



# POWERING THE AI REVOLUTION

Navigating Opportunities in Data Center Growth



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Analyst

# GLOBAL DATA CENTER HUBS

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**530**  
TWh

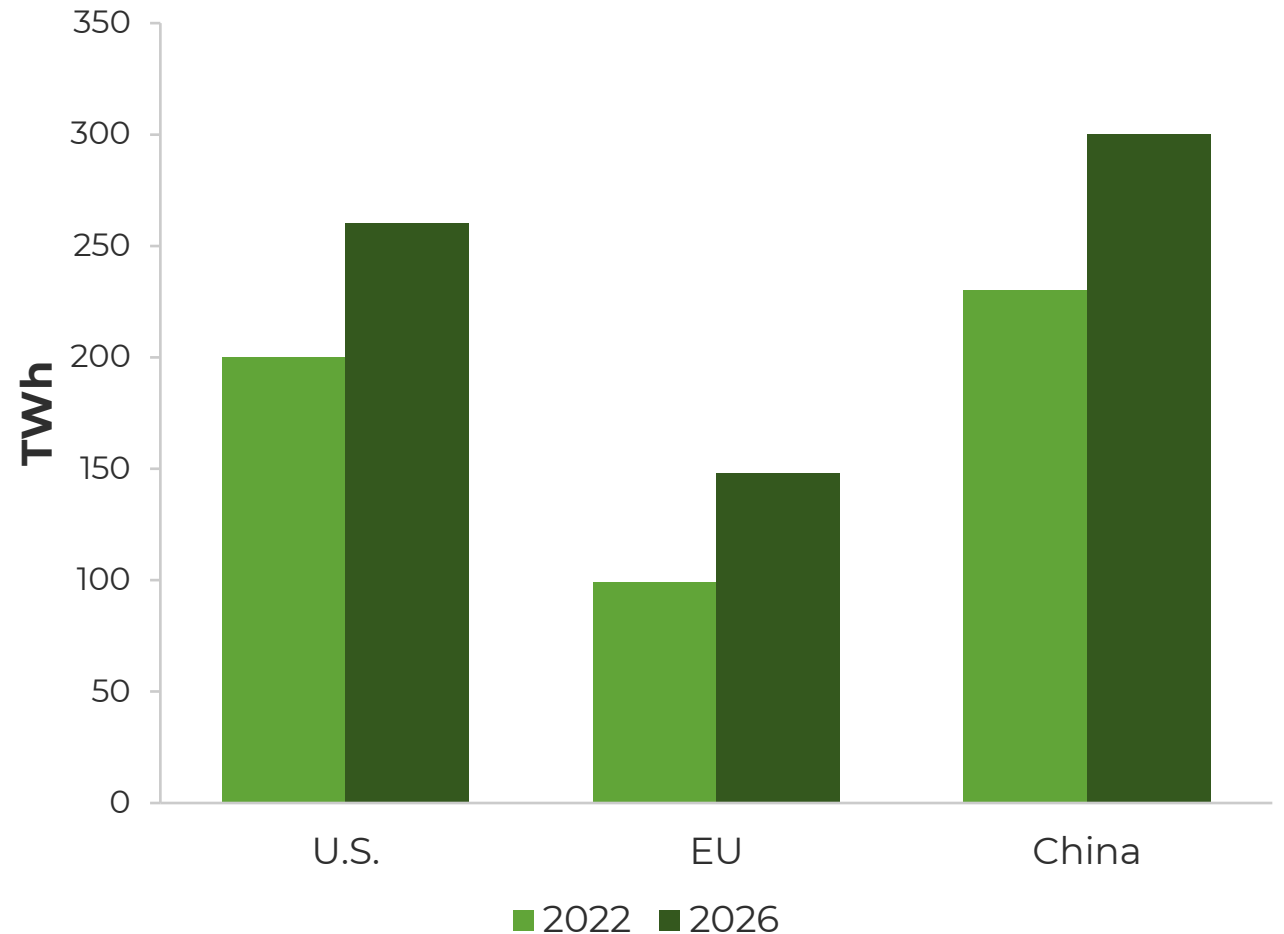


# NEED MORE ELECTRICITY

Global electricity consumption expected to reach 710 TWh in 2026.

Exact magnitude is uncertain; upward trajectory is undeniable.

## Data Center Electricity Consumption





# Global data center growth compels innovation

# AGENDA

01

**The AI revolution and data center growth is catalyzing low-carbon power and demand-side innovation**

02

In-depth techno-economic analysis of low-carbon power options and innovation opportunities addressing the unmet needs of AI's growth

03

Outline the foundation of your innovation roadmap to capitalize on the undeniable opportunities for growth in the global AI revolution



## RELIABILITY CONCERNS ATTRACT BIG OIL

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**Oil majors like ExxonMobil and Chevron target natural gas power for data centers as a new business avenue.**

## BIG TECH DRIVING ADVANCED NUCLEAR

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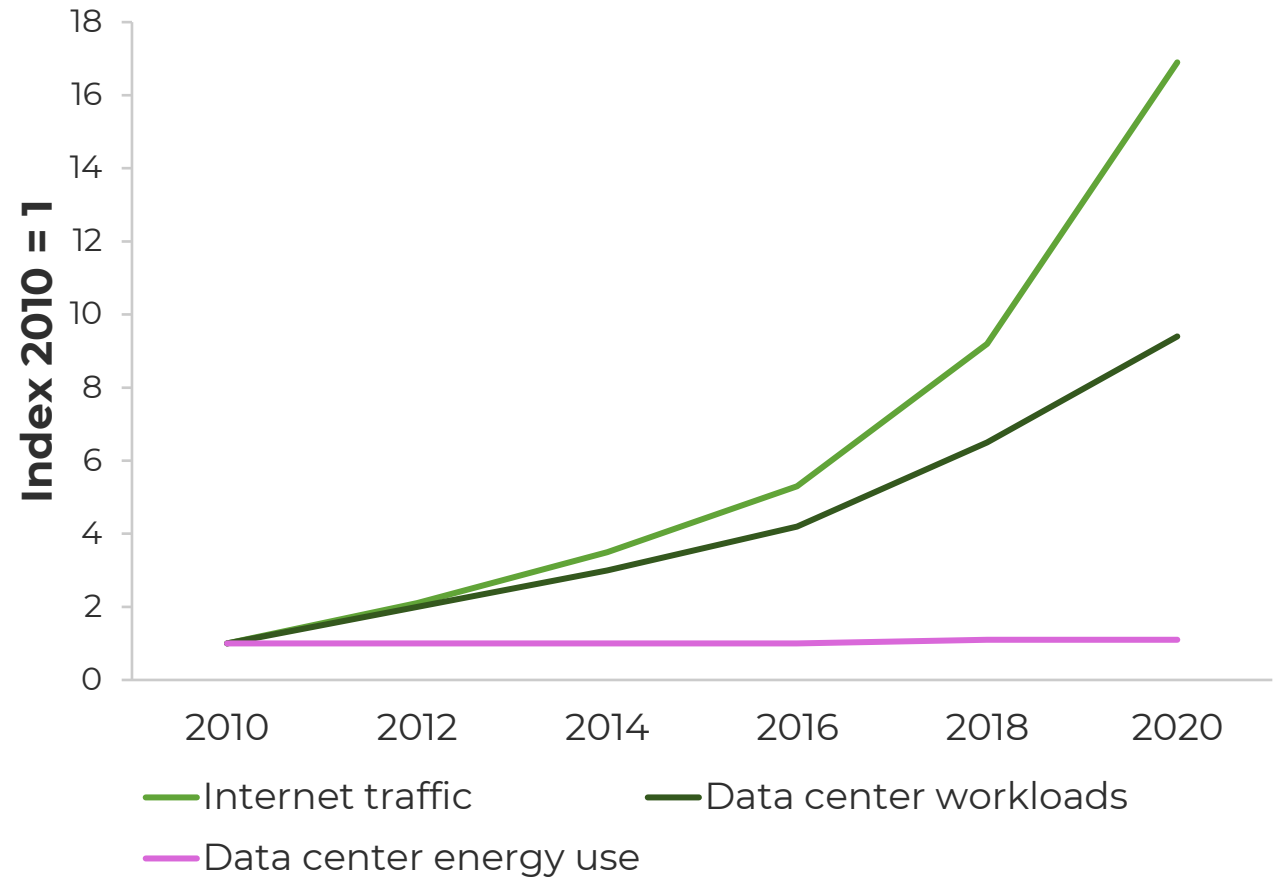
**Google signs a PPA with Kairos Power to deploy SMRs for data centers.**

