Sustainability and Power Consumption in HPC

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HEPiX Autumn workshop at the University of Victoria, Canada,
October 16-20, 2023

About Hypertec

1984
Year
Founded

700+
Employees
Worldwide

3
Headquarters
Canada – USA- Taiwan

3
R & D Centers:
USA – Canada -Taiwan

500
Data Centers
Served Regularly

1,000,000
Servers
Deployed

100,000+
Servers & Storage
Delivered Yearly

1,500,000
Annual Systems
Production Capacity
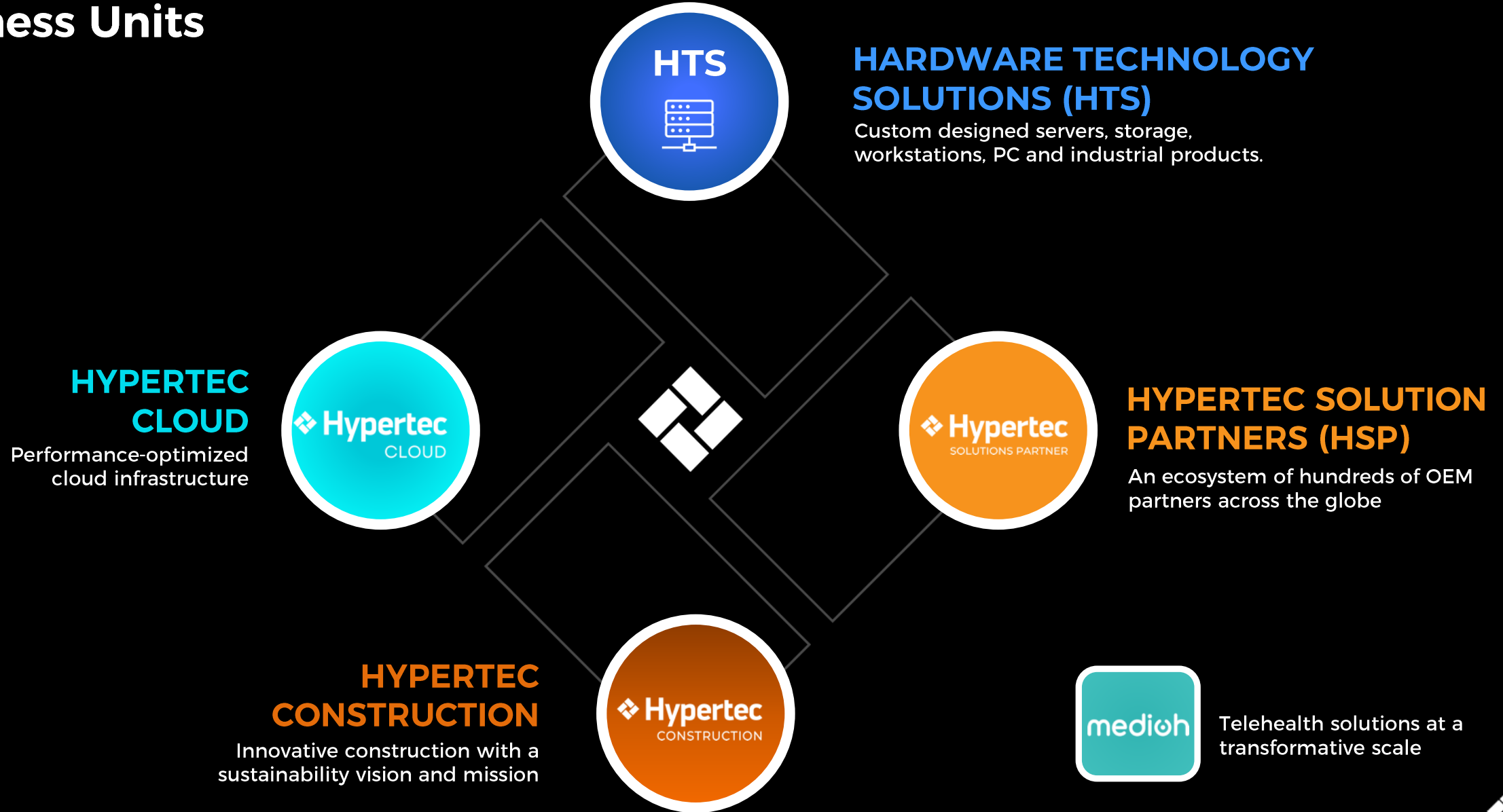
3000+
Customers
worldwide

80+
Countries
Supported

28
Service Warehouse
Locations

Business Units

HTS

HARDWARE TECHNOLOGY SOLUTIONS (HTS)
Custom designed servers, storage, workstations, PC and industrial products.

