

Co<sub>2</sub> eq/emissions

LUMI produces

**20%**

of Kajaani's yearly  
district heat production

# Secure your time-to-market and future scalability



- Ready existing infrastructure in place to secure fastest time to market
- Multiple brownfield and greenfield options from 10 MW to 200 MW available
- Proven expertise in delivering large and complex data center projects
  - Technical and constructional know-how in place to build your data center in time and on budget
  - Data center operations expertise from local ecosystem
- Built in security processes and no risk of natural hazards

Brownfield

**+50 000 m<sup>2</sup>**

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

**ISO 27001**

security certification

# Reach the best total cost of ownership for your data center project



- Excess heat sales opportunity reduces total cost of energy
- Significant cost savings offered by the low cost electricity and the existing infrastructure
- Private electricity network in the area owned by the landlord UPM
- 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 in 2021

**<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 %**

# Kajaani site & LUMI EuroHPC information



## Kajaani:

### [Kajaani data center sustainability](https://www.youtube.com/watch?v=GUCVB0Z4B0s)

<https://www.youtube.com/watch?v=GUCVB0Z4B0s>

### [Kajaani Renforsin Ranta Business park](https://www.youtube.com/watch?v=IMC6zXQM4Uo&t=2s)

<https://www.youtube.com/watch?v=IMC6zXQM4Uo&t=2s>

## LUMI:

### [Making of LUMI part-1](https://www.youtube.com/watch?v=covoiGPdAwY)

<https://www.youtube.com/watch?v=covoiGPdAwY>

### [Making of LUMI part-2](https://www.youtube.com/watch?v=N0z0_6skUG8)

[https://www.youtube.com/watch?v=N0z0\\_6skUG8](https://www.youtube.com/watch?v=N0z0_6skUG8)

### [Making of LUMI part-3 & installation](https://www.youtube.com/watch?v=pWxBS_vcofA)

[https://www.youtube.com/watch?v=pWxBS\\_vcofA](https://www.youtube.com/watch?v=pWxBS_vcofA)

### [LUMI 1<sup>st</sup> phase system arrival](https://www.youtube.com/watch?v=g1laWuOZ26A&t=24s)

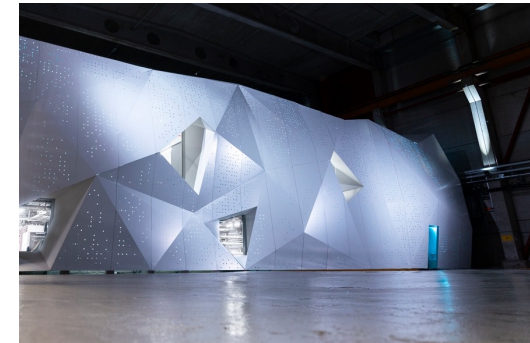
<https://www.youtube.com/watch?v=g1laWuOZ26A&t=24s>

### [LUMI Youtube channel](https://www.youtube.com/@LUMIsupercomputer)

<https://www.youtube.com/@LUMIsupercomputer>

### [LUMI world-class supercomputer](https://www.youtube.com/watch?v=gZrw58_Cu4g&t=39s)

[https://www.youtube.com/watch?v=gZrw58\\_Cu4g&t=39s](https://www.youtube.com/watch?v=gZrw58_Cu4g&t=39s)



# Contact Information

Kajaani data center location offering is promoted and negotiated by CSC - IT Center for Science Ltd. with the support of Kainuu Regional Council and City of Kajaani.

For more detailed information and promotion material contact us:



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IT Center for  
Science Ltd.



City of **Kajaani**



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