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SUSTAINABLE PLACES 2021

Sep. 28 - Oct. 1, 2021 | Rome, Italy

ECO-Qube

Artificial-Intelligence-Augmented System for Small Data Centres

29.09.2021

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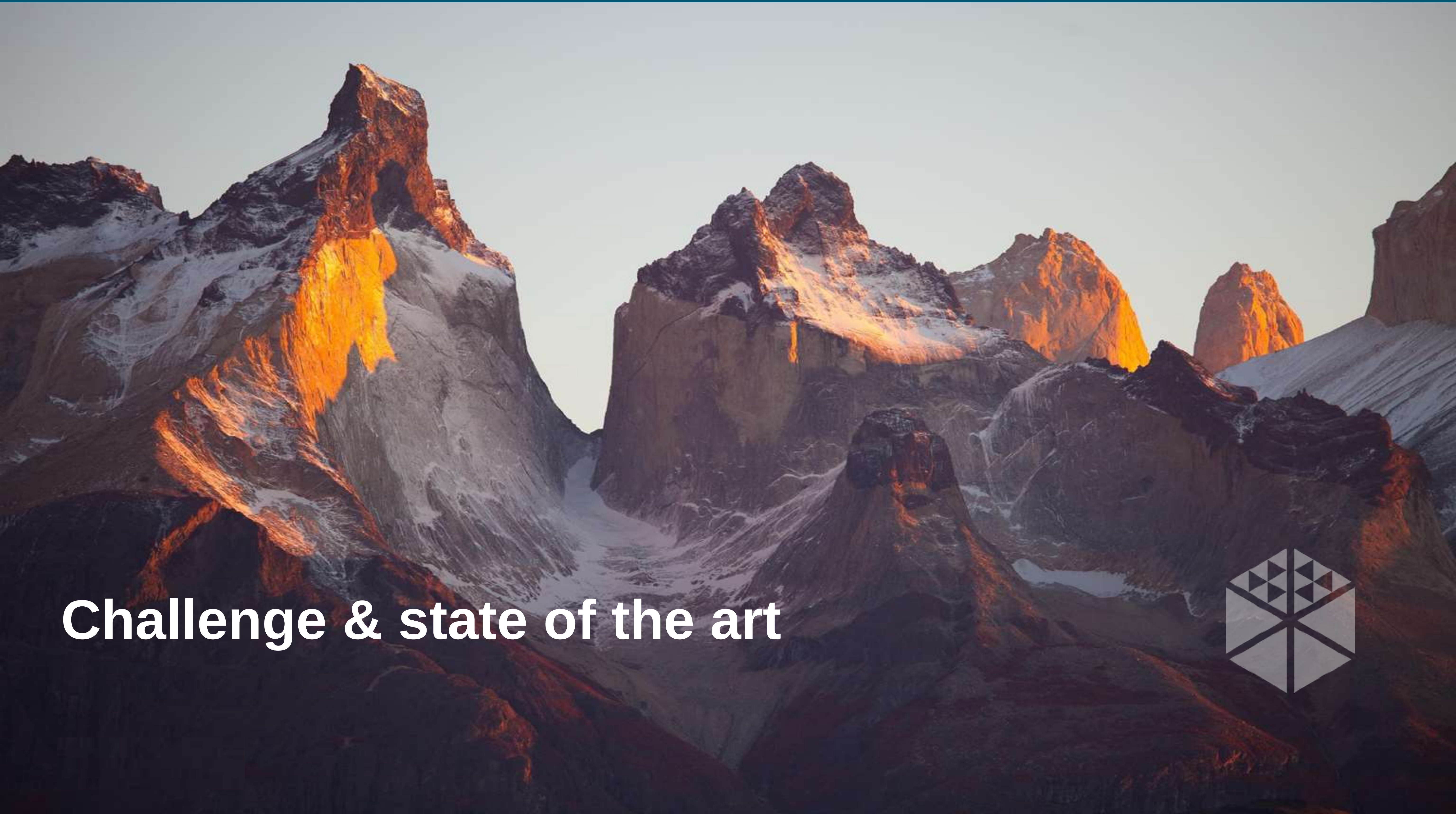
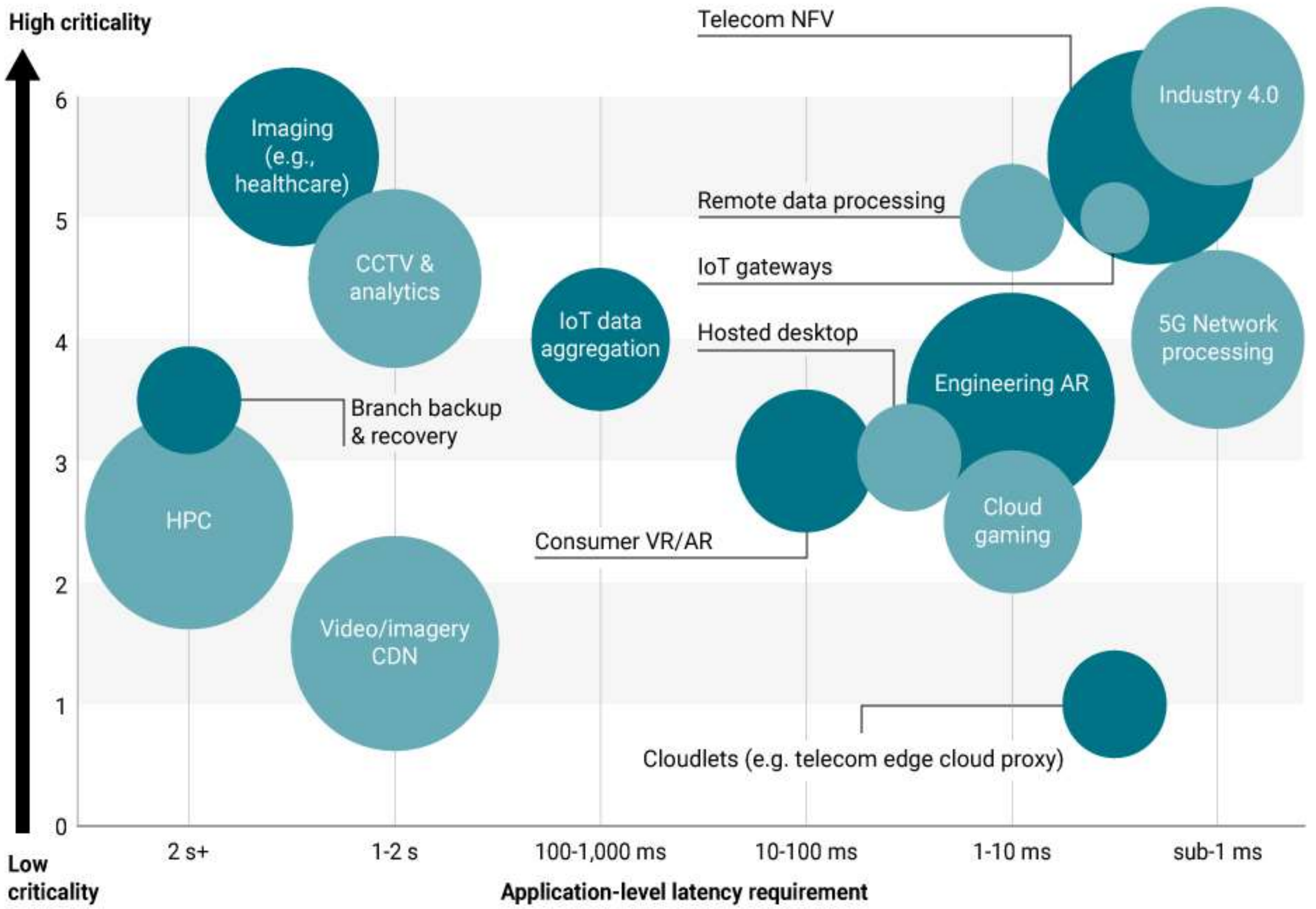