HYPERTEC CLOUD
Performance-optimized cloud infrastructure

Hypertec CLOUD

Hypertec SOLUTIONS PARTNER

HYPERTEC SOLUTION PARTNERS (HSP)
An ecosystem of hundreds of OEM partners across the globe

HYPERTEC CONSTRUCTION
Innovative construction with a sustainability vision and mission

Hypertec CONSTRUCTION

medioh
Telehealth solutions at a transformative scale

Recent Sustainability and Innovation Awards

EcoVadis Award

Orange Silicon Valley
Green IT Challenge Winner

Les Mercuriades Award

Topics

Challenges of sustainability and power consumption in HPC

What is Immersion Cooling?

Hypertec's Immersion Cooling solutions

Sustainable HPC

Three examples of Power, CO2, and Cost savings from using
Immersion Cooling:
- Ontario, Canada
- Midcontinent, USA
- Germany, Europe

Challenges of sustainability in HPC

Approximately 50% of global green house gas emissions come from electricity production

The IT and Data Centers sector have been singled out as being a major contributor to these emissions

Over 3% of the world's power is attributed to Data Centers with an estimated 8% to the IT industry. Both numbers are growing at a rapid pace

Challenges of sustainability in HPC

Increasing power consumption of components from every major manufacturer: Intel, AMD, NVIDIA
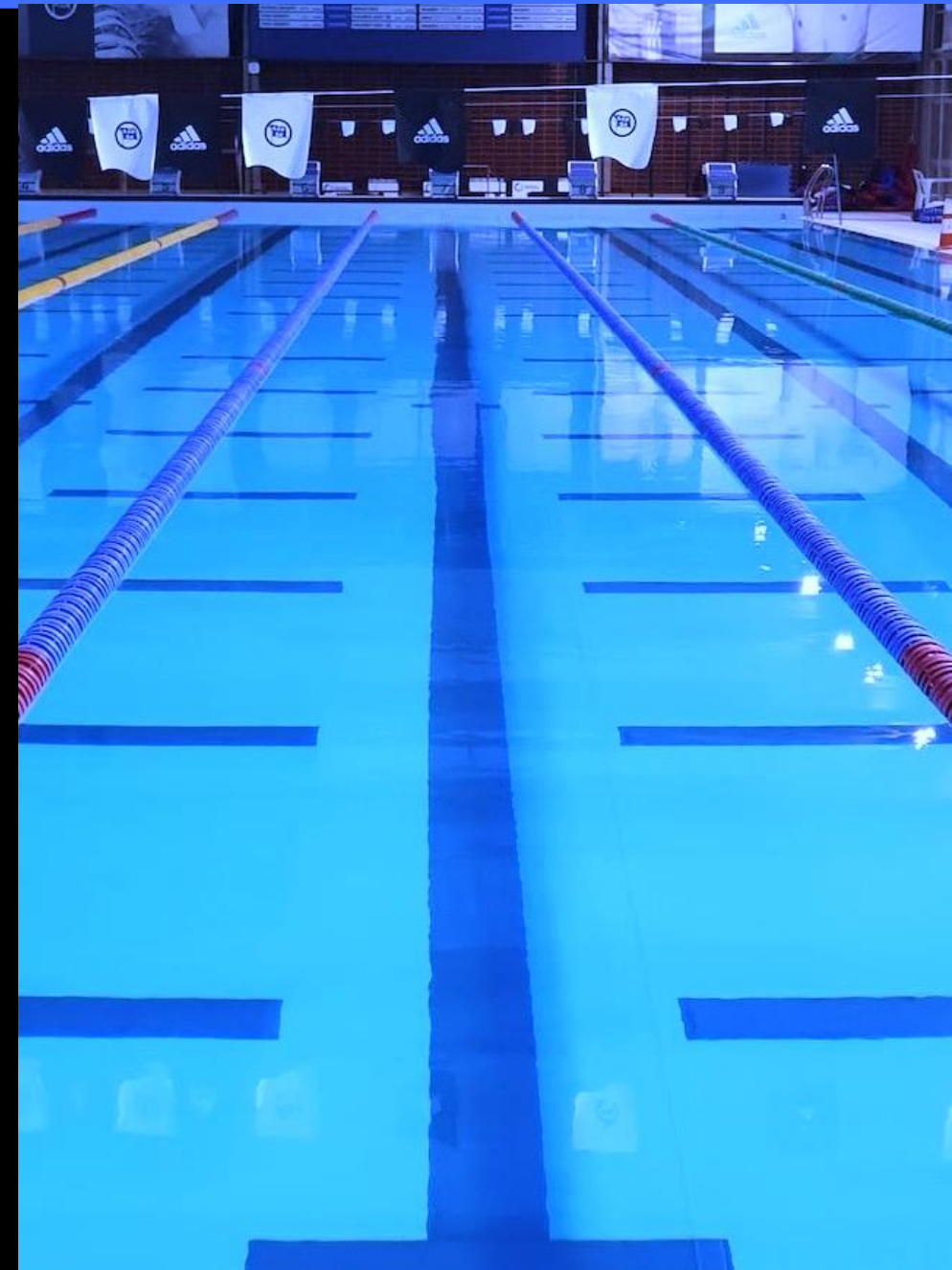
Carbon footprint of typical HPC systems and data centers are quite high

Balancing performance efficiency, cost and environmental impact are important

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Did you know?