# NEED MORE ELECTRICITY?

Data center computing demand has increased nine times since 2010.

Data center energy use has increased only 10% in the same time.

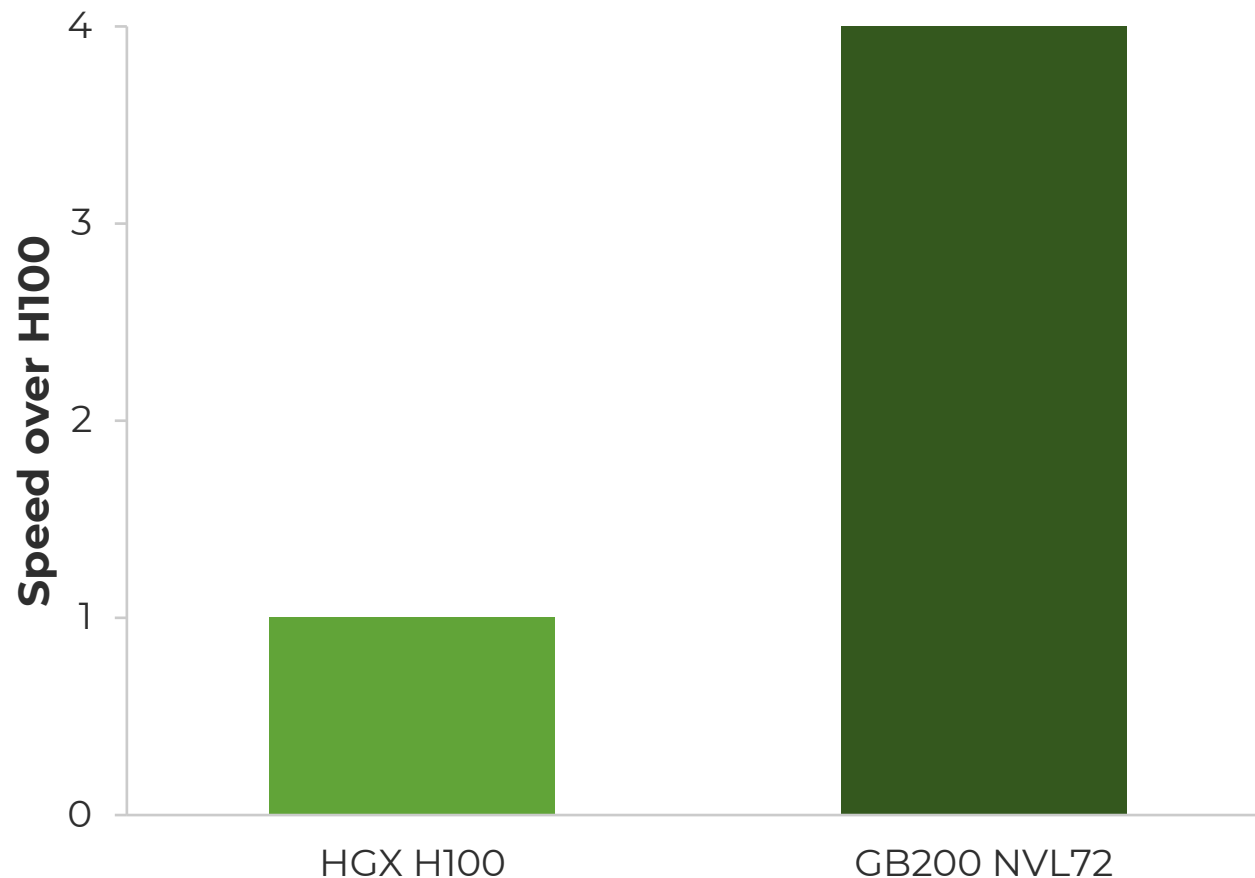
Global Internet Traffic, Data Center Workloads, Data Center Energy Use



# HARDWARE INNOVATIONS

Nvidia's GB200 chips claim **faster training performance**, real-time inference performance, and a 25-times reduction in energy use.