Challenge & state of the art



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

Raise of the edge computing

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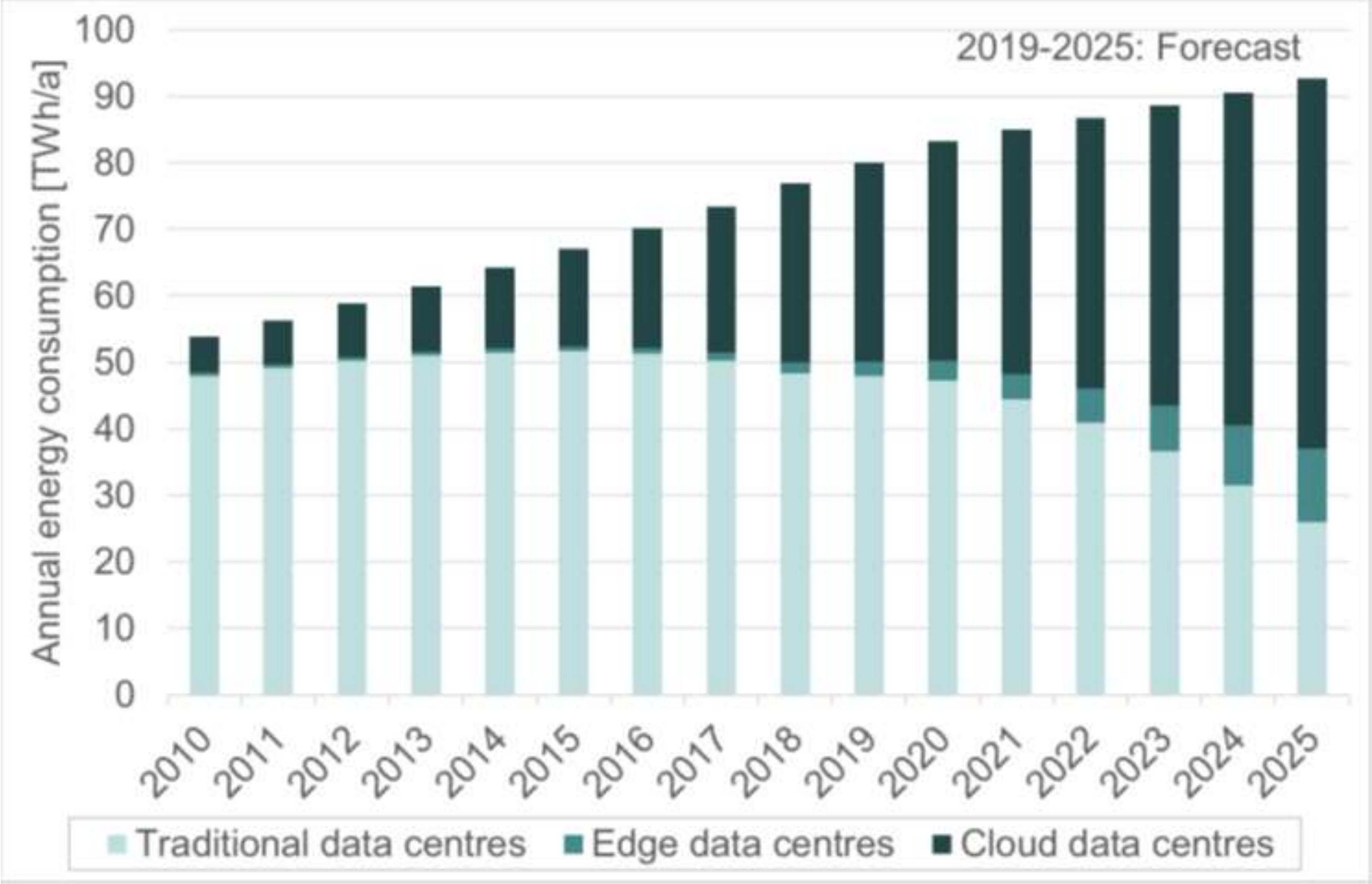
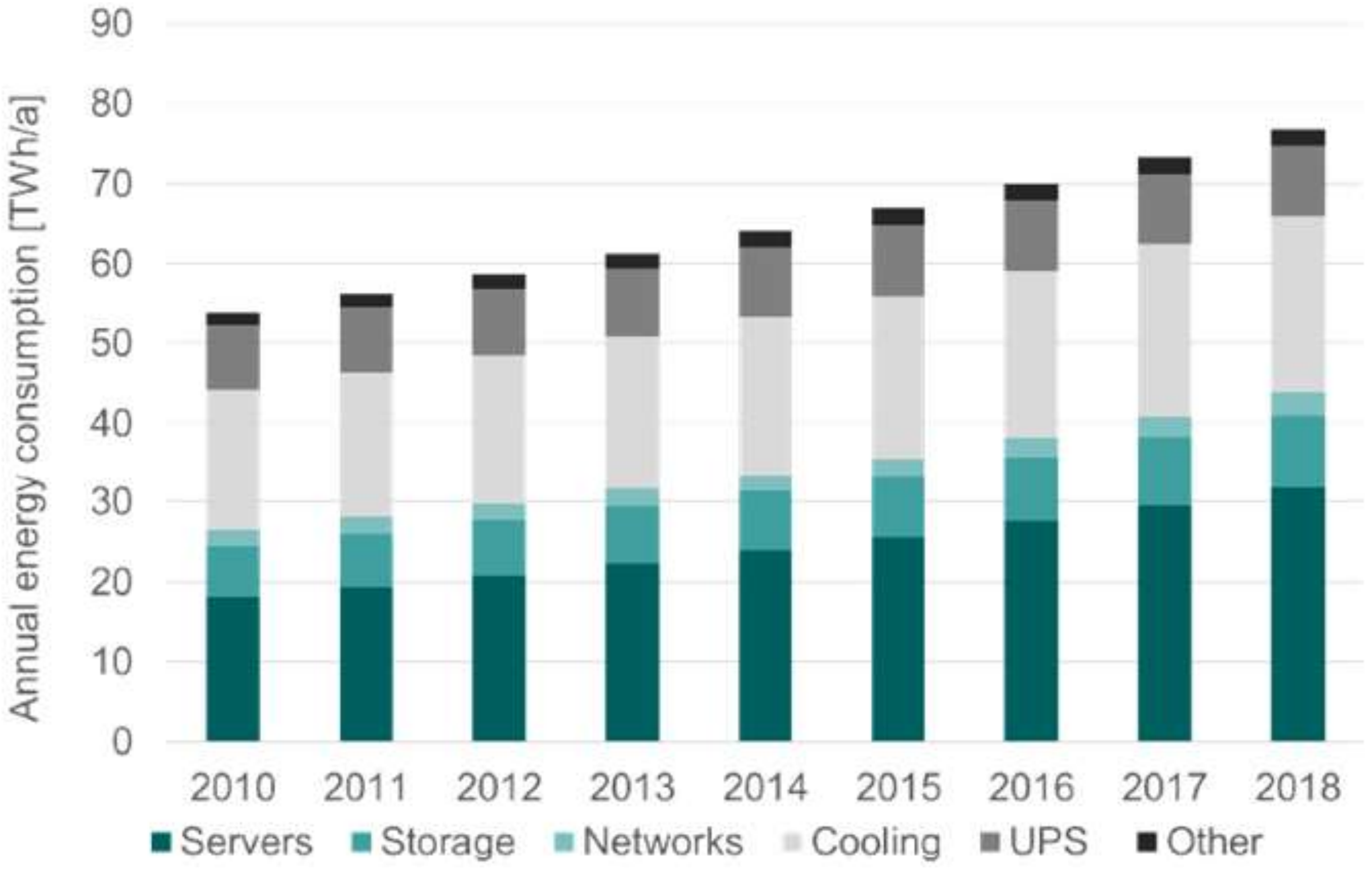