Every 48 hours, a typical datacenter consumes the amount of water required to fill an Olympic size swimming pool

Did you know?

98% of the energy consumed by a datacenter
is rejected in the form of **heat** into the atmosphere.

There's a massive opportunity-cost by not re-using it.

Traditional air-cooling technology only allows to capture
<5% in the form of low-grade heat (max 25 °C supply).

Did you know?

Growth
Global DC

Next 10 years
at 5% CAGR

Growth
of Immersion cooling

Immersion Cooling
market growth at
least 13% CAGR

Implementation
of Energy Programs

80% High-end DC
will implement
these programs to
reduce energy
consumption by
2022

Sustainability
in Business KPI's

60% of G2000 companies
will have sustainability
parameters in their
business KPI's by 2023

What is Immersion Cooling?

Immersion cools IT hardware by directly immersing it in a non-conductive liquid.

Liquid immersion cooling **moderates** compute **temperatures** by completely immersing **all heat-generating server components** in a circulating, non-conductive liquid coolant.

It offers the **highest level of efficiency** plus virtually unlimited capacity.

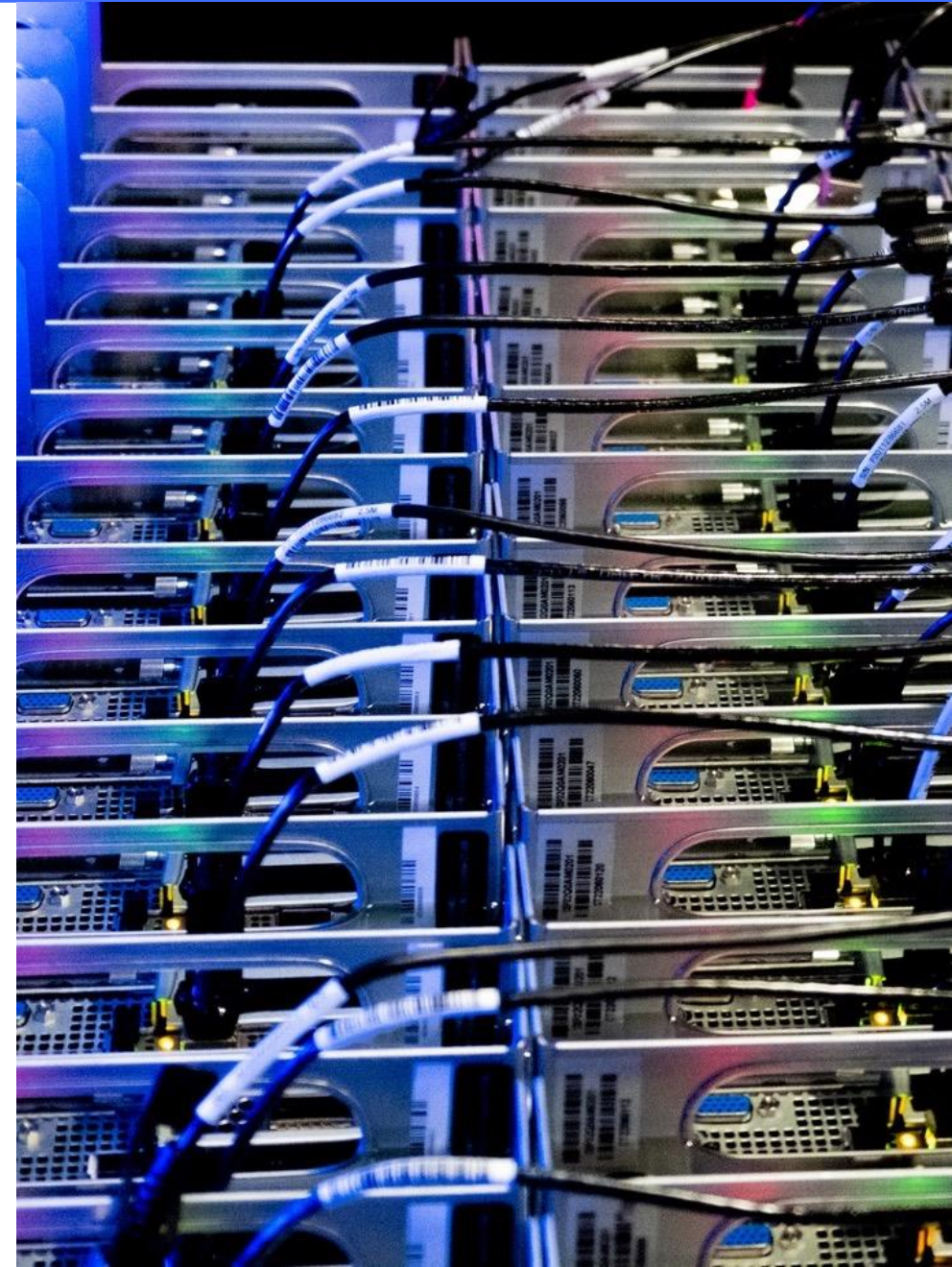# What can be submerged?