Nvidia Blackwell Benchmarks:  
Training Performance

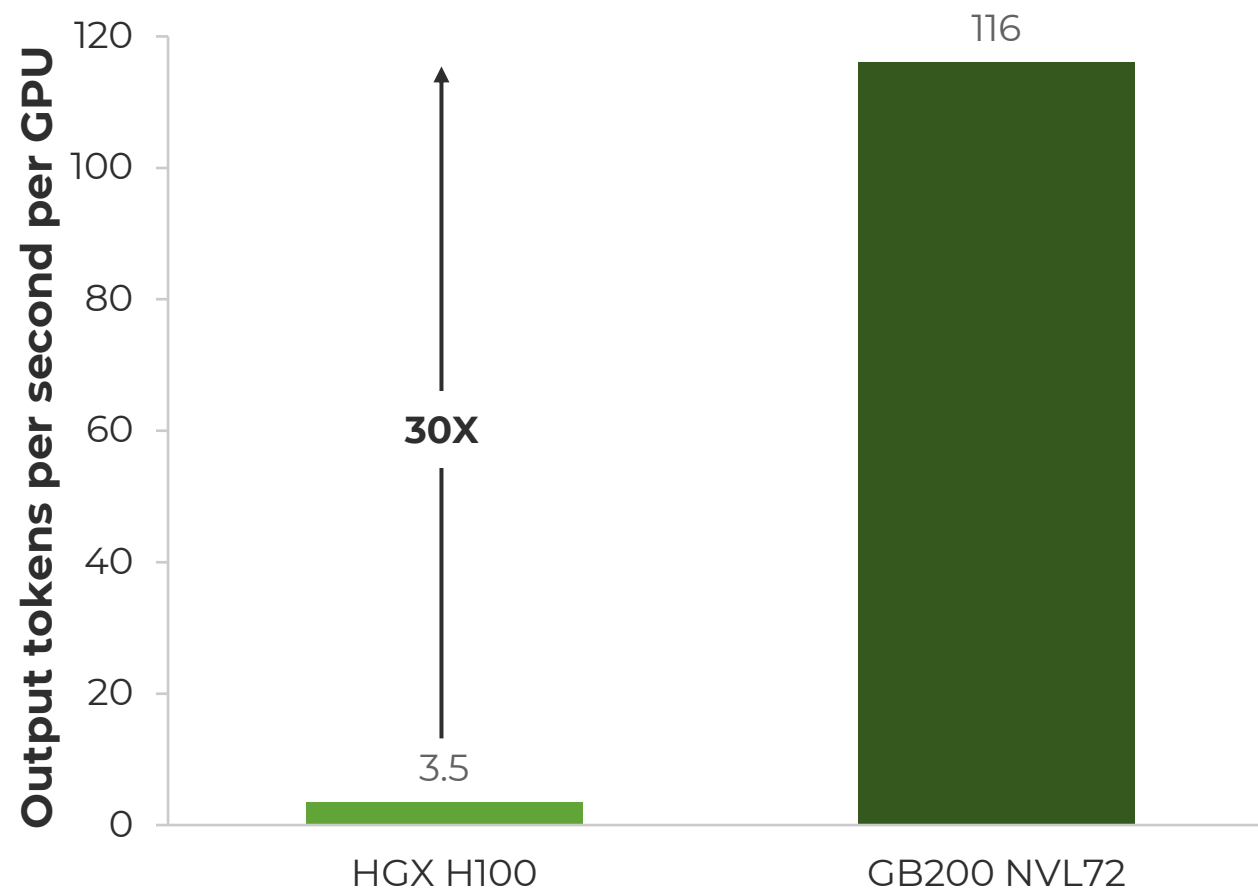




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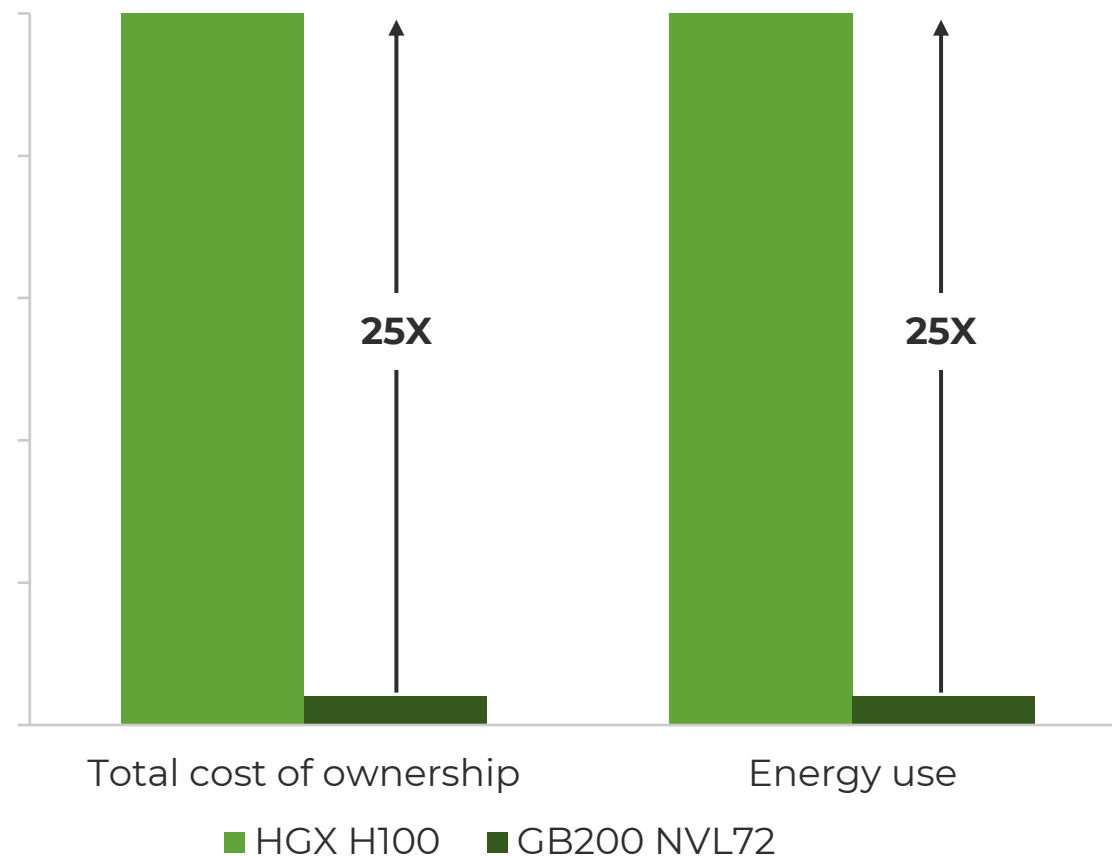
Nvidia Blackwell Benchmarks: Real-Time Inference Performance



# HARDWARE INNOVATIONS

Nvidia's GB200 chips claim faster training performance, real-time inference performance, and a **25-times reduction in energy use.**

## Nvidia Blackwell Benchmarks: Total Cost of Ownership and Energy Use



# SOFTWARE INNOVATIONS

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DeepSeek's 10-times faster and 10-times cheaper model was a "Sputnik moment" in AI.





# WORKLOAD OPTIMIZATION

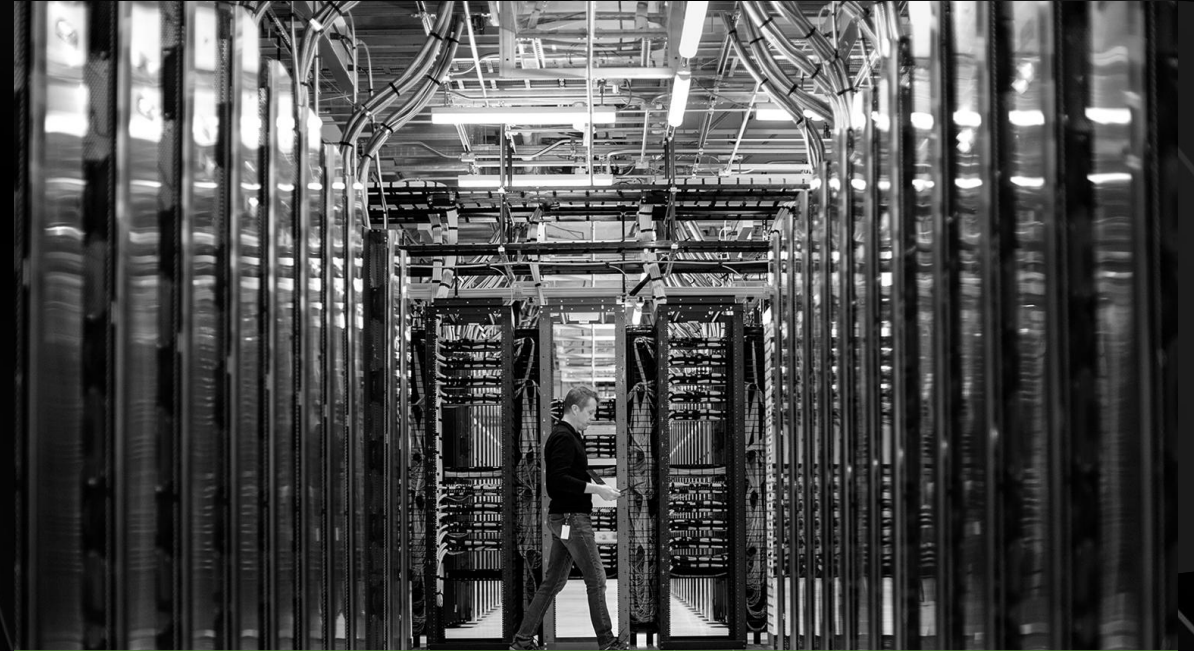
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**Google has been reducing energy use by using its carbon-intelligent computing platform.**

# PREDICTIVE MAINTENANCE

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**Microsoft uses AI-assisted monitoring to reduce data center downtime and energy-consuming incidents.**