Hyper scale energy efficient data centres are becoming more and more common. However, smaller scale latency and security sensitive data centres are still irreplaceable because of the demand on edge computing and IoT applications.

*Annual enery consumption of data centres in EU28.

Enery-Efficiency Cloud Computing Technologies and Policies for an Eco-Friendly Cloud Market

Energy consumption characteristics of data centre components



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The EU Code of Conduct Data Centres Energy Efficiency identifies data centre cooling (which account for up to 40% of the energy demand) as frequently the largest energy loss in the facility and, as such, represents a significant opportunity to improve the energy efficiency.

*Annual energy consumption of data centre components.

Enery-Efficiency Cloud Computing Technologies and Policies for an Eco-Friendly Cloud Market

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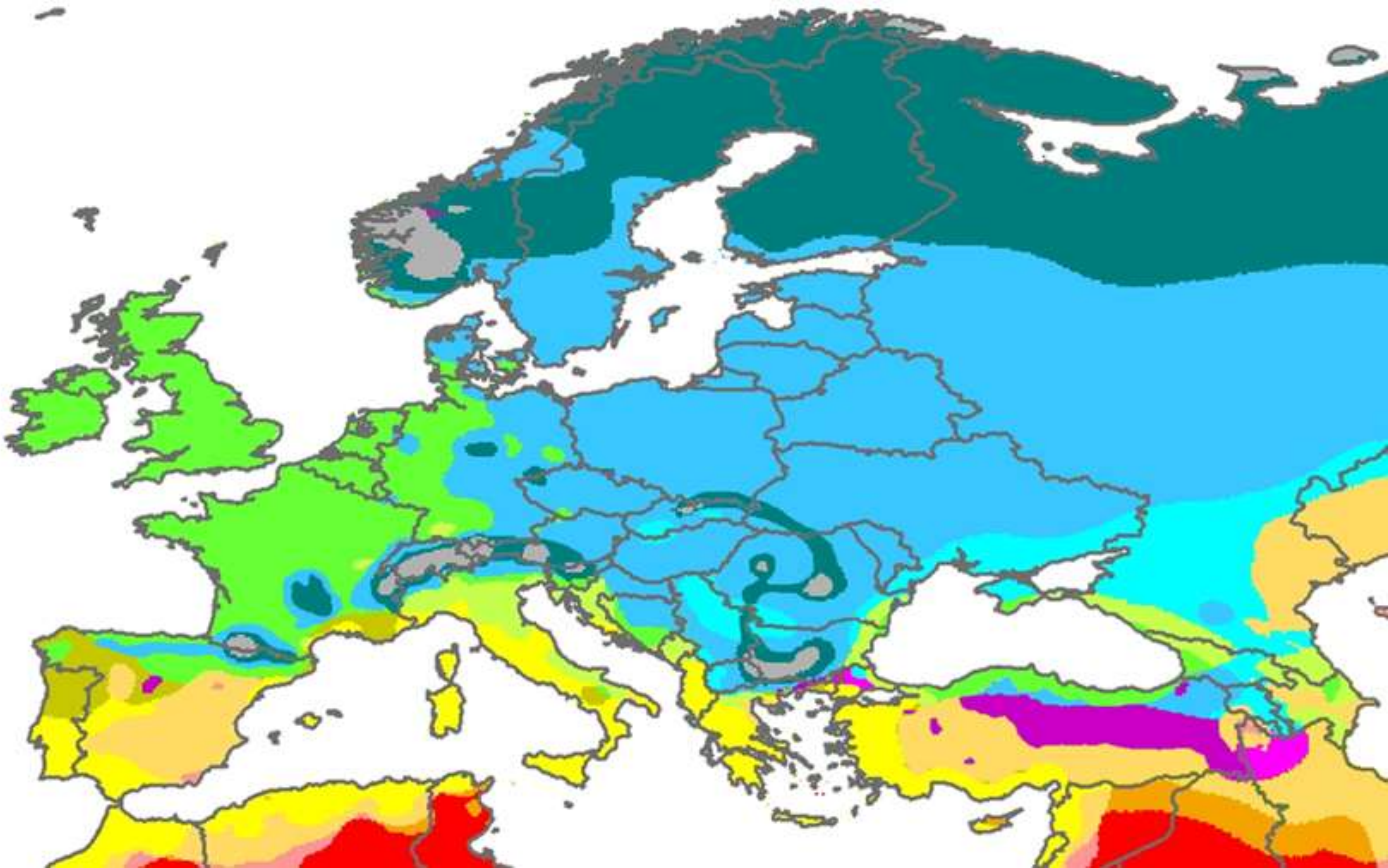
Problem analysis: Cooling efficiency in different climates