Any Retrofitted / Immersion Born servers

Any solid-state SSD / NVMe drives

Network switches

Fabric (copper, single mode fiber)

Battery backup

Power distribution (PDUs)

Smart Pods

SmartPod XL+

SmartPod XL

SmartPod X

Heat dissipation capacity (kW)	50 to 100 kW
Double tank IT gear capacity (U, OU) Note: OCP's power shelf(s) (3 U each) is/are excluded.	21 U to 45 U 19 OU to 42 OU
Max. power consumption (W)	750 W to 1500 W
Built-in redundancy	2N Pump
Power supply	(CE) 3 Phase + N / 380-400 V 50 Hz (UL) 3 Phase 208 V 60 Hz
Monitoring	Temperature and flow for both SmartCoolant and water
Water supply inlet temperature	Recommended ≤ 32 °C (89.6 °F)
Heat dissipation capacity (kW)	50 to 100 kW
Double tank IT gear capacity (RU)	21 U to 45 U
Max. CDU power consumption (W)	750 W to 1500 W

Smart Coolant

Protects IT Hardware

- Barrier against dust & moisture
- Thermal uniformity
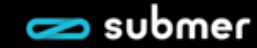- Sealed environment

15 year Lifespan

- Non-corrosive
- Non-oxidative
- No fluid loss

Environment & People Friendly
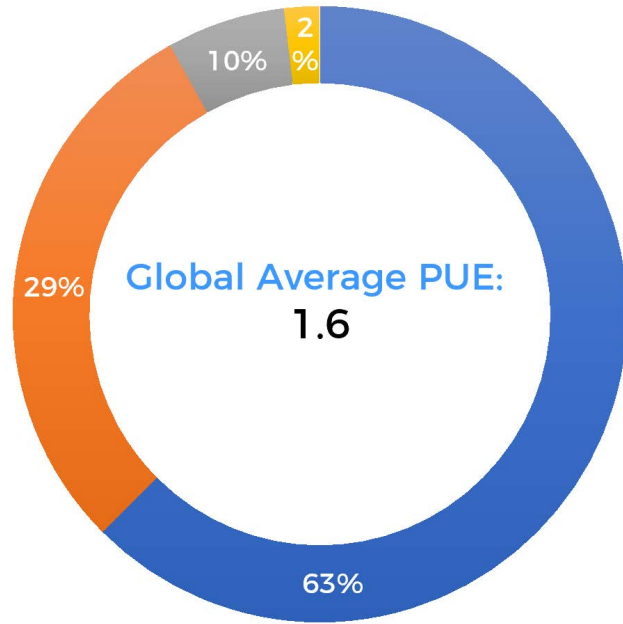
- Non-toxic
- Biodegradable
- Non-flammable

submer — TECHNICAL SPECS

| Fluid Type	Synthetic
Fire Point	233°C
Density @ 20°C	796 Kg/m³
Water content	≤20mg/kg
Thermal conductivity @ 40°C	0.14 W/m-K
Specific Heat @40°C	2,26 kJ/Kg-K
Breakdown voltage	≥50 kV
Biodegradability (28 days)	Readily Biodegradable

Power Usage Effectiveness (PUE)

is a ratio that describes how efficiently a computer data center uses energy; specifically, how much energy is used by the computing equipment.

Global Average PUE:
1.6

2%
10%
29%
63%

Global Average PUE:
< 1.0

(with immersion cooling)

