This project has received funding from the European Union’s Horizon 2020 research and innovation programme under grant agreement No 956059

SUSTAINABLE PLACES 2022

Transforming the server room into a sustainable micro cloud

ECO-Qube

Artificial-Intelligence-Augmented Cooling System for Small Data Centres

ecoqube

European Green Deal

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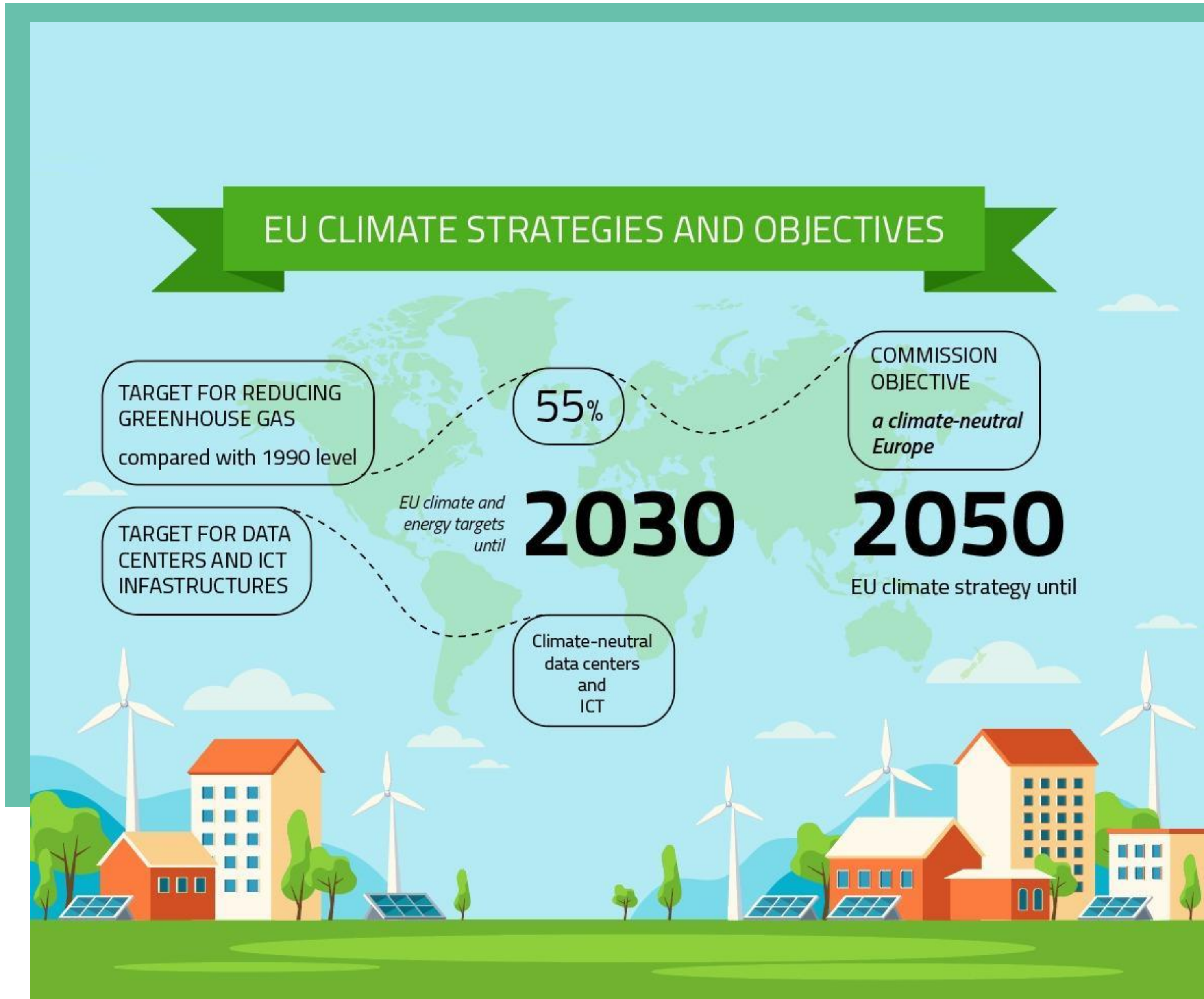
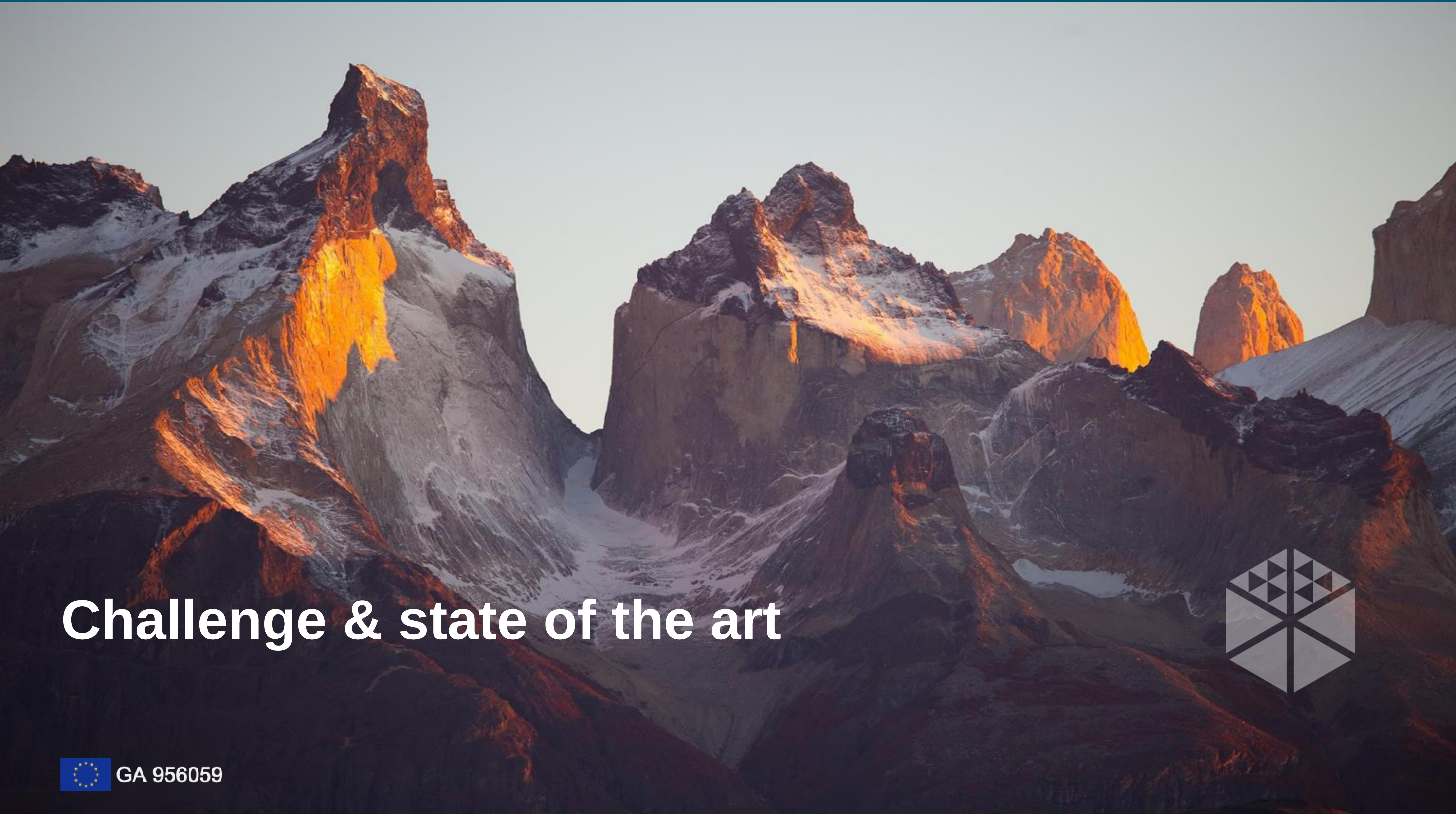
- no net emissions of greenhouse gases by 2050
- economic growth decoupled from resource use
- no person and no place left behind

Data centers are responsible for 2-3% of global electrical power consumption, expected to rise to 4-6% by 2022.