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**The traditional data center industry is very conservative. Period.**

North American data center advisory firm

**Do not believe everything you read about data center demand flexibility. Data centers are for-profit and not philanthropic.**

Asian data center developer



# LOW-CARBON POWER

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# DEMAND-SIDE INNOVATIONS

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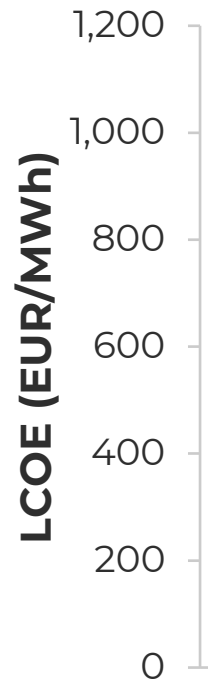
Outline the foundation of your innovation roadmap to capitalize on the undeniable opportunities for growth in the global AI revolution

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# LOW-CARBON POWER OPTIONS FOR DATA CENTERS

# ECONOMICS OF POWER: FRANKFURT

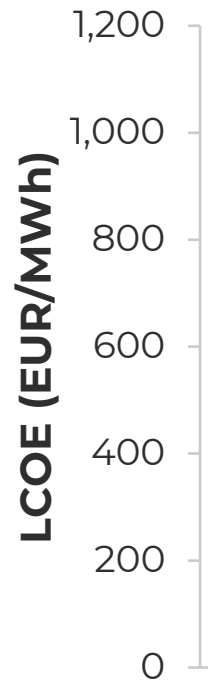
2-MW to 80-MW Data Centers by Power Generation Type



# ECONOMICS OF POWER: HELSINKI

## 2 MW to 80 MW Data Centers by Power Generation Type

LCOE (EUR/MWh)



# MAINCUBES

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**Maincubes signs 10-year solar PPA for 34 MWp with Stadtwerke Göttingen.**

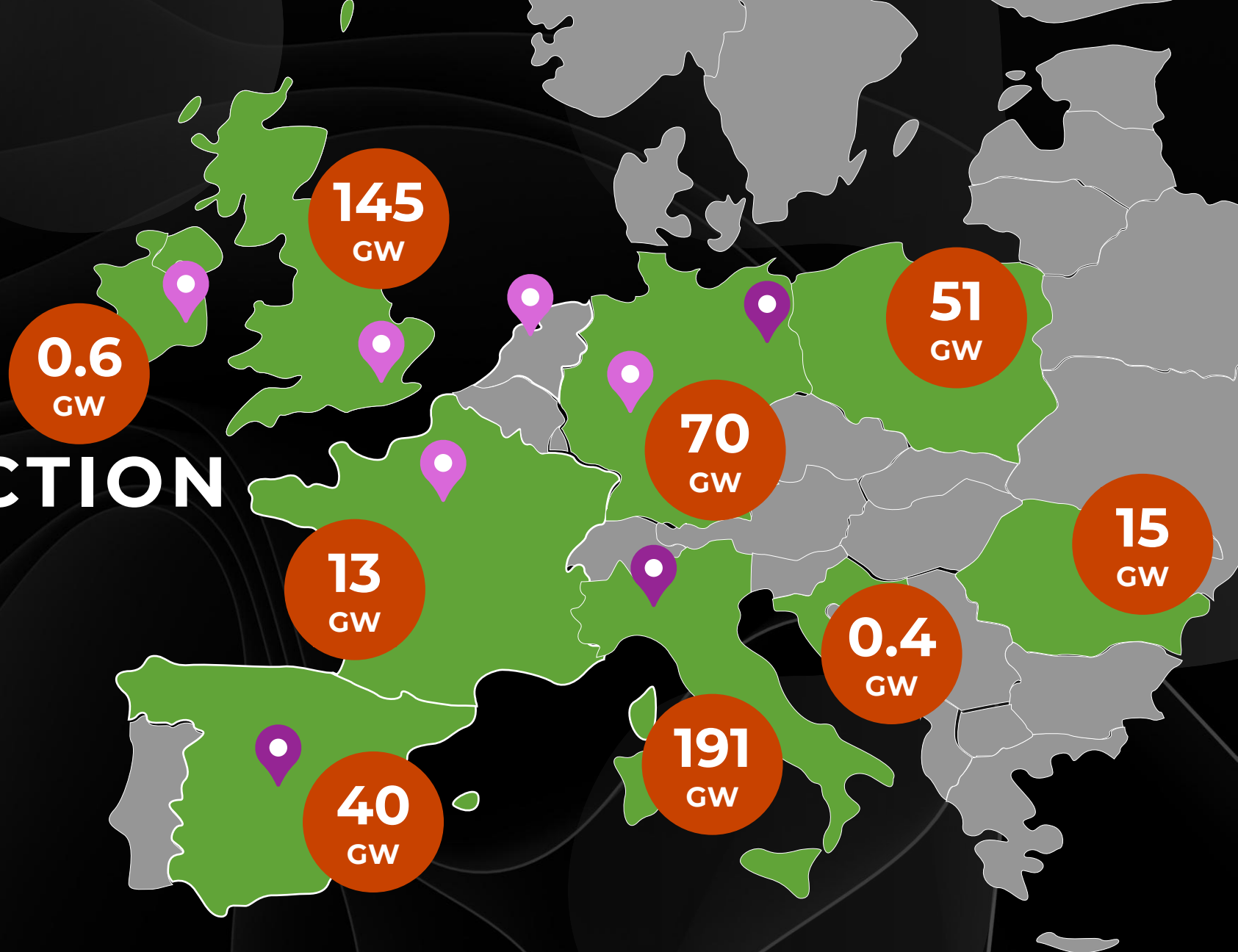
# AMAZON WEB SERVICES

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**AWS to buy 59 MW from two Renantis onshore wind farms in central Finland.**