Even in the world's hottest regions

3% 4%
93%

Current Data Center

Energy used by	PUE	%
IT Equipment	1.00	63%
HVAC Cooling	0.47	29%
Electricity	0.10	10%
Lighting	0.03	3%
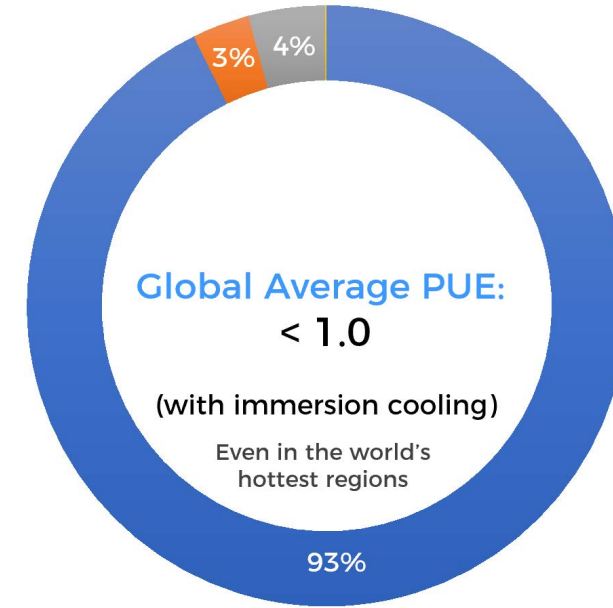
Data Center of the Future

Energy used by	PUE	%
IT Equipment	0.90	93%
HVAC Cooling	0.03	3%
Electricity	0.04	4%
Lighting	0.001	0.1%

Source: https://www.slideshare.net/Raritan/data-center-pue-reconsidered

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Our Immersion
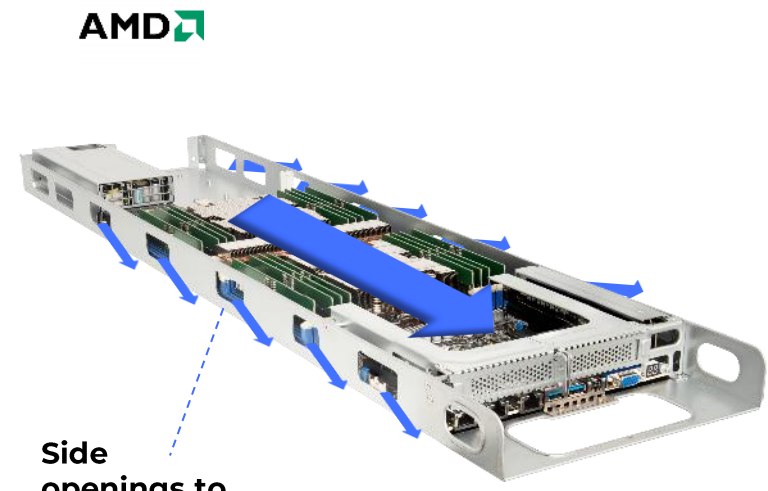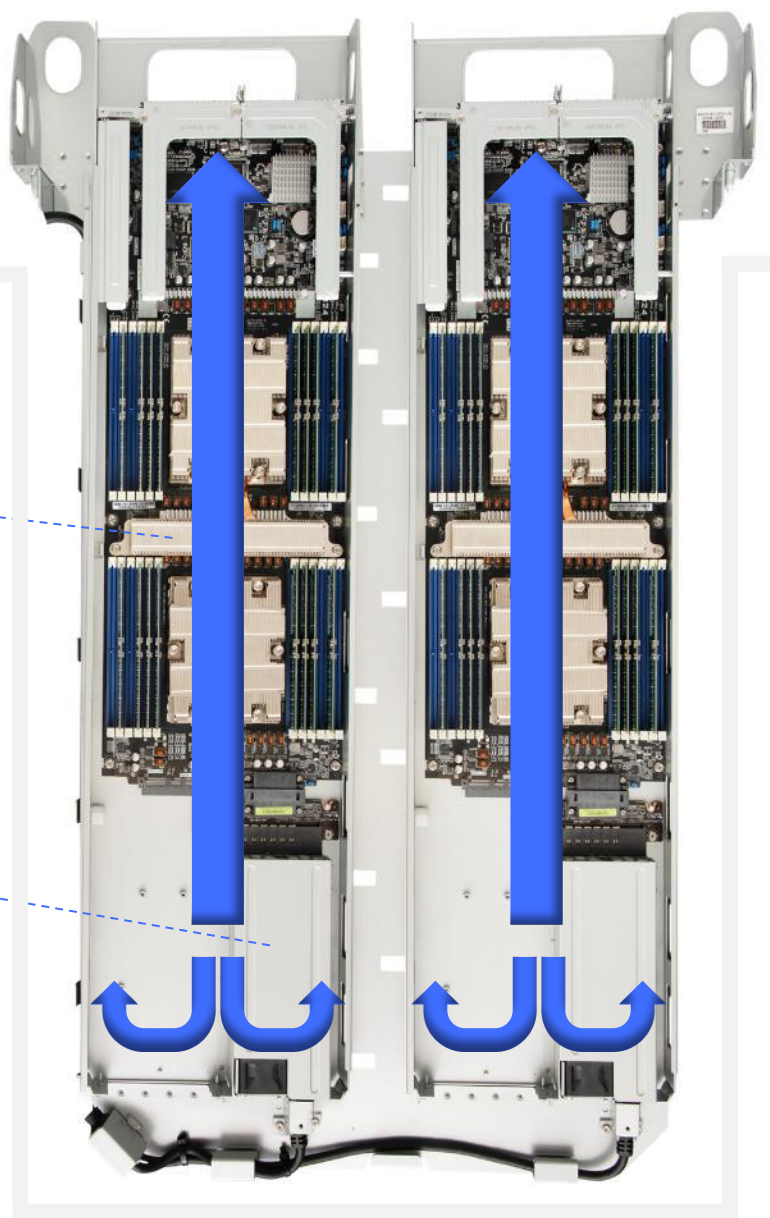Cooling Solution