Challenge & state of the art

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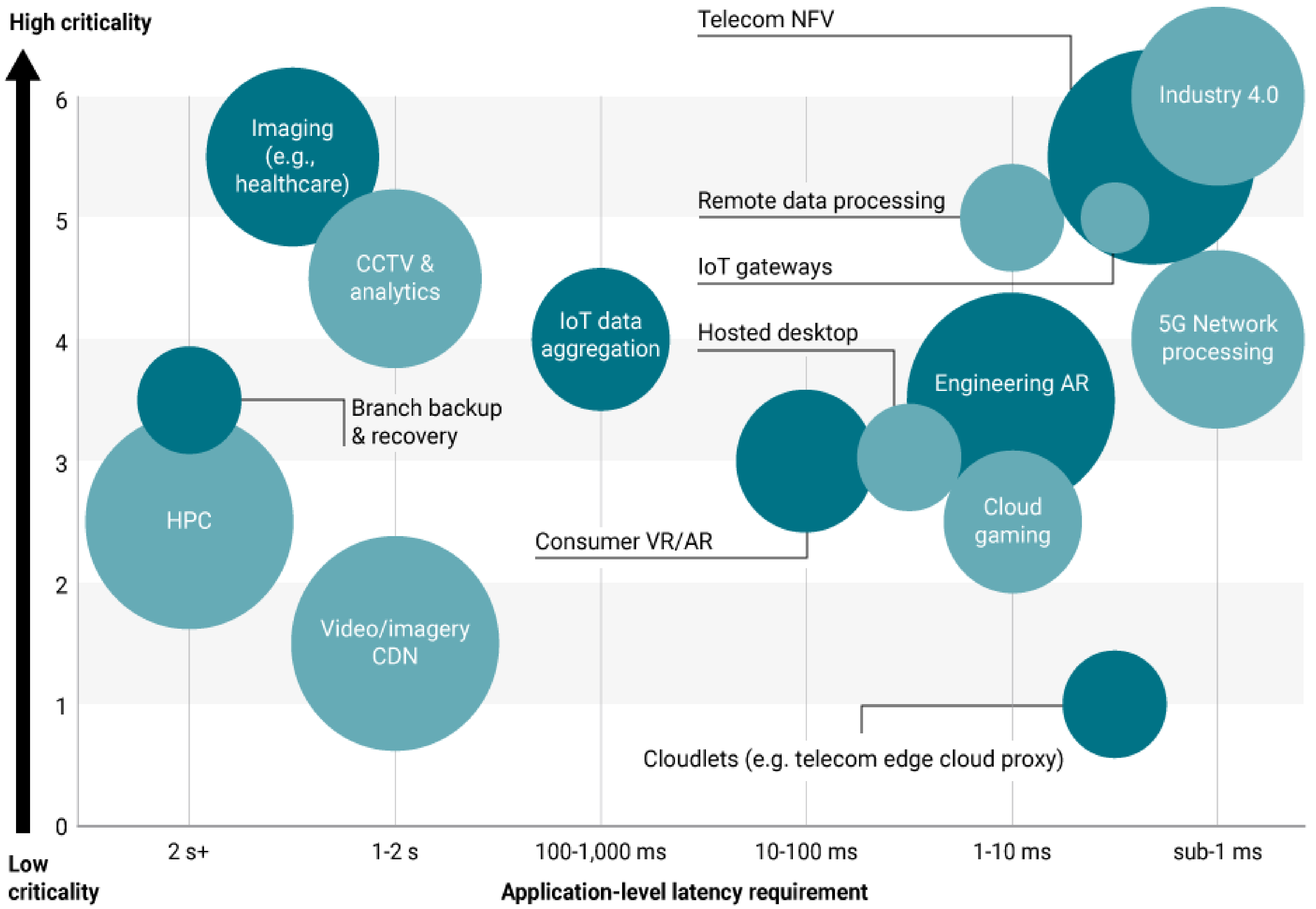
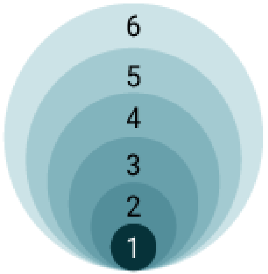


Score value	Volume / day / site	Criticality (availability of data or site)
6	100 TB+ (10 Gbps+)	0 downtime/extreme business risks
5	10-100 TB (1-10 Gbps)	few seconds/ high risks
4	1TB-10 TB (0.1-1Gbps)	few minutes / moderate risks
3	100-1,000 GB (10-100 Mbps)	few hours / low risks
2	10-100 GB (1-10 Mbps)	few days / little risk
1	10 GB (1 Mbps)	irrelevant / no risk

Key for volume/day/site



Uptime Institute Intelligence, 2021

UptimeInstitute | INTELLIGENCE

Edge workloads by latency, criticality and daily data volume

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Emerging digital trends – from artificial intelligence (AI) to augmented reality (AR), and 5G to the Internet of Things (IoT) – require lower latency, wide band connection and consequently forcing data centres to be located closer to end users.

*UptimeInstitute UI Intelligence Report 48: Demand and speculation fuel edge buildout

Evolution of the market

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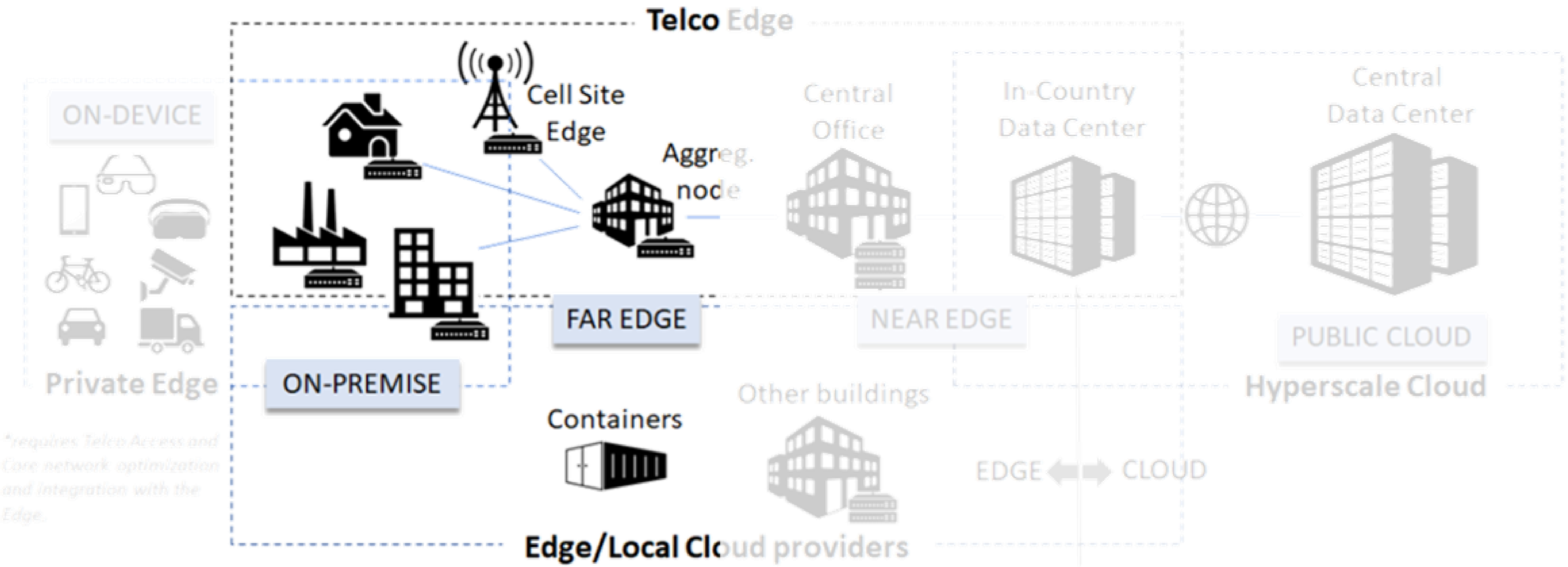
DC power	<20 kW	<50 kW	30-100kW	0,5-1 MW	5-20 MW	20-100 MW
Cost/MW				9 MEUR/MW	7 MEUR/MW	
Average latency *	1 ms	2-5 ms	5 ms	10 ms	< 20 ms	> 20 ms
# per market	100.000s	10.000s	100s	10s	<10	Units



