# DATA CENTERS DECARBONISATION & COMPUTING EFFICIENCY

Data centers are the backbone of our digital world but pose significant environmental challenges. Previously, efficiency improvements kept their energy demands stable despite growing workloads. However, slower progress in efficiency combined with the surge in AI means that data-center-related power demand will likely more than double by 2030. Considering they have the fastest growing energy consumption across the whole ICT sector, climate experts warn about the negative impacts both in terms of carbon emitted and water used. Greening data centers is crucial for sustainable digital transformation and supports climate change mitigation and adaptation efforts.

**Thesis:** Technology-driven solutions are essential to support data center decarbonization initiatives while also creating a modern platform for business innovation. At AENU, we are particularly excited about startups that support these efforts by focusing on (1) renewable energy procurement (ie., 24/7 energy matching), (2) energy-efficiency (ie., replacing aged hardware, modernizing and automating workflows, compressing and deduplicating data) and (3) cooling solutions (ie., reutilizing heat for other use cases or using advanced cooling technologies).

## The Impact Problem

### *Power Consumption*

- Only in EU, data centers consumed in total 100 TWh electricity in 2022, 4% of total EU demand, and it is expected to rise 1.5x by 2026. On the national level e.g., in Ireland, data centers account for 17% of electricity demand, and it is expected to reach 32% by 2026.
- The gains in in Power Usage Efficiency (PUE) have stalled during the past decade and particularly since 2020 (see graph).
- This combined with the surge in AI will result in data center power demand to grow 160% by 2030 (excluding cryptocurrency).

### *Carbon Emission*

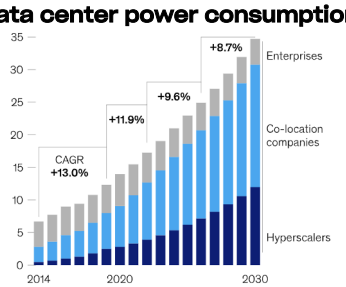
- Data centres emissions are projected to double by 2030 compared to 2023 levels.
- Power-Hungry AI is driving a surge in tech giant carbon emissions: Google announced a 48% increase from 2019-24, Microsoft a 40% from 2020-23 and Meta's scope 3 emissions rose by 65% from 2020-22.

### *Water Usage*

- Data centres generate a lot of heat and consume large amounts of water to cool their servers.
- According to a 2021 study, data centres in the US use about 7,100 litres of water for each megawatt-hour of energy they consume; yearly equivalent of approx. 3 hospitals.
- In regions where climate change is increasing water stress, the water use of data centres is becoming a particular concern.

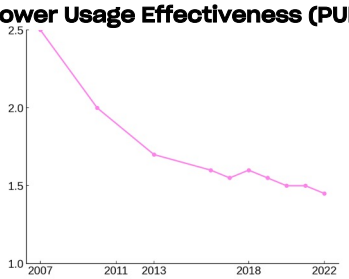
## US case study illustration: Increasing power demand combined with decreasing effectiveness of power usage

### Data center power consumption




The demand for data centers measured by power consumption will increase by 60% until 2030, reaching 35 GW, only in US (40% of global market).

### Power Usage Effectiveness (PUE)




However, the efficiency of power consumption stagnates - the ratio of the total facility to IT equipment energy usage has been flat for last decade, away from expected PUE of 1.0. To tackle these challenges, companies are in need of new technologies like immersion cooling or AI and machine learning.

Source: McKinsey & Company (2023), Investing in the rising data center economy

## Solutions

### Design & Construction

- Modular data centers
- Location optimization
- Green Building Standards
- Resource circularity

### Energy Efficiency

- Server virtualisation
- AI & ML monitoring
- Virtual plant operator
- Hybrid cloud deployment
- Data storage
- Improved IT equipments

### Heat Reutilisation & Cooling

- Repurposed heat (i.e., district heating)
- Ultra-efficient cooling systems
- Other advanced cooling technologies (ie., liquid cooling)

### Energy Procurement

- Tailored / Predicted PPAs
- 24/7 energy matching

## Tailwinds & trends

- Sustainability is a top priority for European data center operators, as shown by the Climate Neutral Data Center Pact (CNDCP), which aims to make all data centers climate neutral by 2030; initially formed by 25 cloud operators, now includes 81 operators covering 90% of the industry.
- This is followed by other initiatives such as The European Code of Conduct on Data Center Efficiency, a voluntary initiative at improving the energy efficiency in data centers across Europe, setting annual PUE goals; currently counts 500+ data centers.
- Efforts to increase power usage efficiency are evident, e.g., in Singapore, where data center developers were allowed to apply for new construction after the moratorium (2019-2022) if they met decarbonization and efficiency goals, including achieving a PUE of 1.3.
- Minimum Energy Performance Standards (MEPS) have been already adopted by some countries e.g., Germany which requires existing data centers to reach PUE ≤ 1.5 by 2027, and ≤ 1.3 by 2030, whereas the new data centers need to reach PUE ≤ 1.2.

## Startups to Watch

*Check our full market map*

DATA CASTLE
CHAINERGY
Vaire
granular energy
Renewabl'
639
LUMAI
hive
LIGHTIUM
MANGOBOOST

# Data Centers Decarbonisation & Computing Efficiency

## Design & Construction

### Repurposed Heat

blockheating
DEEP GREEN
HEAT
QARNOT
heata

### Data Centers Infrastructure

ECL
FLEXNODE
DATA CASTLE
CHAINERGY
Multigrid

## Cooling

### Advanced Cooling Technologies

incooling
FLUIX
GRC GREEN REVOLUTION COOLING The Immersion Cooling Authority
immersion4
IMPACT COOLING
liquid stack
submer

## Energy Procurement

### 24/7 Matching

INRANGE
granular energy
Renewabl

### RE Procurement

639
CFEX

## Energy Efficiency

### Energy Efficient Software

ARMADA
hive
cerabyte
etalytics energy intelligence
FlexAI
Green Pow
evroc
LUMAI
phaidra
OCIENT
Cubbit
RED DOT ANALYTICS

### Energy Efficient Hardware

LIGHTIUM
CRAFTING LIGHT, SHAPING THE FUTURE
MANGOBOOST
Vaire
AVANEIDI
WAVE PHOTONICS