Native immersion cooling

Optimized for clear pathways

Hypertec Immersion Born Server

Fluid moving freely for better efficiency

Power supply at the bottom

AMD

Side openings to improve liquid flow

Forced fluid convection flow rate
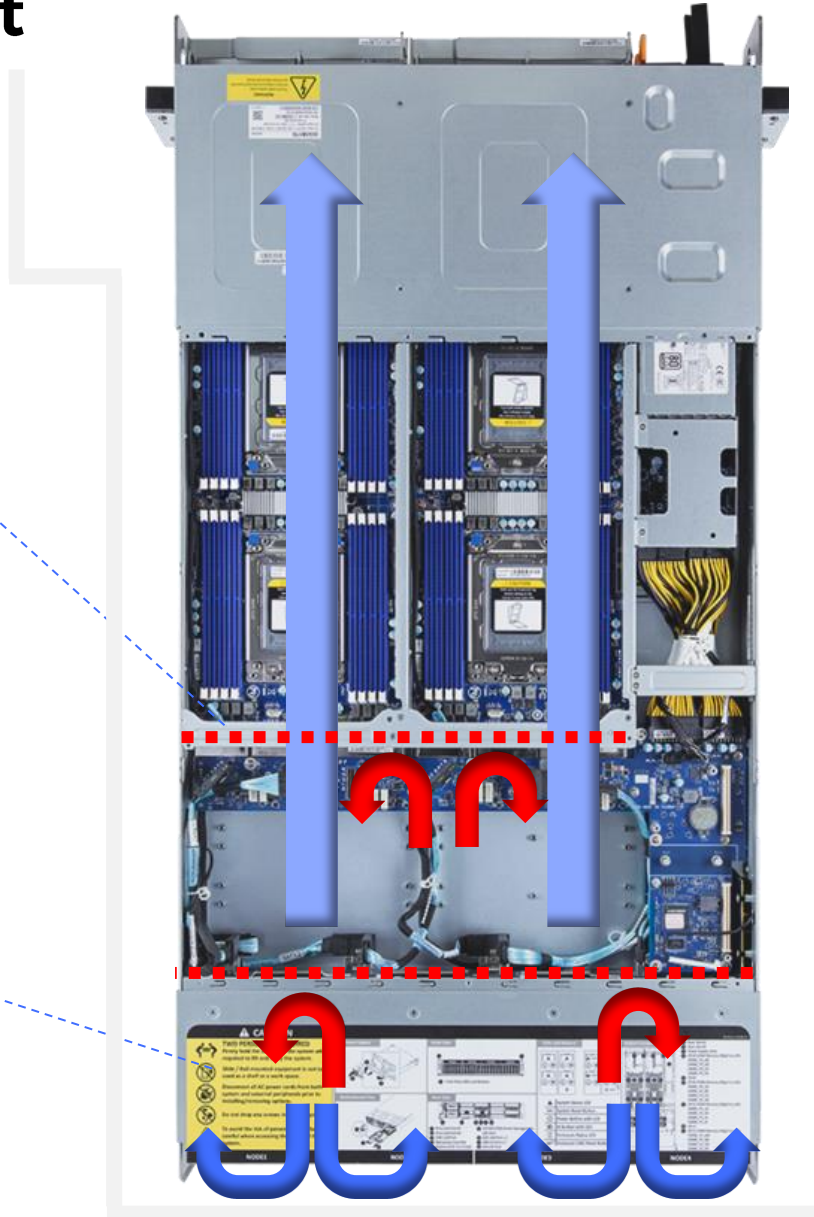
Air to Immersion Retrofit

Not optimized for paths of least resistance flow

Air cooled to immersion

Obstructed flow by chassis housings

SSD drives and the backplane at the bottom blocks the flow.