# INTERCONNECTION DELAYS

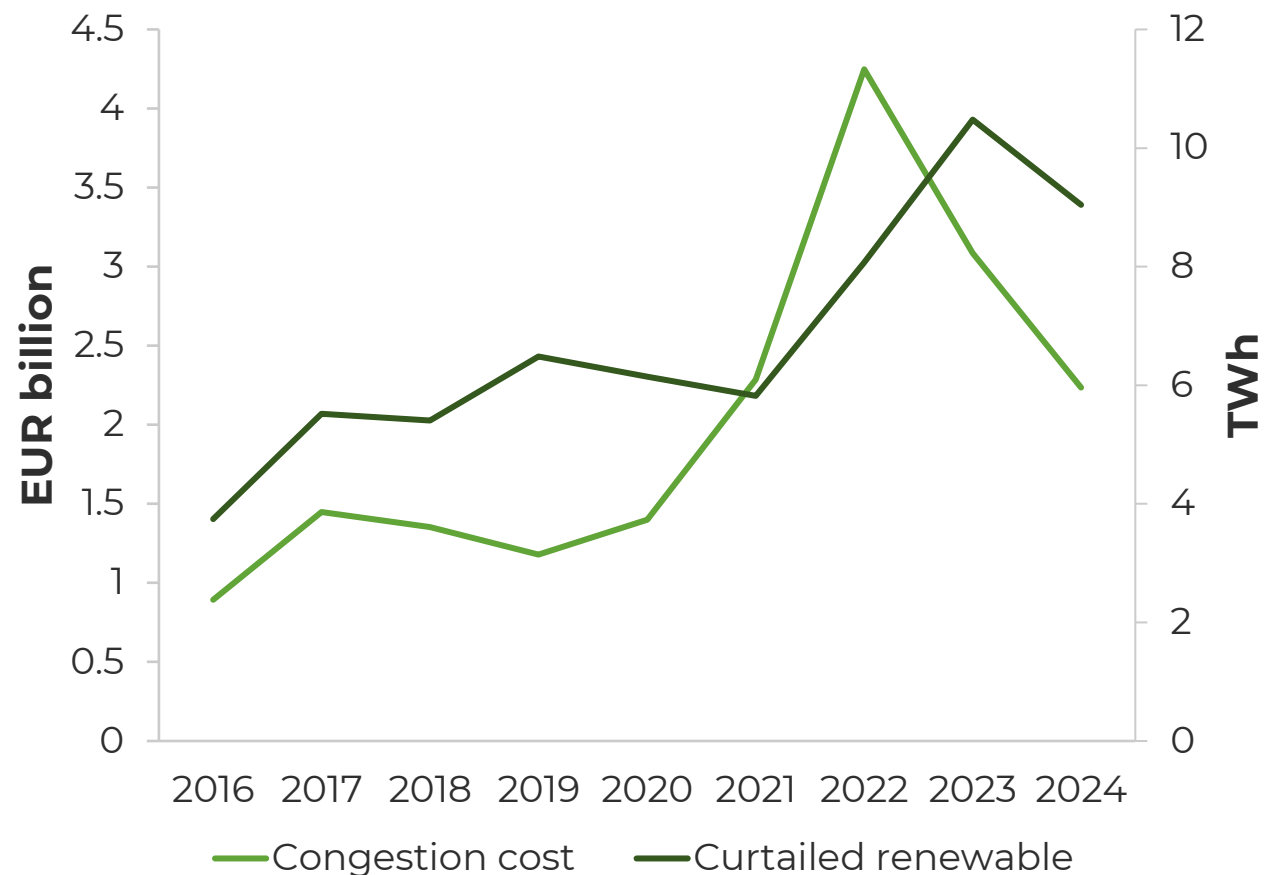




# GRID CONGESTION

Grid congestion challenges are prevalent throughout FLAP-D countries, impacting deployment timelines for data centers.

## Germany Congestion Cost and Renewable Curtailment



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# OPPORTUNITIES IN ENERGY STORAGE AND THERMAL MANAGEMENT

# DATA CENTER DOWNTIME IS COSTLY

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**43%**

data center outages  
caused by power-  
related problem

**63%**

of outages resulted  
in **>EUR 100,000 in  
losses**

**>EUR 1  
million**

in losses in **15% of  
outages**

# BATTERIES REPLACE DIESEL



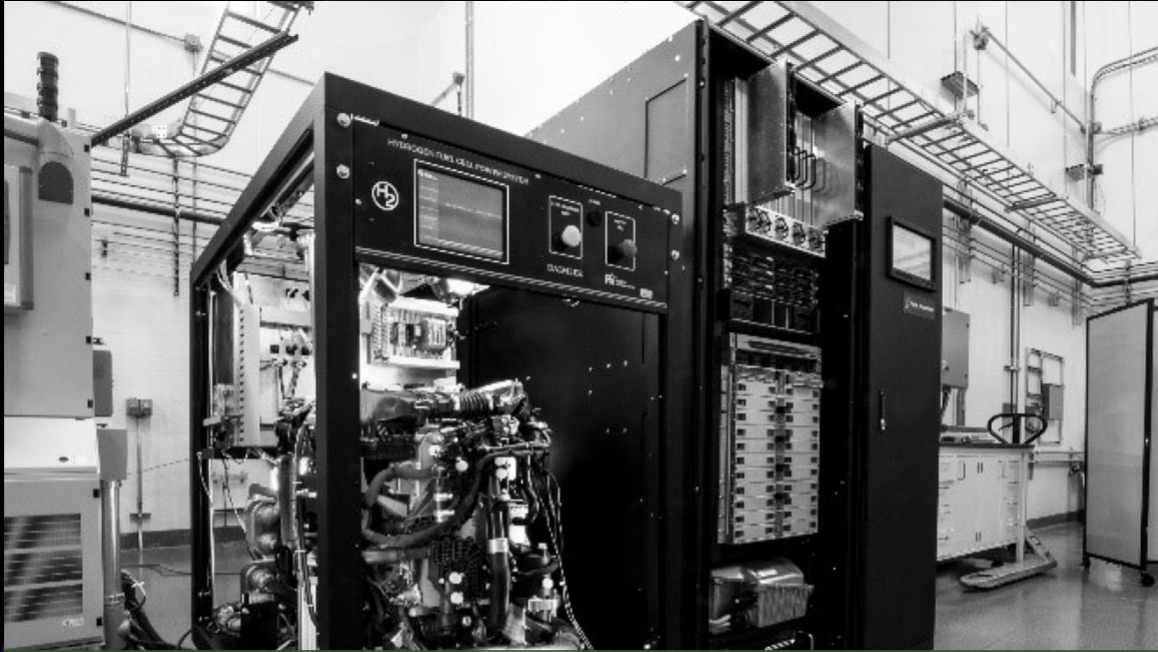
**Microsoft deployed a 24-MW/16-MWh system to provide backup power up to 80 minutes in Sweden.**



**Google complements diesel generator backup capacity with a 2.75-MW/5.5-MWh system in Belgium.**



# BACKUP POWER DEMANDS RELIABILITY



**Microsoft tested a 250-kW fuel cell system to power a row of data centers for 48 hours back in 2021.**



**Microsoft partners with ESB for fuel cell pilot at its Dublin campus.**

# DATA CENTER COOLING IS CRITICAL

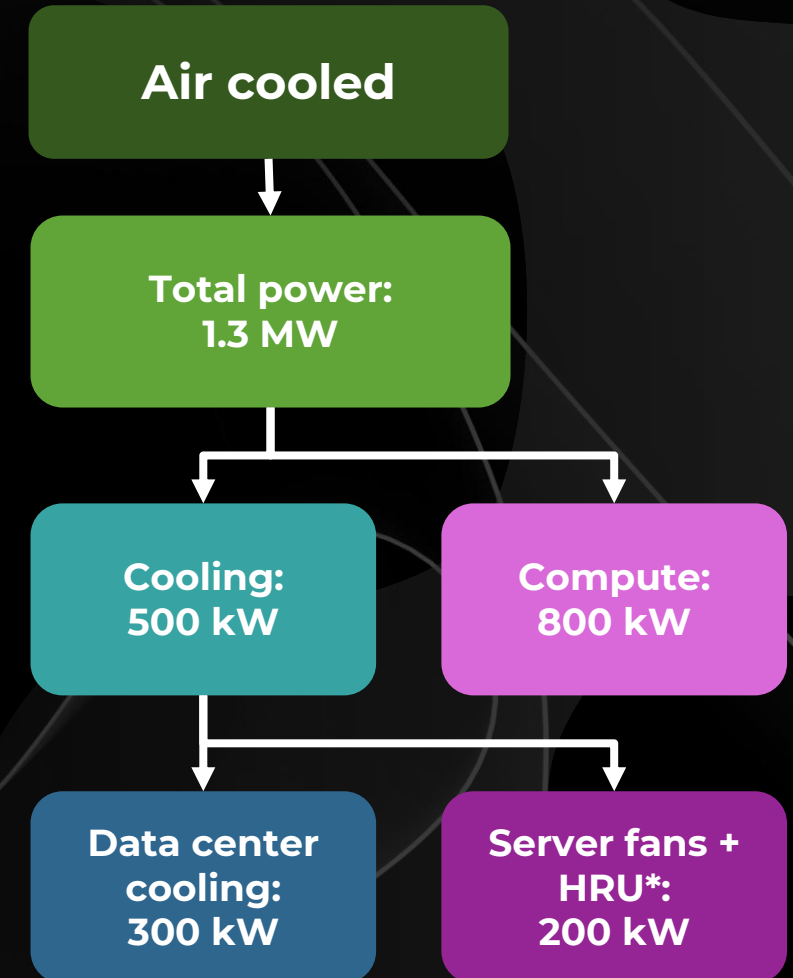
“ ”