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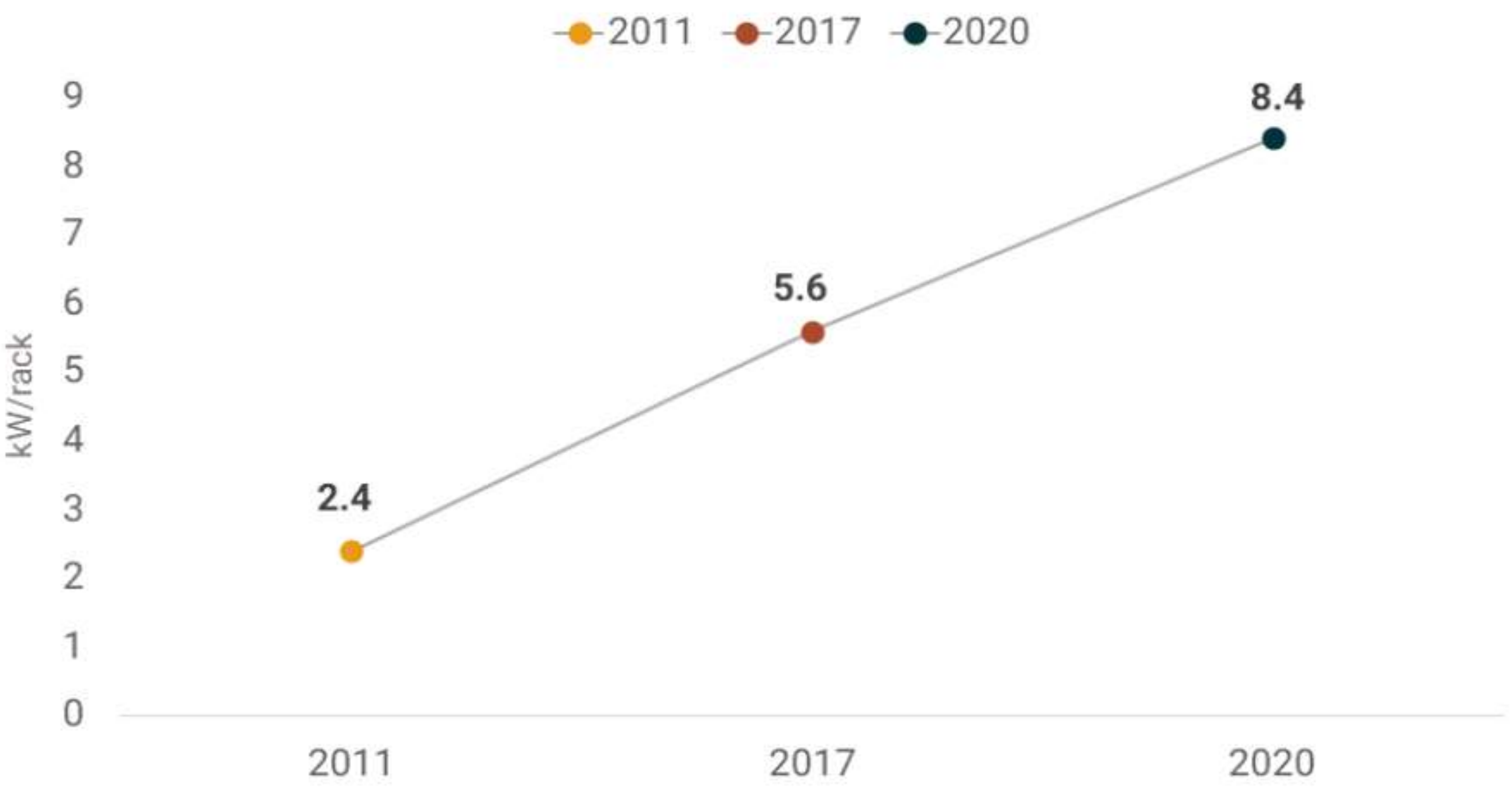
Rack power density



What is the overall average server rack density (kW/rack) deployed in your organization's data center(s)? Choose one.*

Challenge: Average power density per rack is more than tripled in the last decade, while cooling and power distribution technologies remain the same.

*Uptime Institute Global Data Centre Survey 2018

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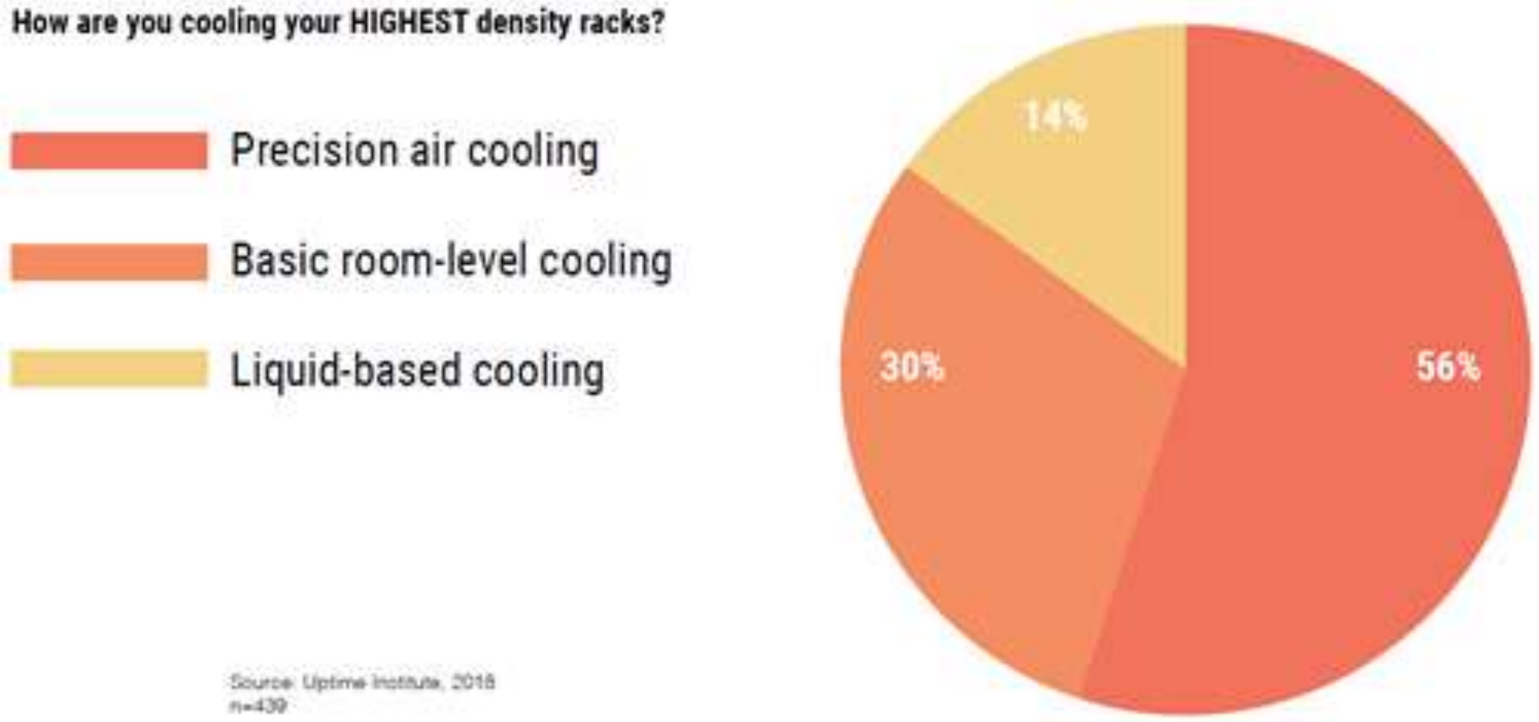
Cooling of data centres



Challenge: Recent survey showed that data centres are using mainly air for cooling; while only 14% is using liquid-based cooling, 56% is using precision cooling and 30% is using basic room-level cooling. This shows that air cooling systems are still being used by far the majority of the data centres. However, a significant percentage of the air cooling systems are not capable of precision cooling.