[* European Industrial Technology Roadmap for the Next Generation Cloud-Edge Offering]

Challenges of edge computing systems:

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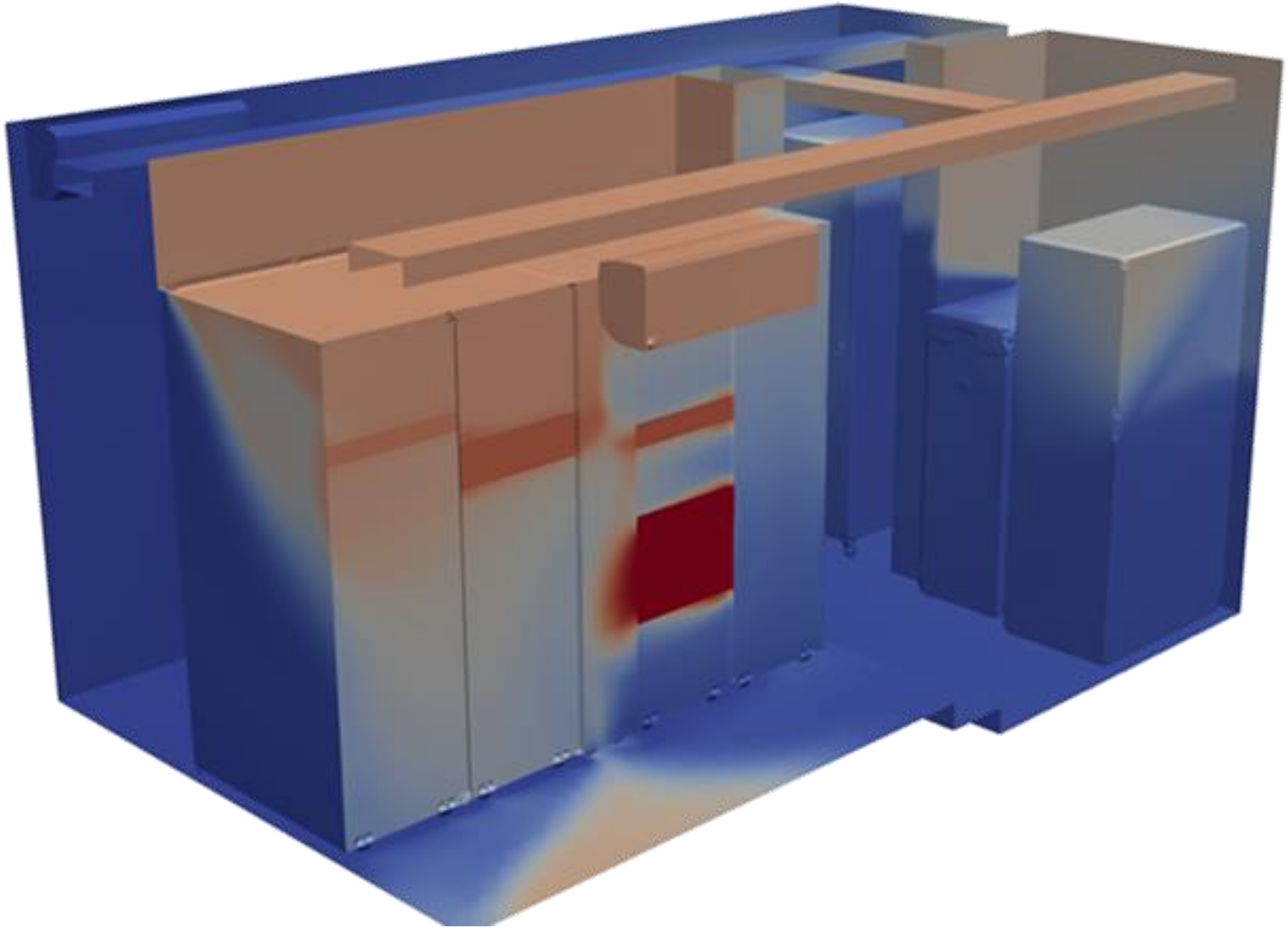
- We are not listening the data centers!
- All subsystems in data centers act individually (IT, cooling, power)!
- There is no holistic approach (hardware – software)!
- Most of the existing technologies are designed for hyperscalers/cloud!



ECO-Qube approach

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Future of data centre infrastructure management systems: ECO-Qube!

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$$PUE = E_{DC}/E_{IT}$$

$$ERF = E_{Reuse}/E_{DC}$$

$$REF = E_{Ren}/E_{DC}$$

$$REF = \frac{\sum_{i=1}^{n}(E_{DC\ grid-used\ i} \cdot \frac{E_{ren\ i}}{E_{tot\ i}} + E_{DC\ ren\ onsite\ i} + E_{DC\ ren\ cert\ i})}{\sum_{i=1}^{n} E_{DCi}}$$

$$PES = \frac{\sum_{i=1}^{n}[(E_{DCi} + E_{OthDCi})_{bas} - (E_{DCi} + E_{OthDCi})_{cur}]}{\sum_{i=1}^{n}(E_{DCi} + E_{OthDCi})_{bas}}$$

$$CO_2Savings = \frac{\sum_{i=1}^{n}[(CO2_{ei} + CO2_{Othi})_{bas} - (CO2_{ei} + CO2_{Othi})_{cur}]}{\sum_{i=1}^{n}(CO2_{ei} + CO2_{Othi})_{bas}}$$

$$CO_2Savings = \left[1 - \frac{CO2_{current\Delta t}}{CO2_{baseline\_adjusted\Delta t}}\right] * 100\%$$

$$Work\ per\ unit\ of\ energy = bops\ /\ Energy\ Consumption\ (W) * CPU\ Utilization$$