No side openings, initially design for air flow

Forced fluid convection flow rate

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An example immersion cooled server (CIARA **TRIDENT** iC610TR-G6)

Immersion-born design | Ultra high density

DENSITY

Industry best density with up to up 84/96 Nodes in 42/48U SmartPod

FLEXIBILITY

Platform is designed to accommodate multiple **form factors**, **chipsets**, **storage configs** and **power configs**

TCO

Sustainable hardware design **minimizes bill of materials costs**, **extends** useful life and improves serviceability
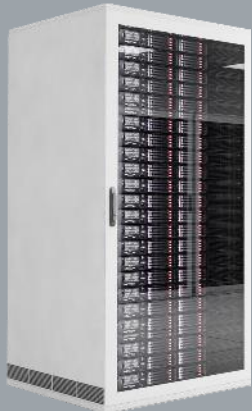
Data Center Do-Over

Data Center
14 GW per year
PUE: 1.6

Traditional Infrastructure

Sustainable Infrastructure

Data Center
9 GW per year
PUE: 1.02

Traditional Rack
50 racks
20 kW per rack

-
56%
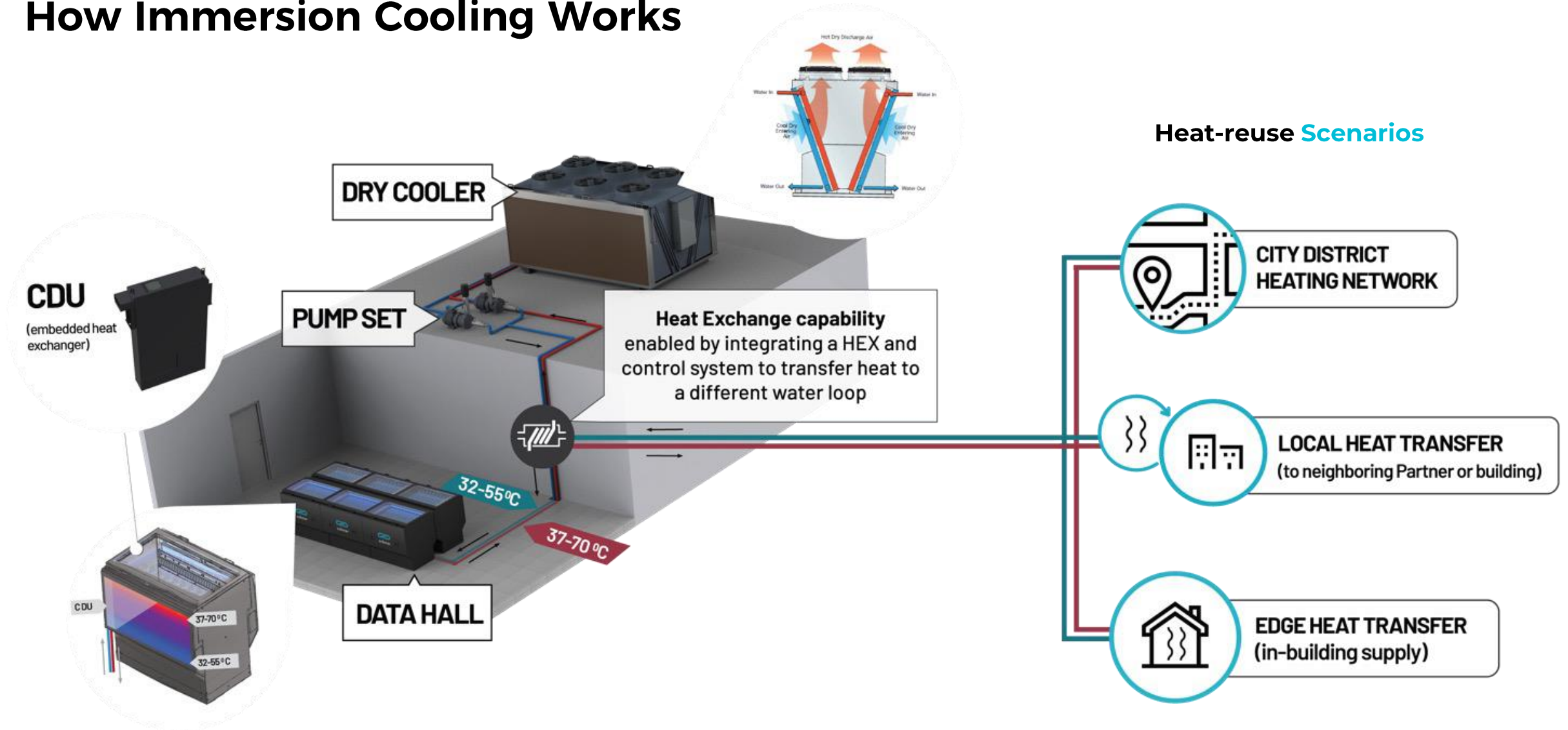in space

Up to -
50%
in annual energy consumption and cost

Immersion cooling
10 pods
100 kW per pod

How Immersion Cooling Works

Heat-reuse Scenarios

DRY COOLER

CDU (embedded heat exchanger)