*Uptime Institute Global Data Centre Survey 2018

Data centre cooling

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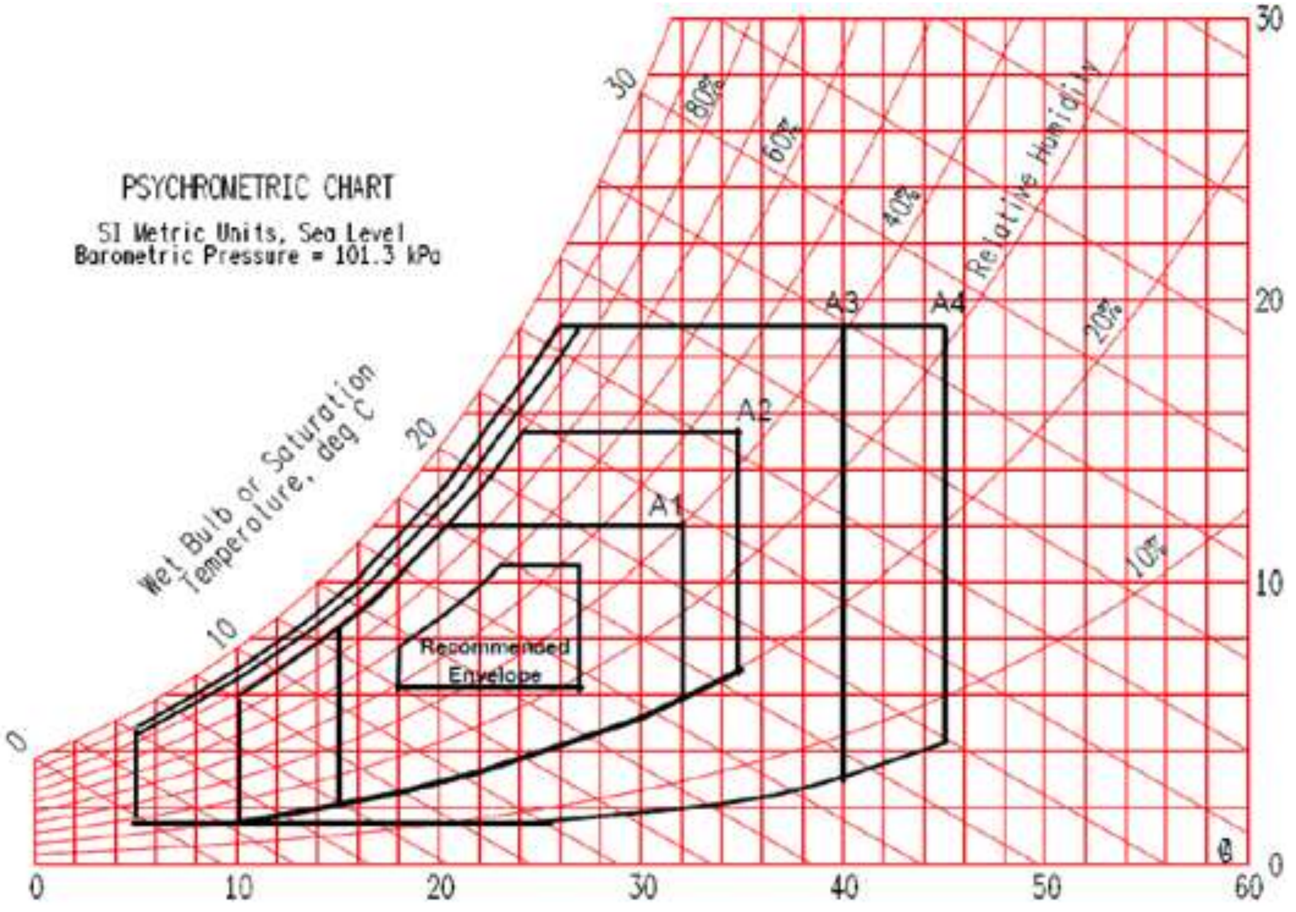
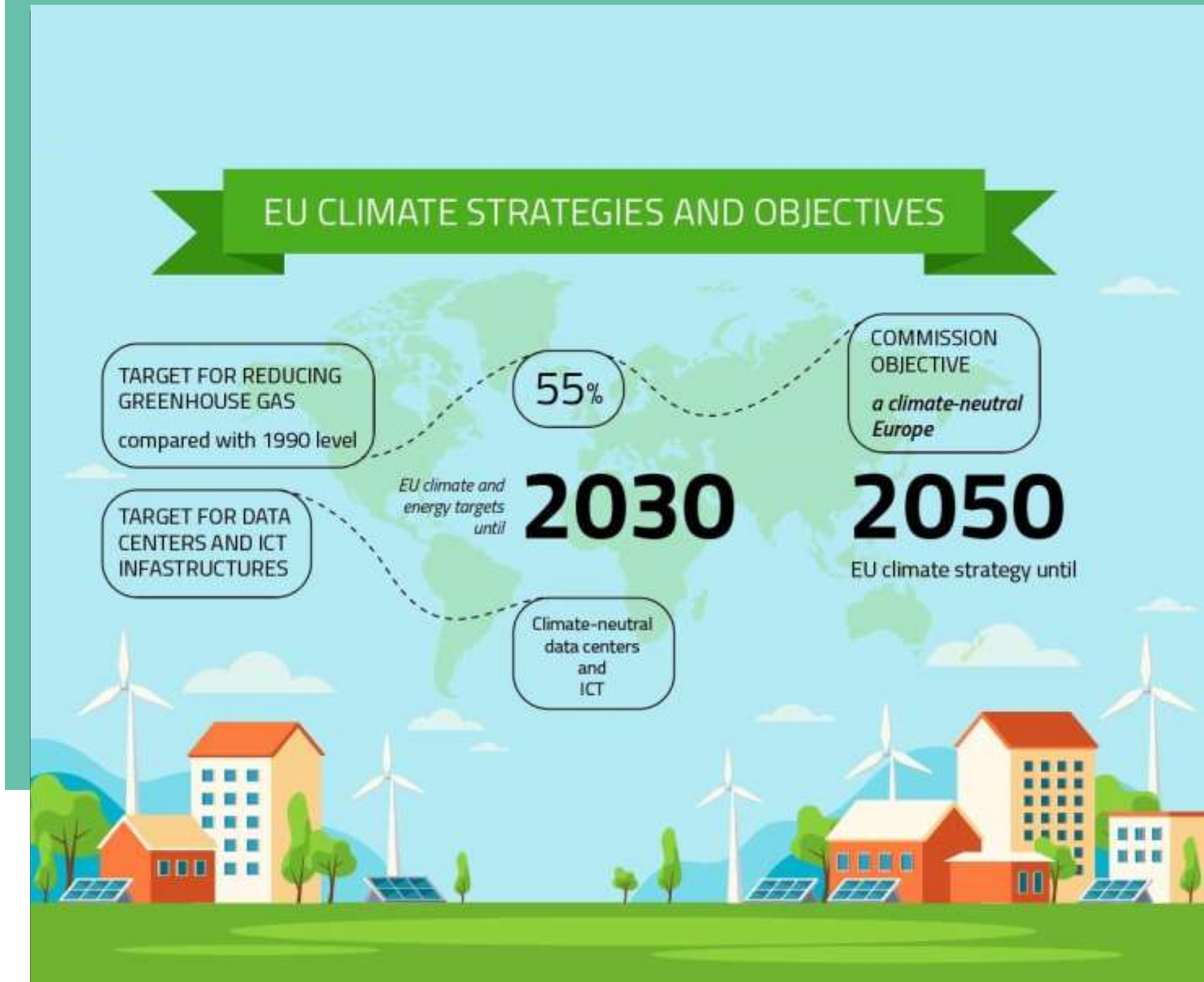