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Environmental Data Agent

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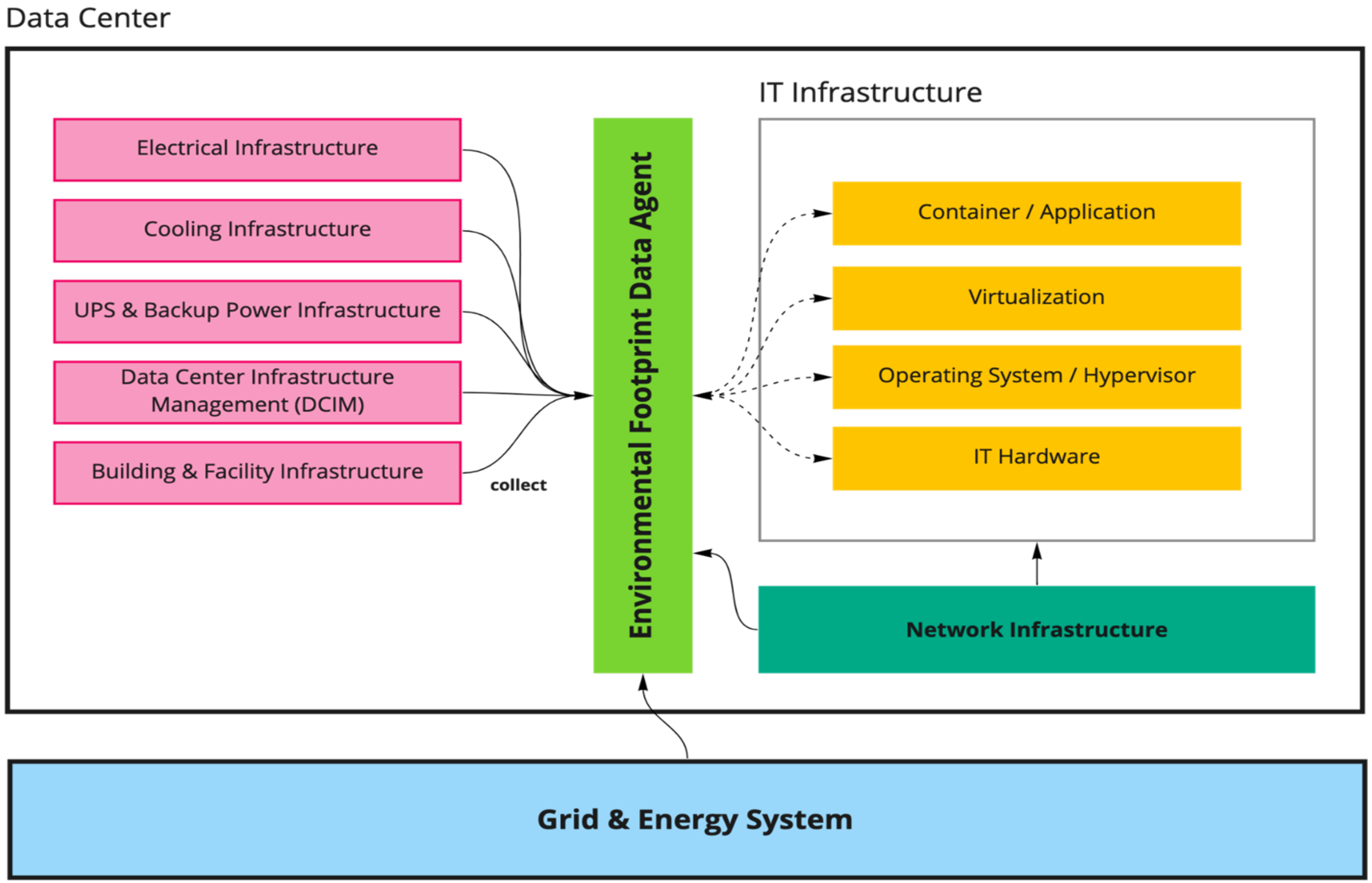
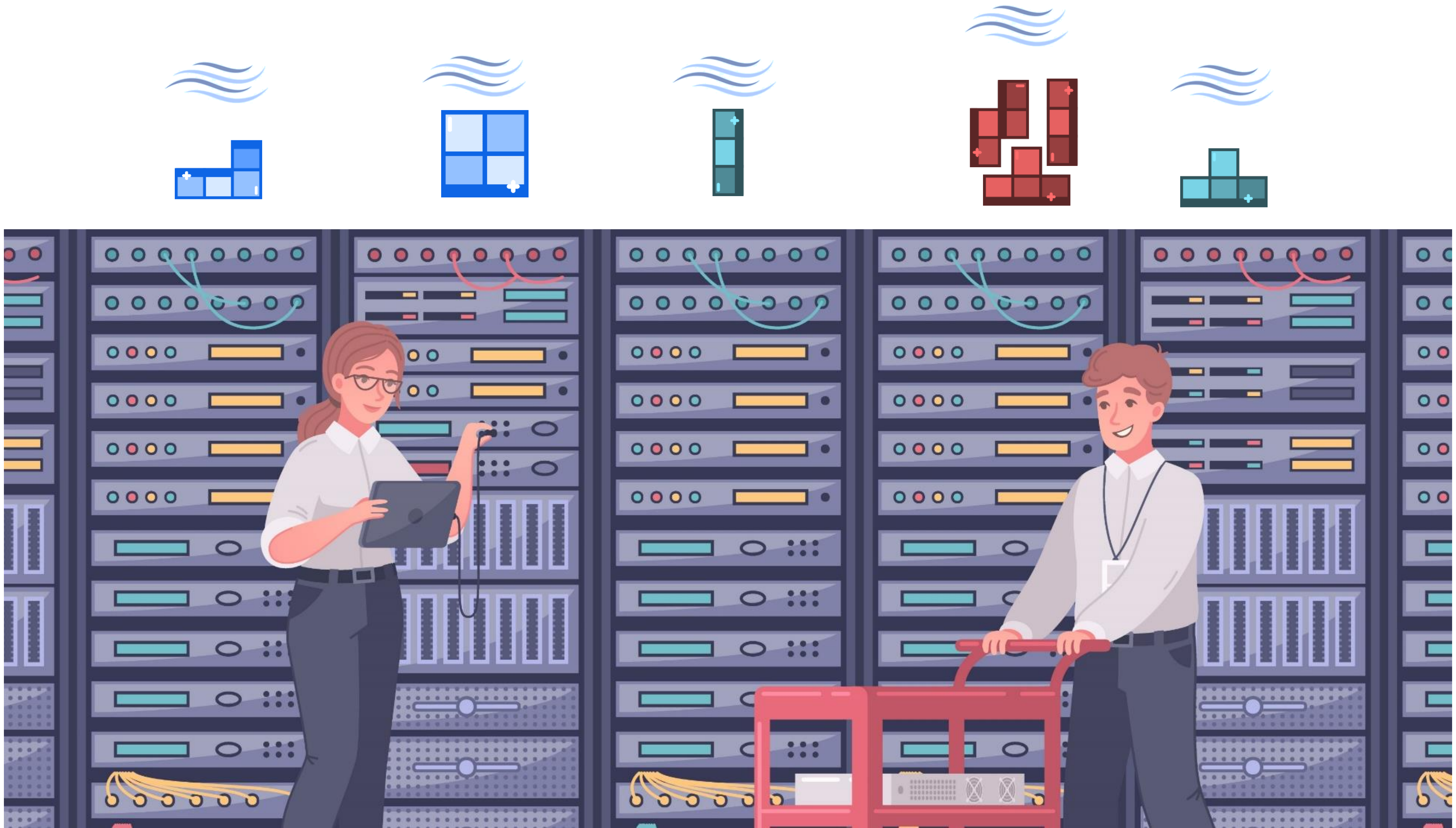