**Current air-cooling systems in data centers are not optimized for airflow.**

North American data center developer

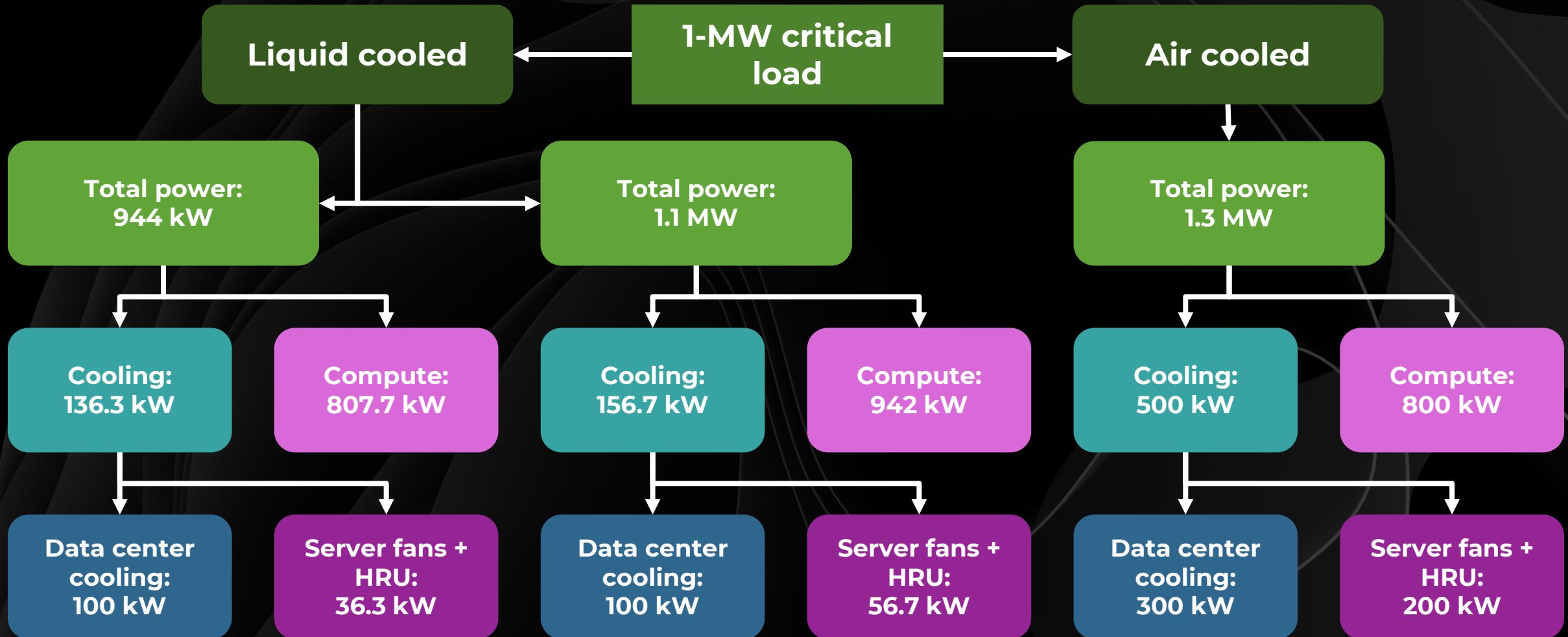
**We will likely see lots of liquid cooling in the next five years.**