Conventional cooling systems keep operating temperatures within a strict interval and do not evaluate measurable cooling performance. This cooling approach relies solely on sensor readings and incapable of measuring cooling efficiency of IT components. Unmeasured cooling efficiency leads underperformed IT performance and consequently enhances overall energy consumption.

European Green Deal

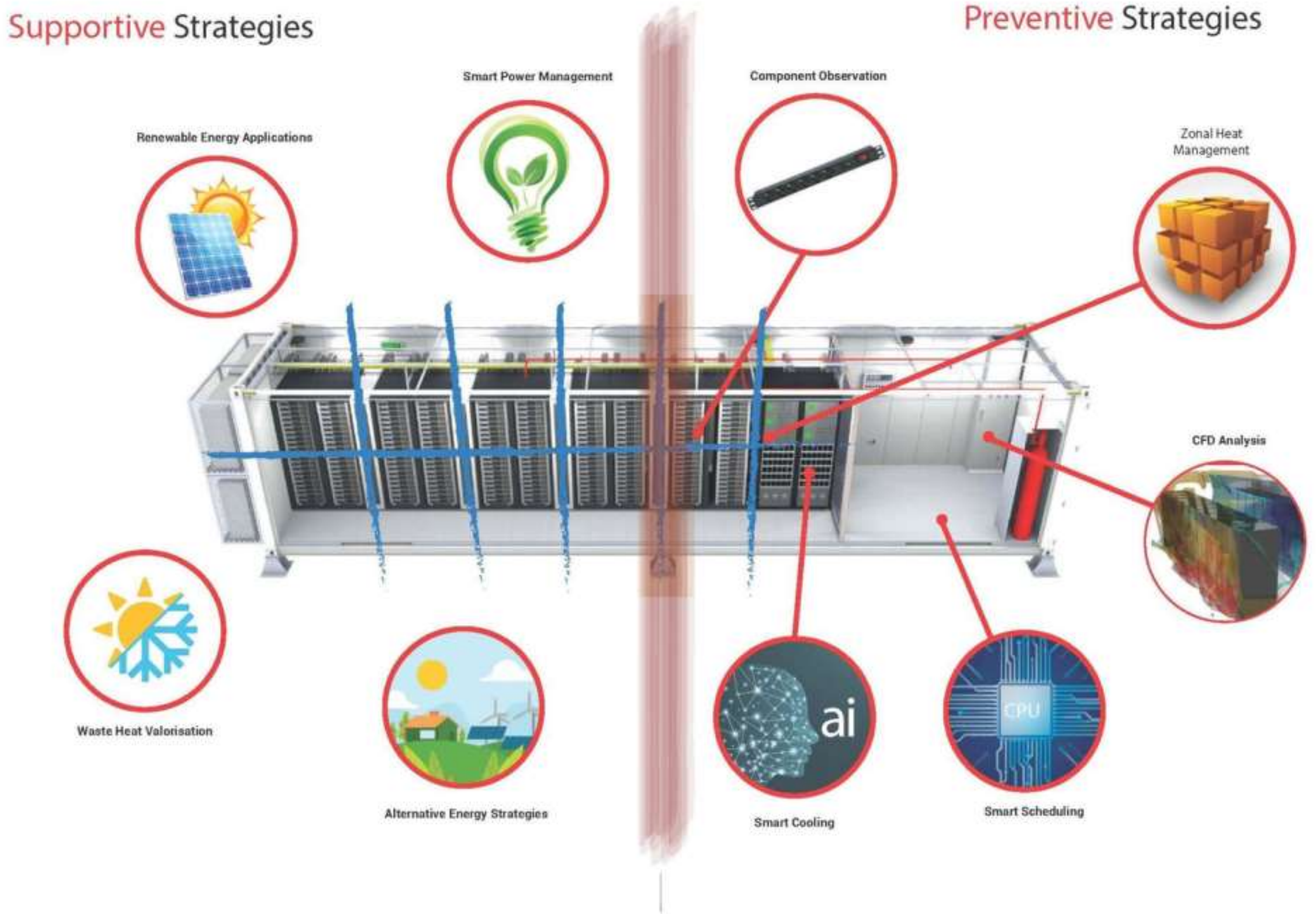
- no net emissions of greenhouse gases by 2050
- economic growth decoupled from resource use
- no person and no place left behind

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



ECO-Qube approach

Artificial-Intelligence-Augmented Cooling System for Small Data Centres - ECO-Qube



Preventive strategies

Data driven approach

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ECO-Qube is a data driven approach which utilizes valuable unused data from active data centre components. Created big data is being used by an artificial intelligence augmented system which detects cooling and energy requirements instantaneously.

Continuous performance assessment

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

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

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

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

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

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

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

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

Created big data is being used to detect cooling and energy requirements instantaneously. This allows ECO-Qube to take the required steps to enhance energy efficiency regarding to multiple efficiency metrics like Power Usage Effectiveness Ratio, Work Per Unit of Energy, Primary Energy Savings, CO2 Savings, Renewable Energy Factor, Energy Reuse Factor and other cooling efficiency metrics.