ECO-Qube



ECO-Qube

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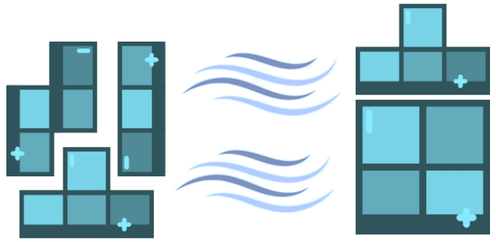

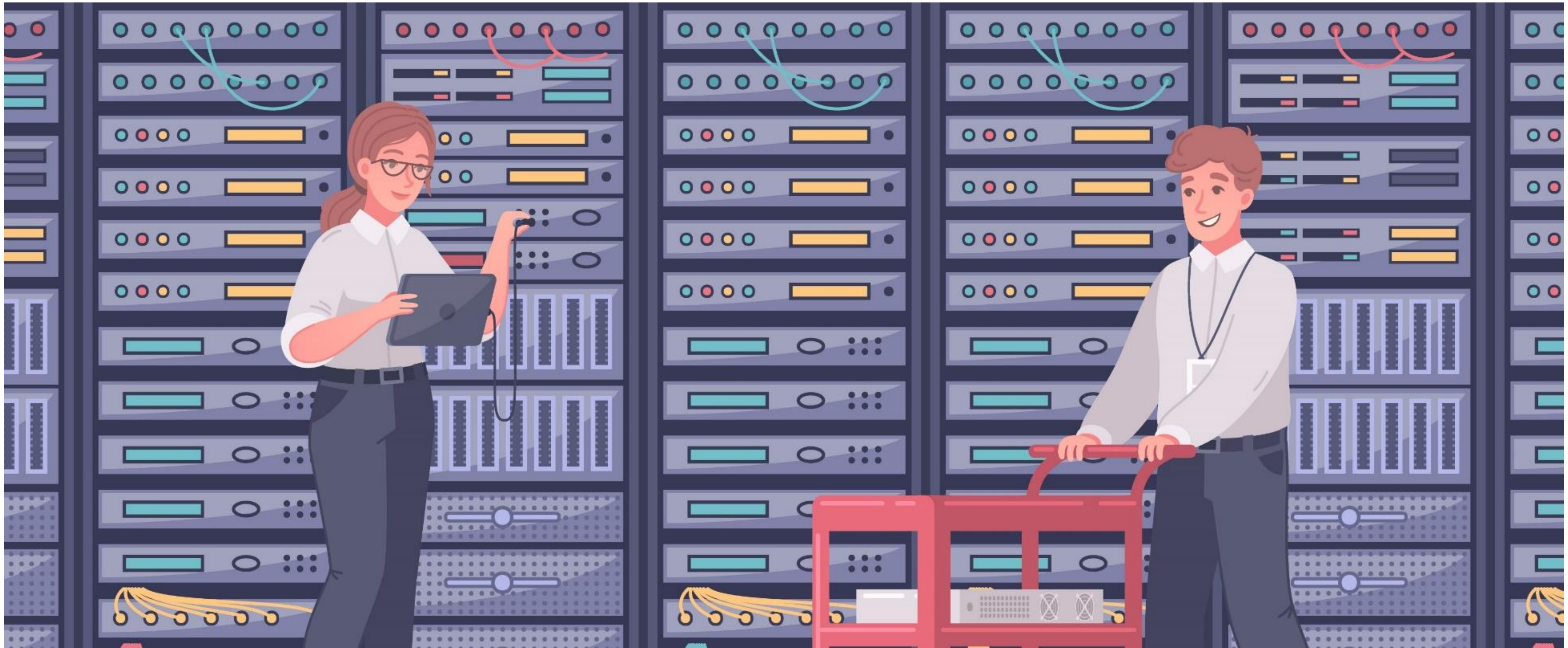

Supportive strategies

Empa

Materials Science and Technology

- Empa's energy research platform 'NEST' is the ideal micro-grid
- At NEST, new technologies, materials and systems are tested, researched, further developed and validated under real conditions

*Photographer: Roman Keller

Empa

Materials Science and Technology

ecoqube

Circular Economy Action Plan

The European Green Deal

OPEN Compute Project ®

- OCP ORV2 > EDGE (cooling + containment)
- Open source hardware for open science
- Customized refurbished rack compatible with the EU Circular Economy Action Plan