European data center co-location company

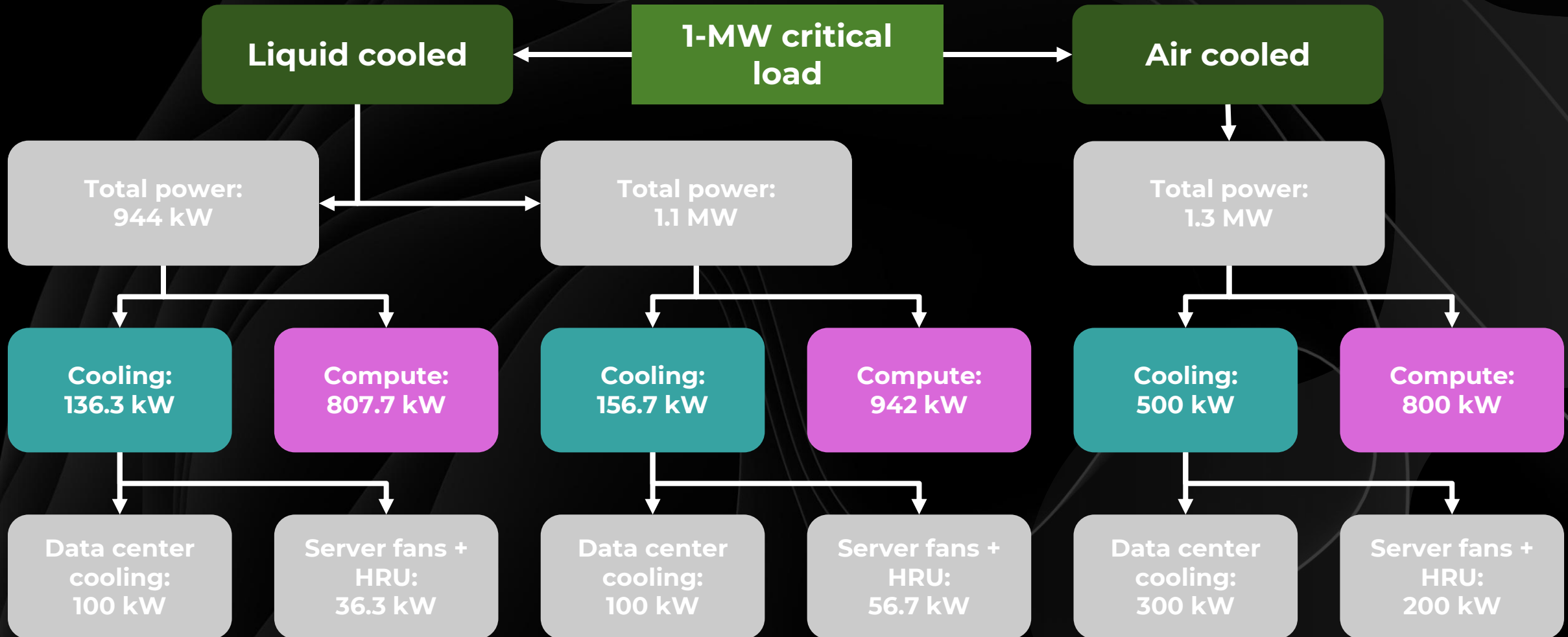




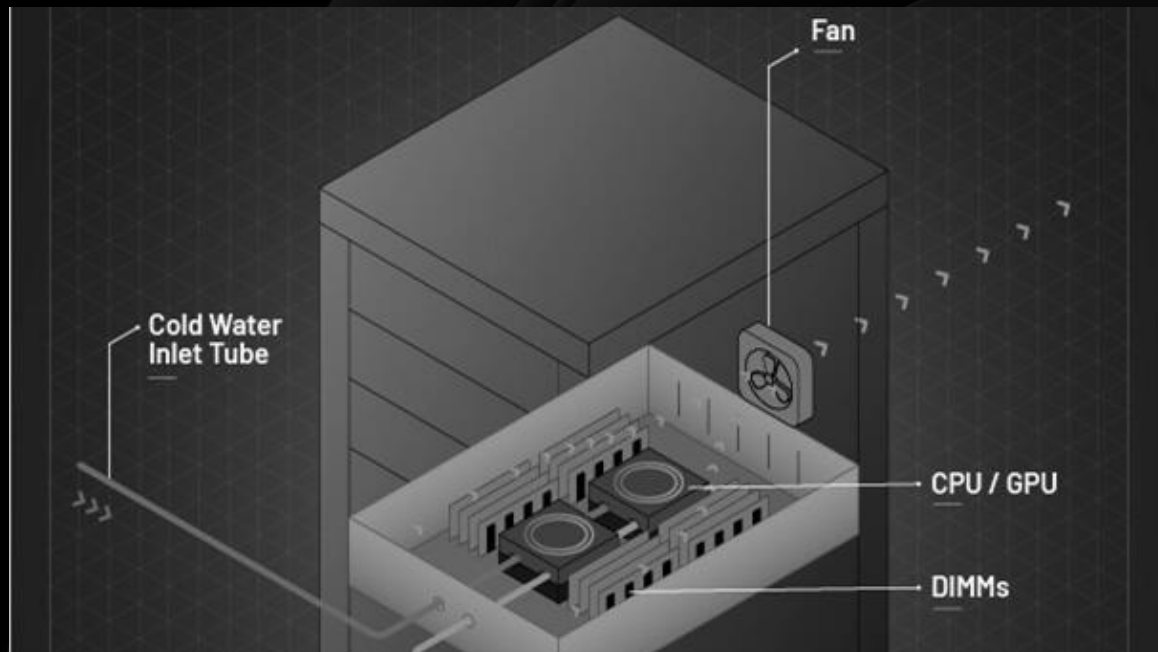
# RISE OF LIQUID COOLING



# RISE OF LIQUID COOLING



# DIRECT TO CHIP



**Industrial HVAC equipment providers are expanding data center offerings with integrated solutions.**

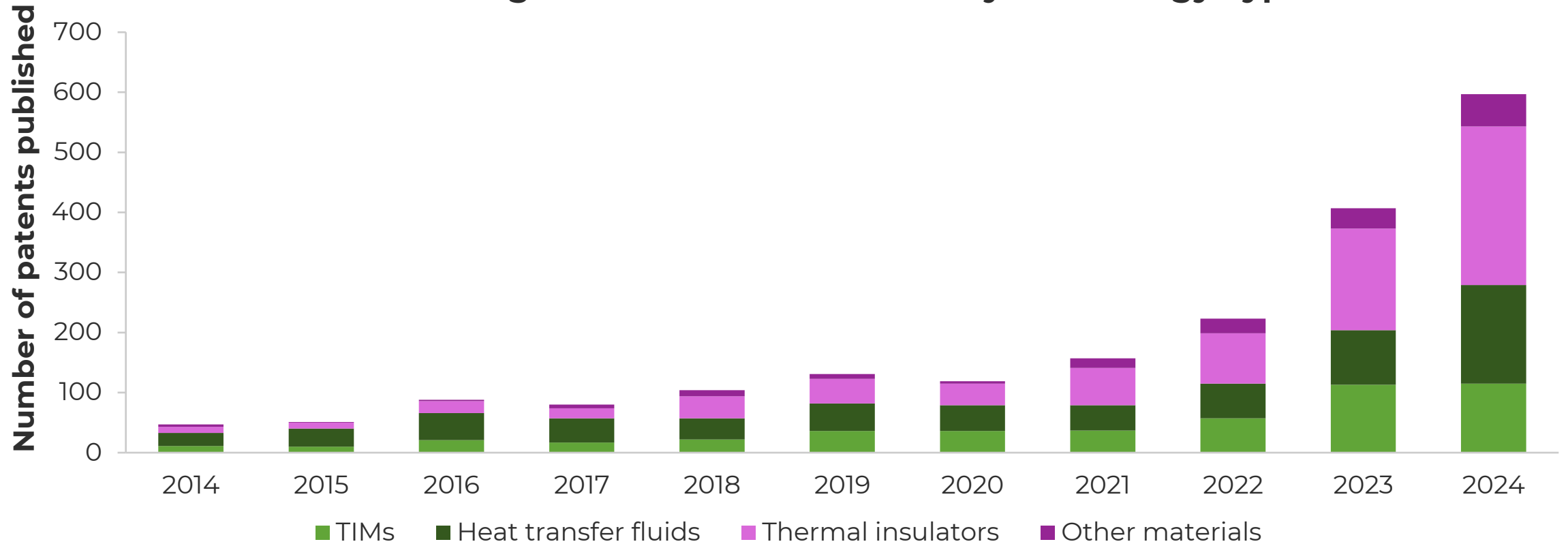
# IMMERSION COOLING



**Oil and gas and chemicals companies are leveraging expertise in lubricants and silicones to tap growing opportunity.**

# INNOVATION IS ACCELERATING

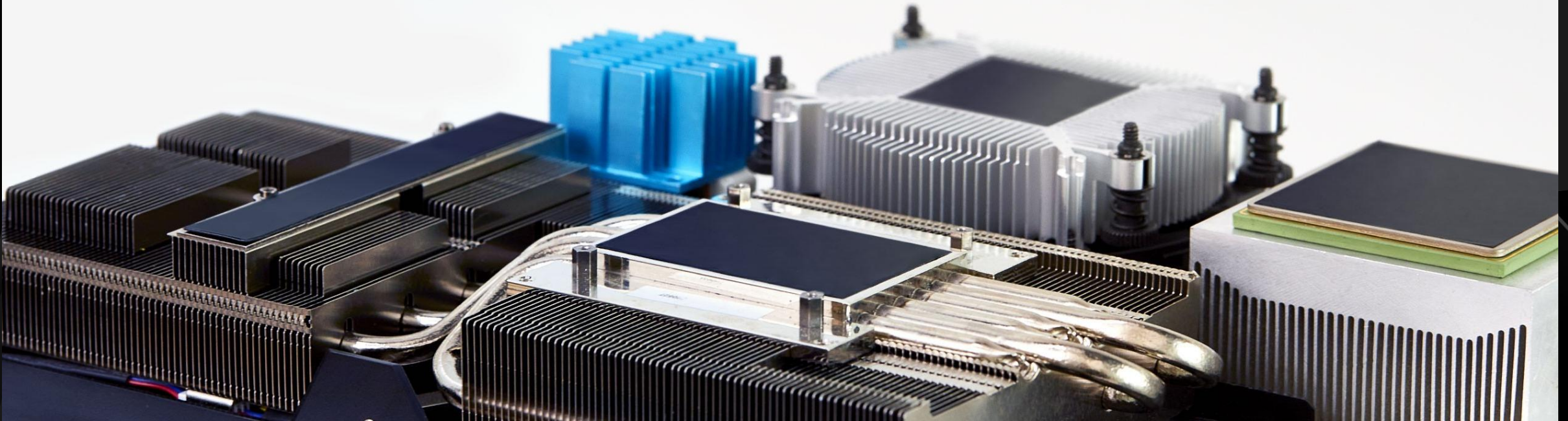
Thermal Management Materials Patents by Technology Type