Computational Fluid Dynamics simulations

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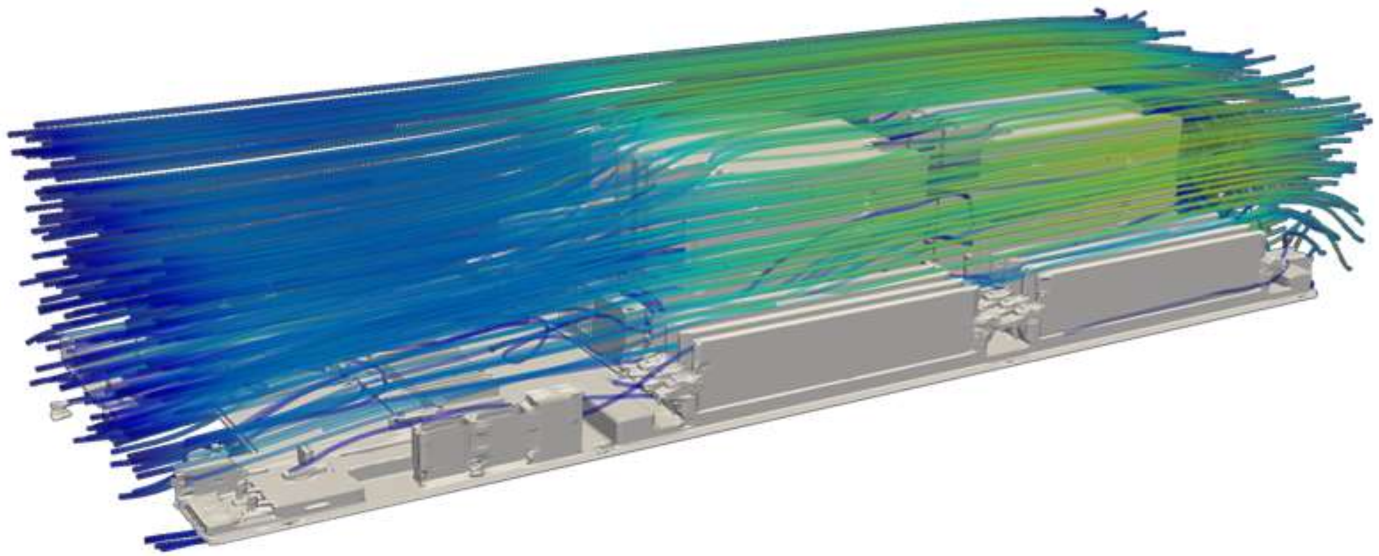
ECO-Qube offers a zonal heat management system which benefits from Computational Fluid Dynamics (CFD) simulations to adapt cooling system for the best airflow and cooling performance with minimum energy consumption.



Data centre cooling

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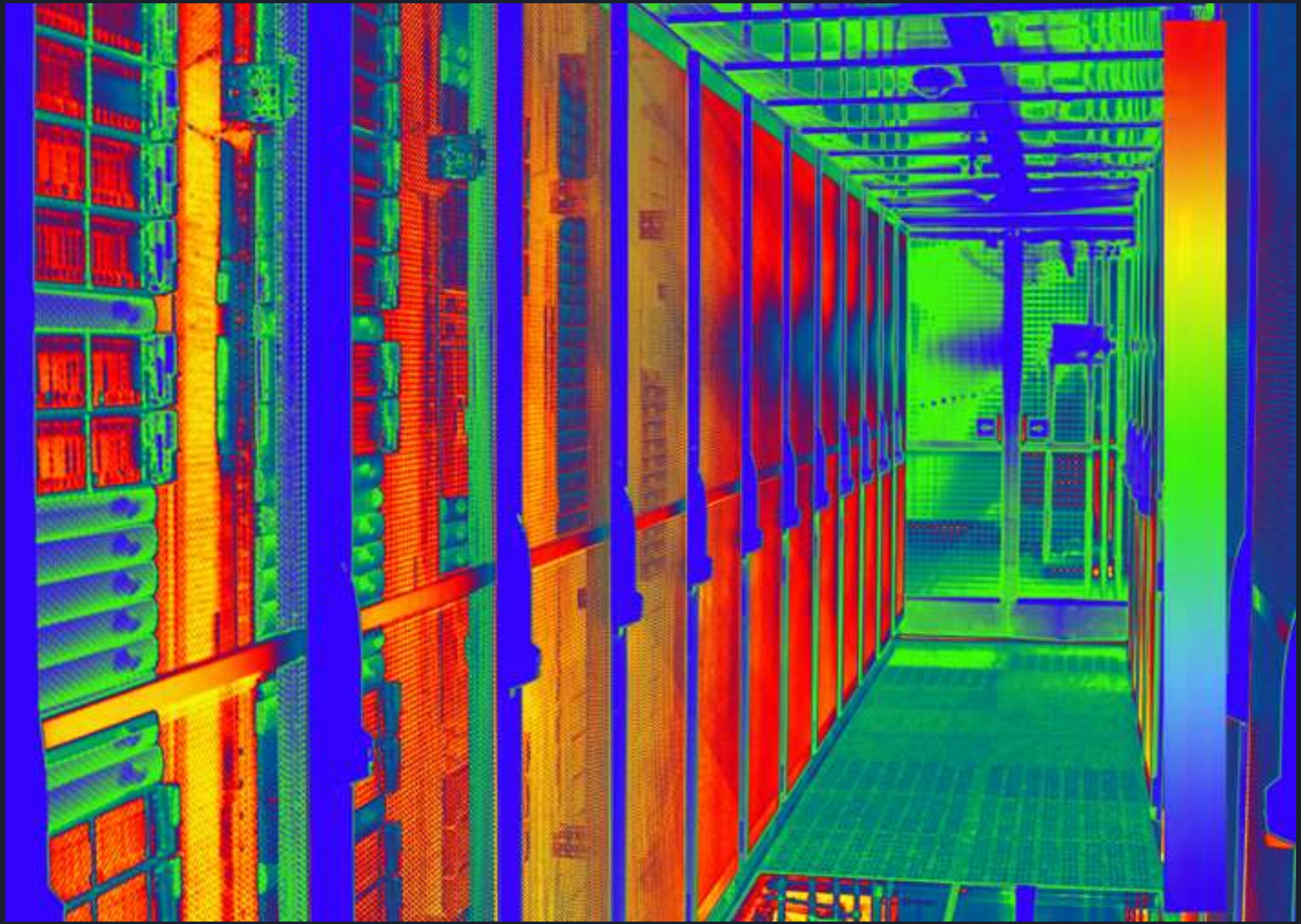

Challenge: Average utilization ratio for data centers are between 11-14%, which proves that most of the servers in data centres are idle. Idle servers are still consuming energy and do not contribute in the computing process. And only a small percentage of servers are randomly loaded and cooling systems has to consume a huge amount of energy to cool down all the data centre only for loaded servers.

Smart scheduling

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ECO-Qube realizes smart workload orchestration to keep the CPUs at their most energy efficient state and reduce overheating risk.