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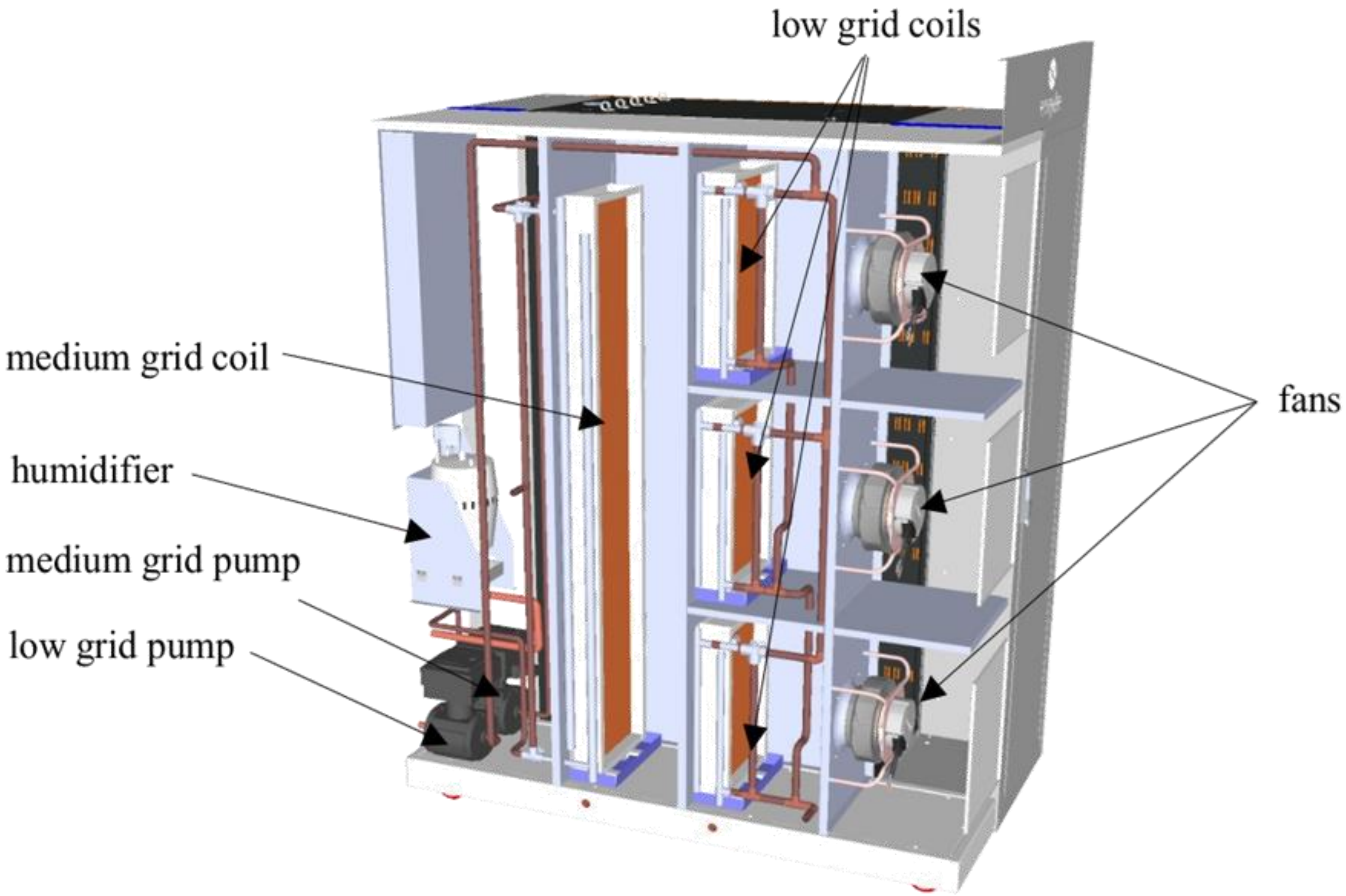
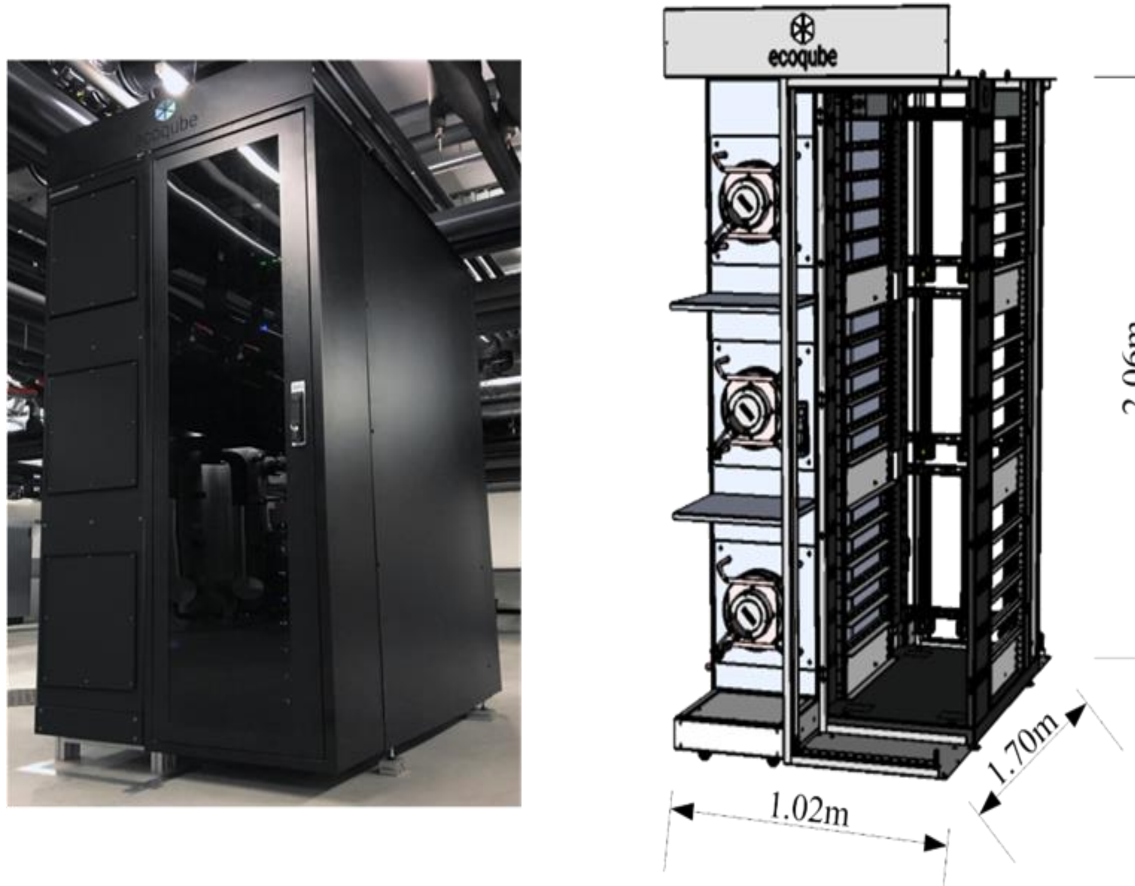
Zonal Cooling Concept (ZCC)





(a) (b)

Empa
Materials Science and Technology

ecoqube

High temperature grid (HTE)

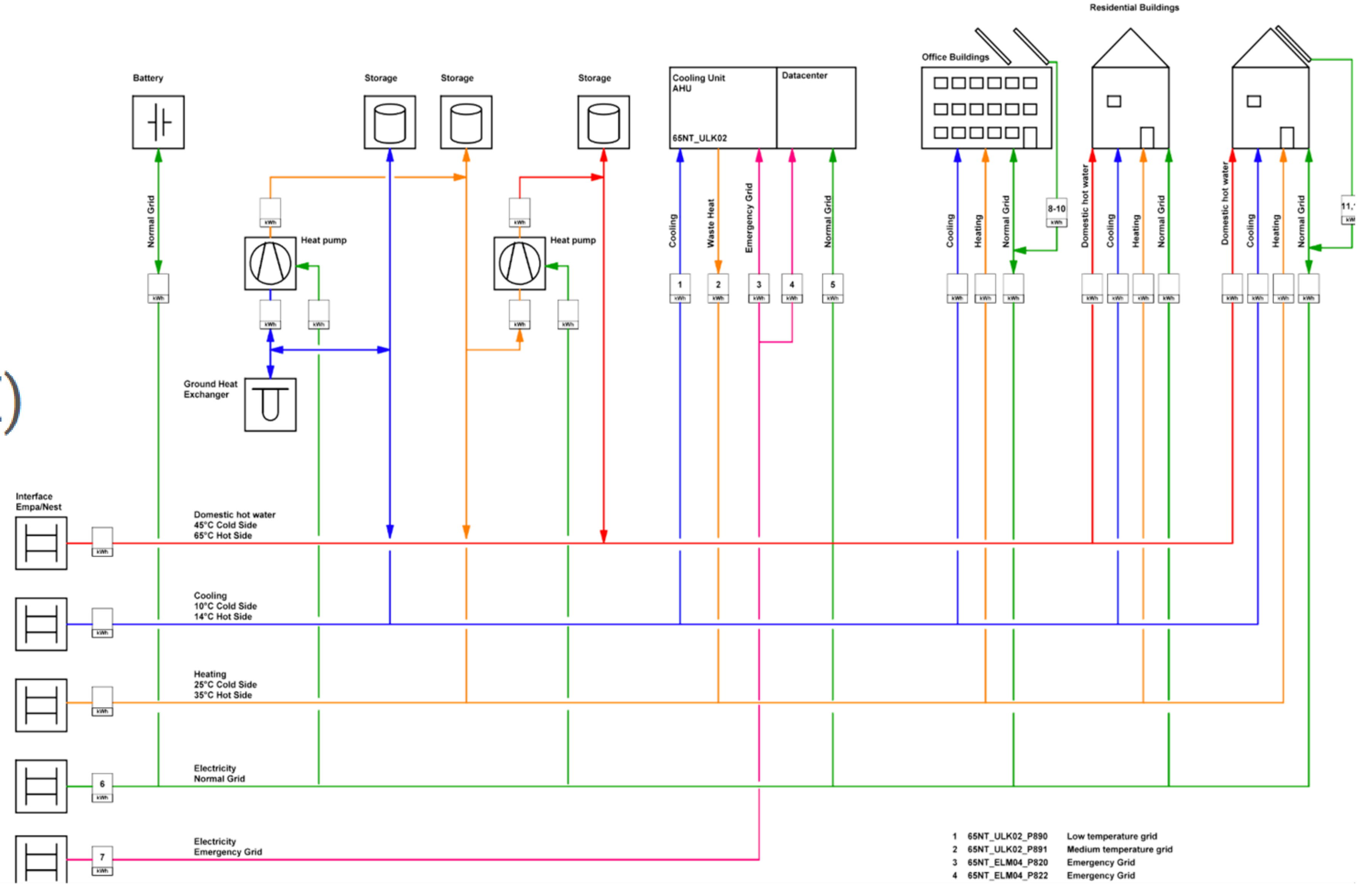
- Static
- Temperature High: 65 °C - 90 °C
- Temperature Low: 45 °C - 50 °C