# THERMAL INTERFACE MATERIALS

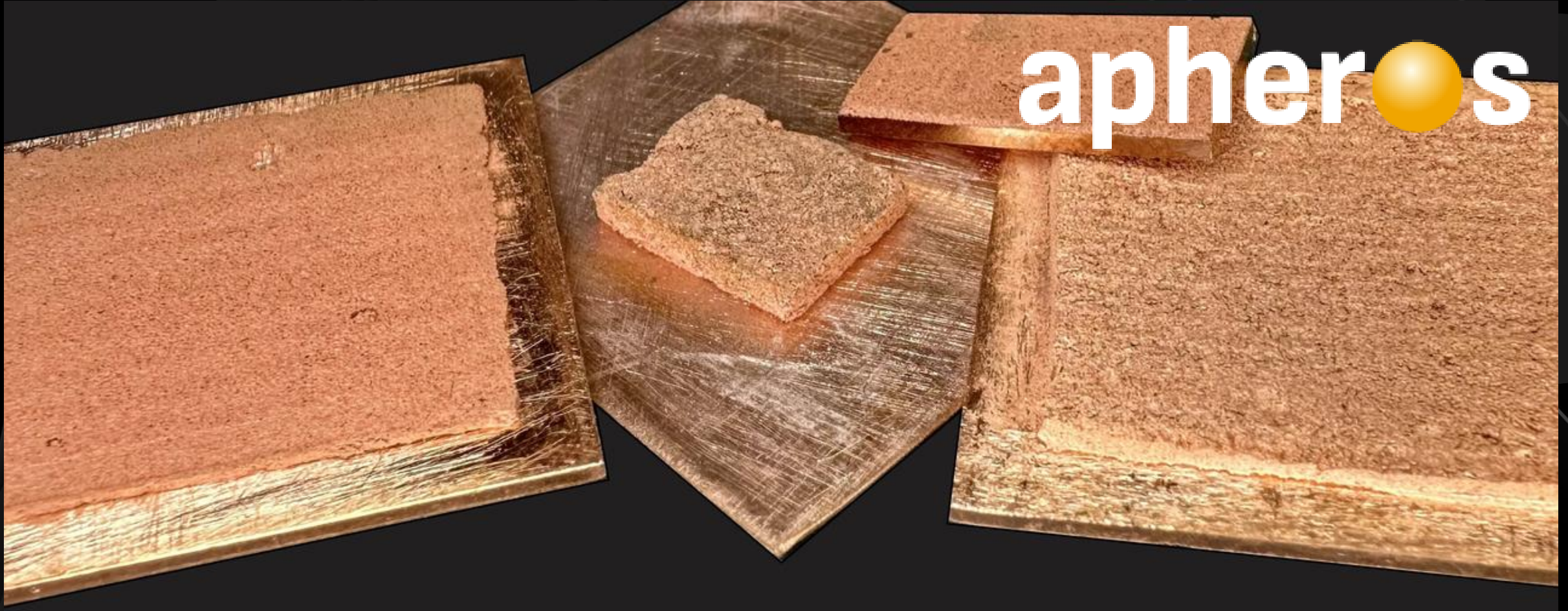
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# THERMAL INTERFACE MATERIALS

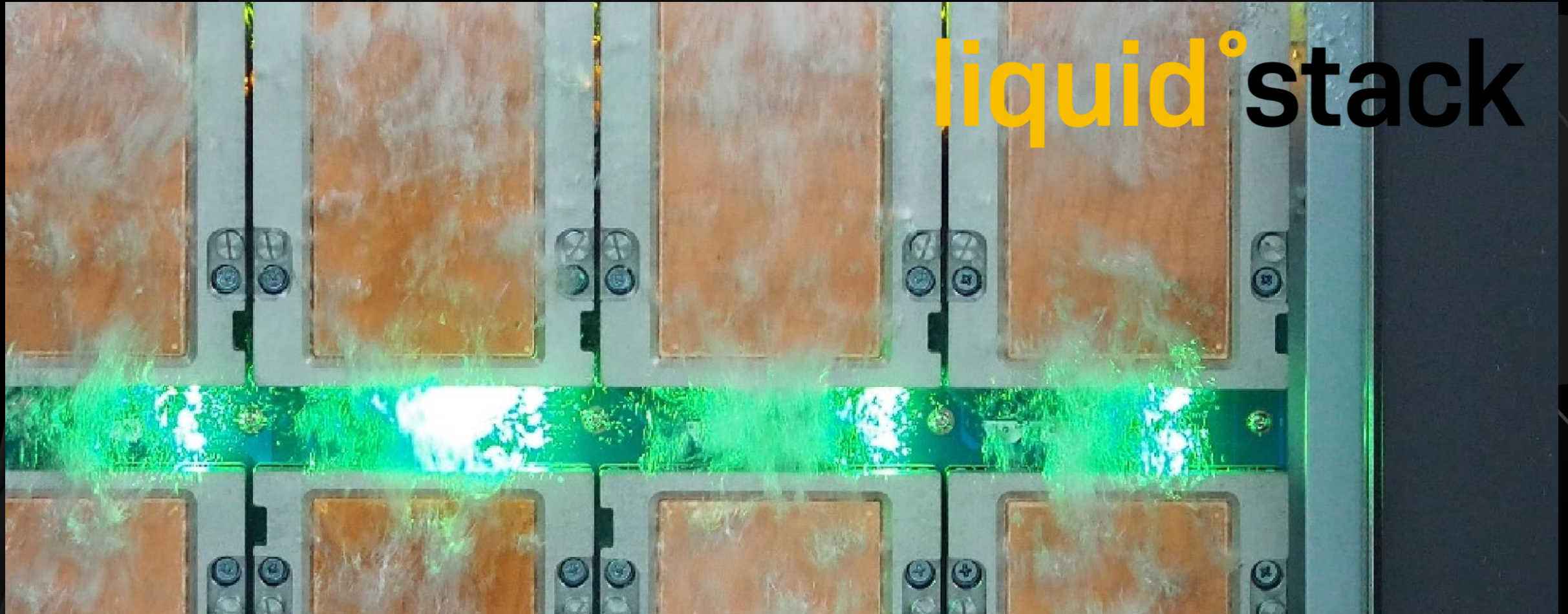
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# HEAT TRANSFER FLUIDS

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# LOW-CARBON POWER

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# DEMAND-SIDE INNOVATIONS

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# CHARTING YOUR INNOVATION ROADMAP

Low-carbon  
power

Continue  
developing solar  
and wind projects  
to meet growing  
demand for PPAs

Implement  
microgrids and  
energy storage to  
enhance reliability  
and stability

Explore baseload  
power options —  
geothermal, fuel  
cells, nuclear —  
enabled by  
hyperscalers

Demand-side  
innovation

Support enabling  
technologies for  
more powerful  
chips and energy  
optimization

Uncover  
opportunities as  
liquid cooling  
replaces air cooling  
as dominant  
method

Develop novel  
thermal  
management  
materials to change  
the architecture of  
data centers



# KEY TAKEAWAYS

1

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**Demand growth is uncertain, but undeniable.**

Grid challenges and a conservative data center create short-term innovation opportunities.

2

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**Innovations in reliability will be instrumental.**

A combination of batteries and fuel cells enables the sector to shift to low-carbon, low-cost power while meeting operational requirements.

3

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**Parallel innovation is necessary; there's opportunity for all.**

Demand-side innovations from hardware to software to advanced materials will enable the next generation of data centers.



# THANK YOU

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