Artificial-intelligence-augmented cooling

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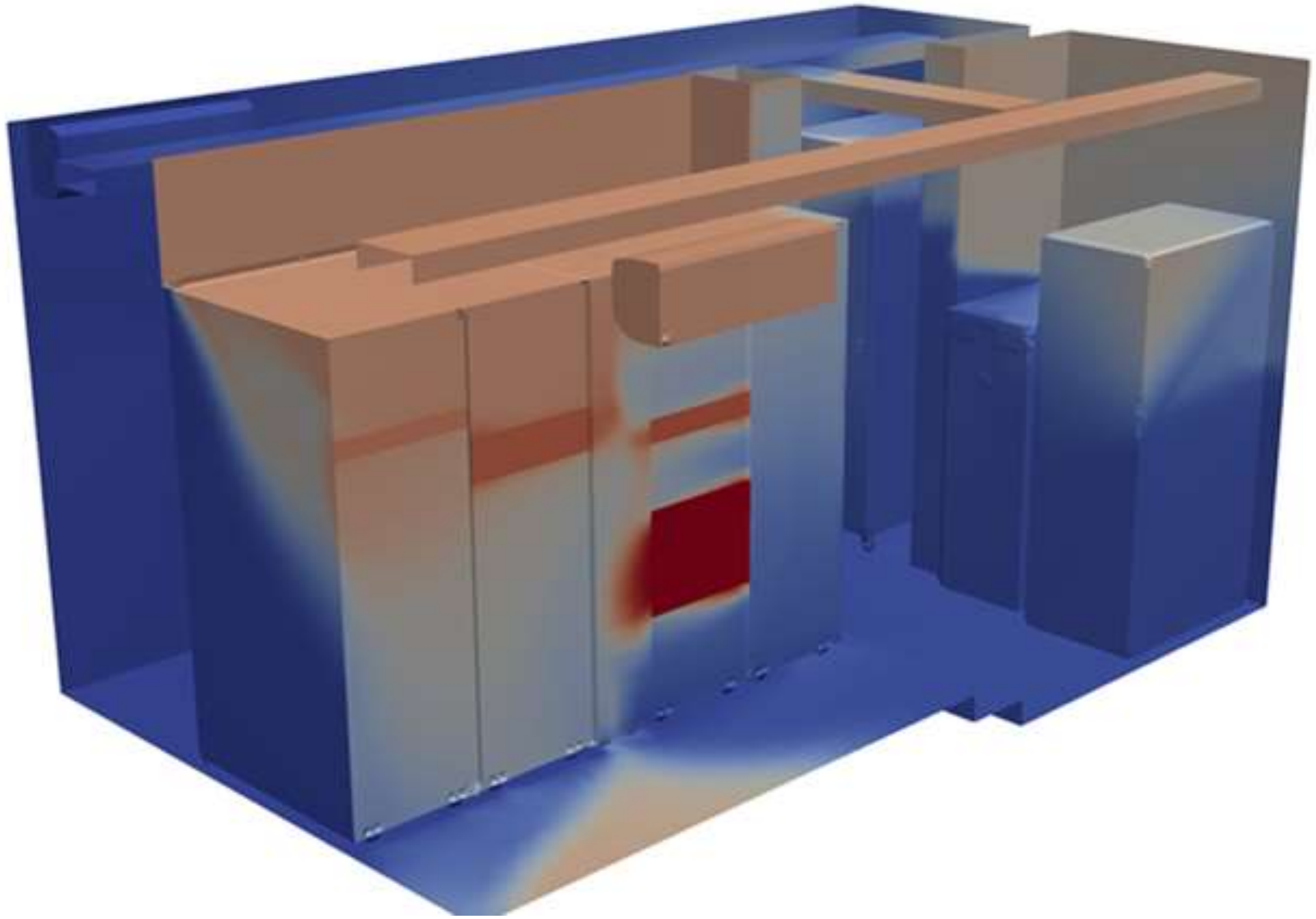
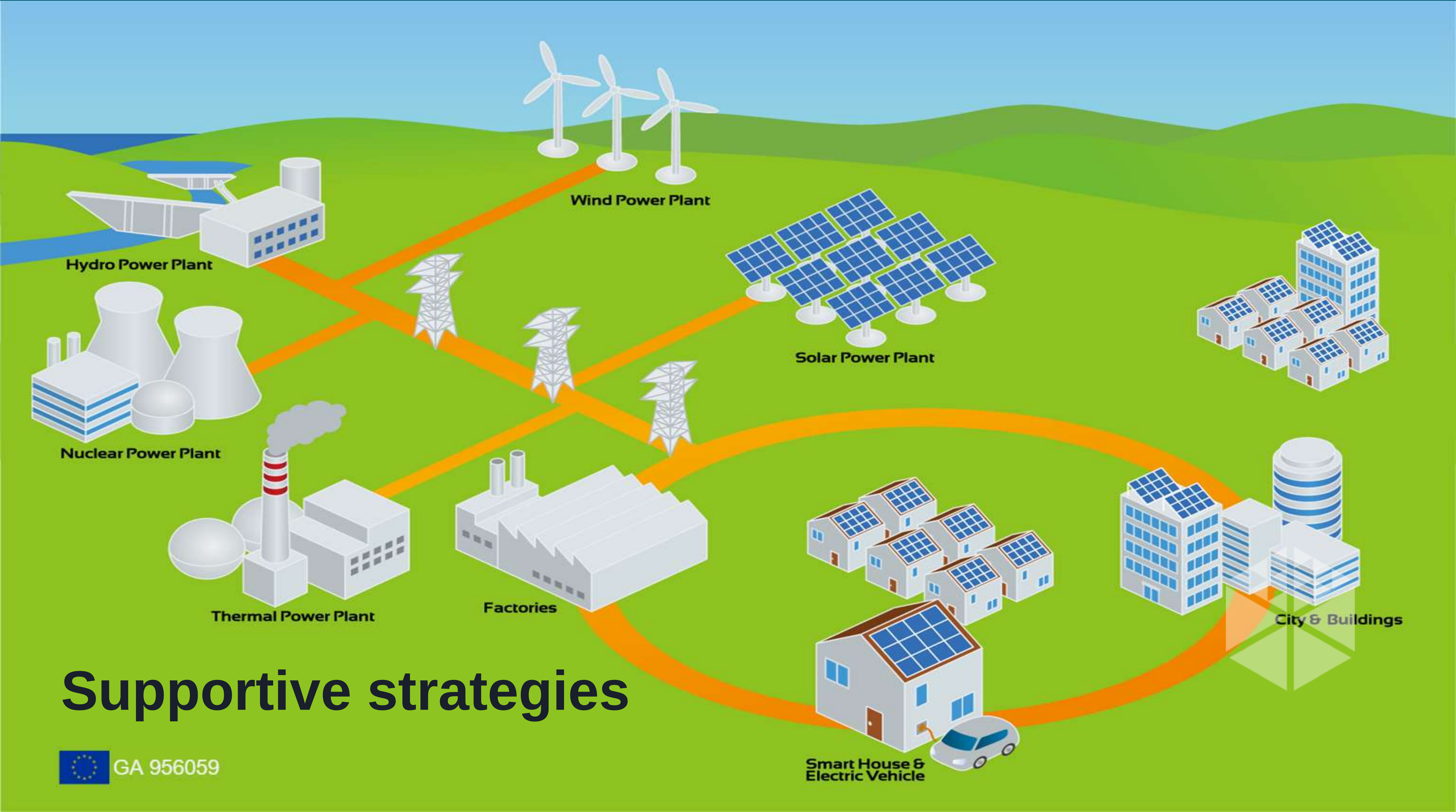
Artificial-intelligence-augmented cooling system delivers the future of data centre infrastructure management systems by orchestrating both hardware and software components. System has machine learning capabilities, to learn from insufficient performance, embedded with a risk analysis and prevention mechanism.





Supportive strategies

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Integration with micro-grids (building & district energy systems)

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ECO-Qube reduces the power consumption by supplying maximum amount of power to the data centre through renewable energy sources. To active this, ECO-Qube, integrates edge nodes to micro-grids for benefiting from the building's cooling and power redundancy systems as well as contributing to the heating systems by reusing waste heat.

ECO-Qube consortium

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CONSORTIUM

ECO-Qube roadmap

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Roadmap

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www.eco-qube.eu

ECO-Qube newspaper

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