Medium temperature grid (MTE)

- Static
- Temperature High: 35 °C - 38 °C
- Temperature Low: 25 °C - 28 °C

Low temperature grid (NTE)

- Static
- Temperature High: 14 °C - 28 °C
- Temperature Low: 7 °C - 12 °C



Empa
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Table 3.1 2021 Thermal Guidelines for Liquid Cooling

Equipment Environment Specifications for Liquid Cooling			
Liquid Cooling Class	Typical Infrastructure Design		Facility Water Supply Temperature, °C (°F)[a]
	Primary Facilities	Secondary/ Supplemental Facilities	
W17	Chiller/cooling tower	Water-side economizer (cooling tower)	17 (62.6)
W27			27 (80.6)
W32	Cooling tower	Chiller or district heating system	32 (89.6)
W40			40 (104)
W45	Cooling tower	District heating system	45 (113)
W+			>45 (>113)

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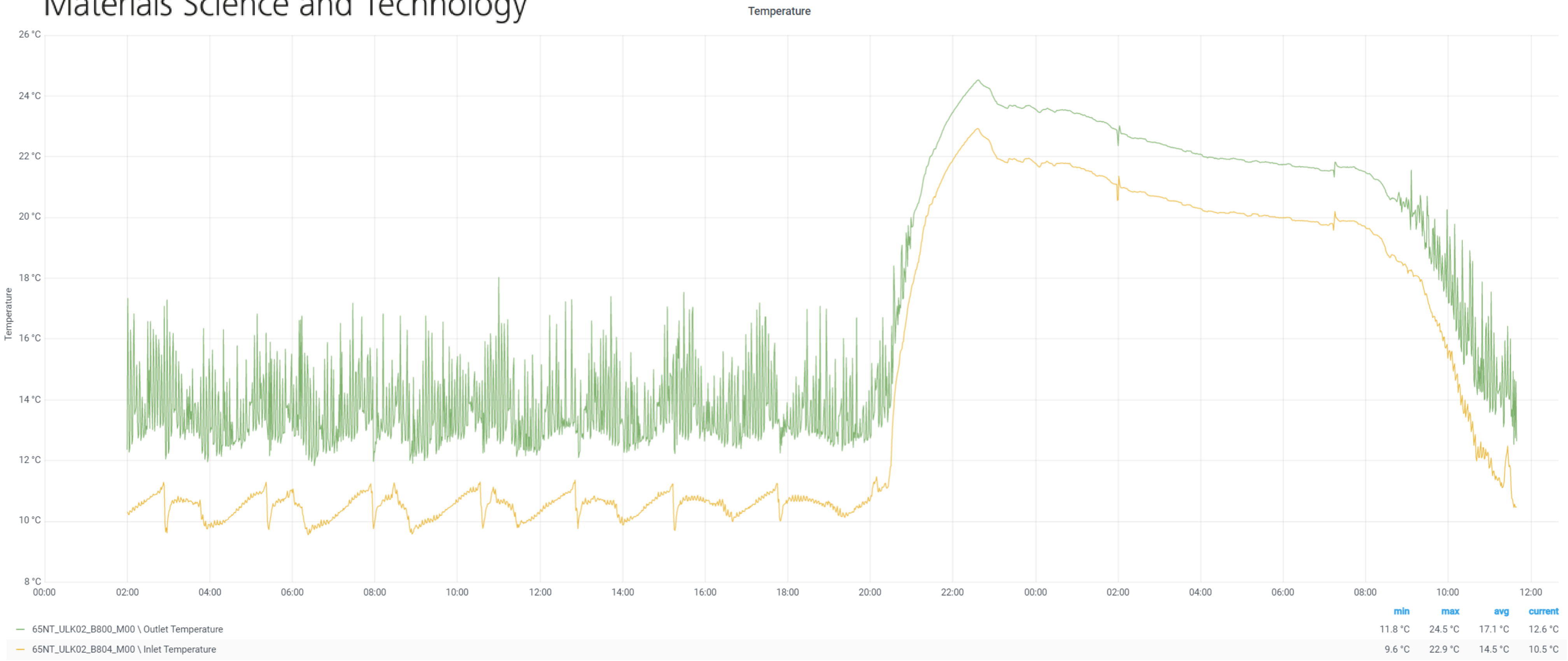
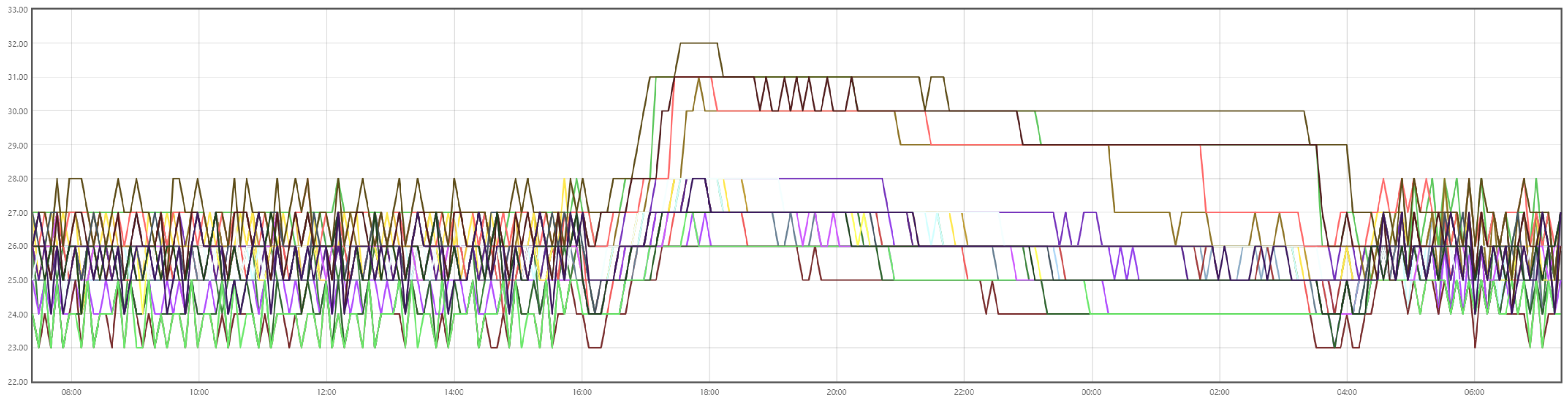


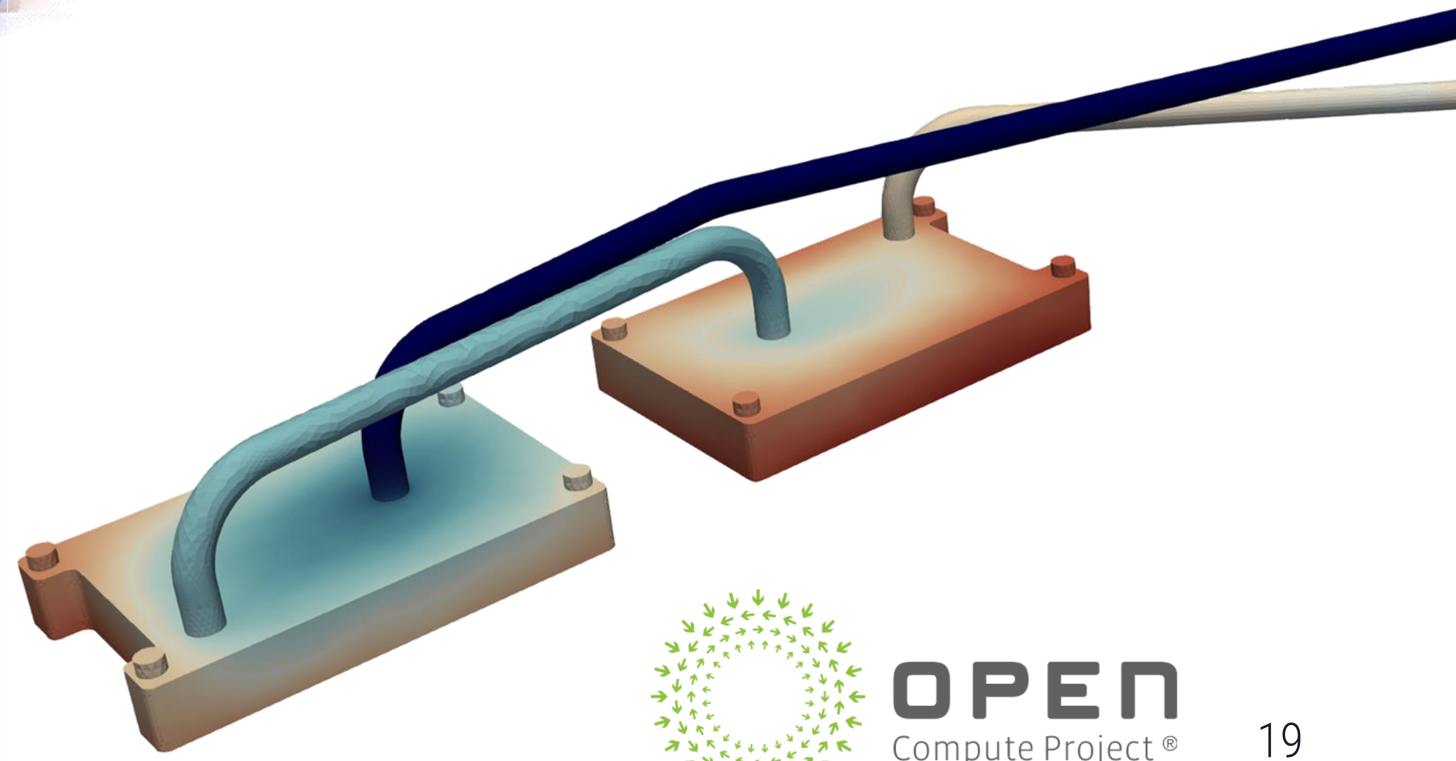


blockheating

ecoqube

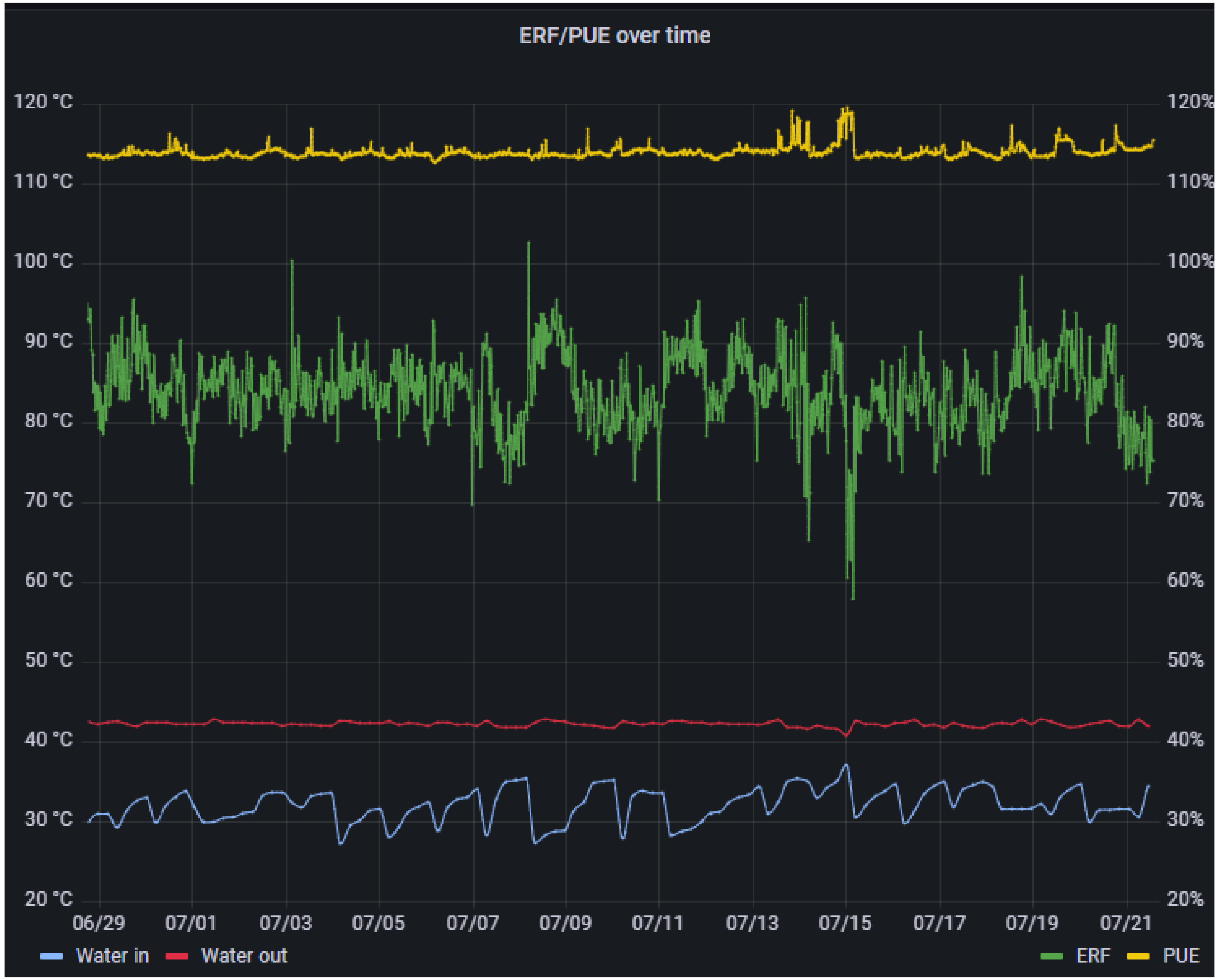
- Lower PUE
- Easier and efficient to use waste heat

Founded to minimize carbon footprint of IT infrastructure
Establishing sustainable data centres for agriculture environments
Waste heat of the datacentres turned into a useful heating source for green houses



OPEN Compute Project ®

Low IT load
25 kW /150 kW
PUE 1,12 > 22 kW IT
ERF 85% > 21,25 kW



Medium IT load
40 kW /150 kW
PUE 1,08 > 37 kW IT
ERF 90% > 36 kW

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www.eco-qube.eu

ECO-Qube newspaper

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