PUMP SET

Heat Exchange capability enabled by integrating a HEX and control system to transfer heat to a different water loop

32-55°C

37-70°C

DATA HALL

CDU
37-70°C
32-55°C

CITY DISTRICT HEATING NETWORK

LOCAL HEAT TRANSFER (to neighboring Partner or building)

EDGE HEAT TRANSFER (in-building supply)

* 70°C outlet temperature is based on the modeling of Submer's proprietary precision cooling of immersion ready IT hardware. Submer is actively working with technology partners to validate these modeling results with real world test data.
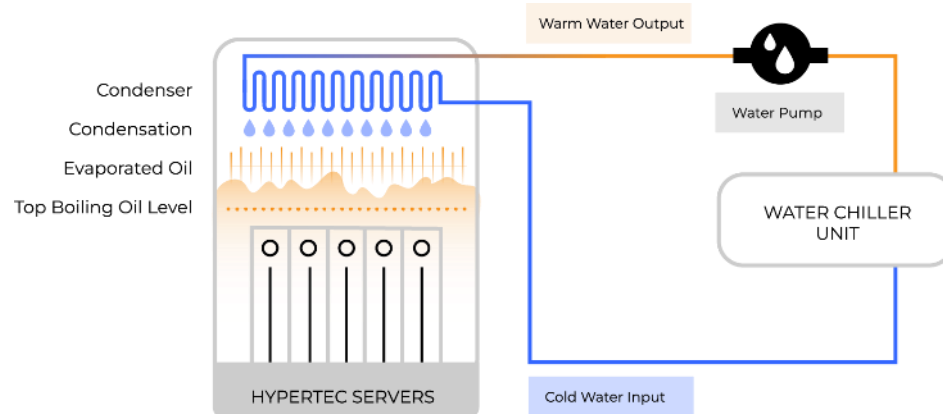
Single-phase vs. Two-Phase Immersion

Following an assessment on single-phase and two-phase immersion systems, Hypertec has decided to entirely focus its roadmap on **single-phase immersion technology.**

SINGLE-PHASE
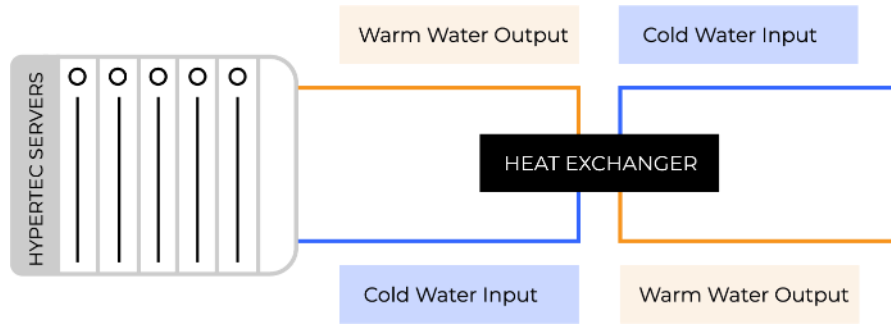
TWO-PHASE

The following table summarizes Hypertec's comparison of the technologies:

CRITERIA	SINGLE-PHASE	TWO-PHASE
Power Usage Effectiveness (PUE)	✔	✔
Fluid Loss	✔	✘
Toxicity of Fluid	✔	✘
Biodegradability of Fluid	✔	✘
Material Compatibility	✔	✔
Cost	✔	✘
Maintenance	✔	✘

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Immersion Cooling Benefits

Efficiency in space, cost & use of resources

Reduce Overall Energy Consumption

Increase your CPU Power

Reduce your HW failure rate

Reduce Building Costs

Reduce Hardware CAPEX & OPEX Costs

Reduce your Carbon Footprint

-95%   Reduction in Cooling OPEX

x 10   Increase in Server Density

0%   Water Consumption or Waste

-50%   CAPEX Reduction

+30%   Increase in HW Life-span

99%   Heat Captured in Form of Warm Water – No Water Consumed

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Additional Key Benefits

PERFORMANCE

15%

⬆ **Performance** (a)
Increased

COST SAVINGS

10%

⬇ **Reduction
in System Cost** (b)

SUSTAINABILITY

85%

**Usage of
Recycled Materials** (c)

(a) CPU frequency (base vs Hypertec AOT Static Turbo-Lock – Intel® Xeon® Platinum 8358 Processor – 32 cores)

(b) Up to 10% chassis bill of materials cost savings comparing CIARA TRIDENT iCX610-G5 vs Market Retrofit Options

(c) Expected % of the chassis and blade for the CIARA TRIDENT iCX610 series that will be made of recycled materials starting in Q1 2023

Ontario, Canada

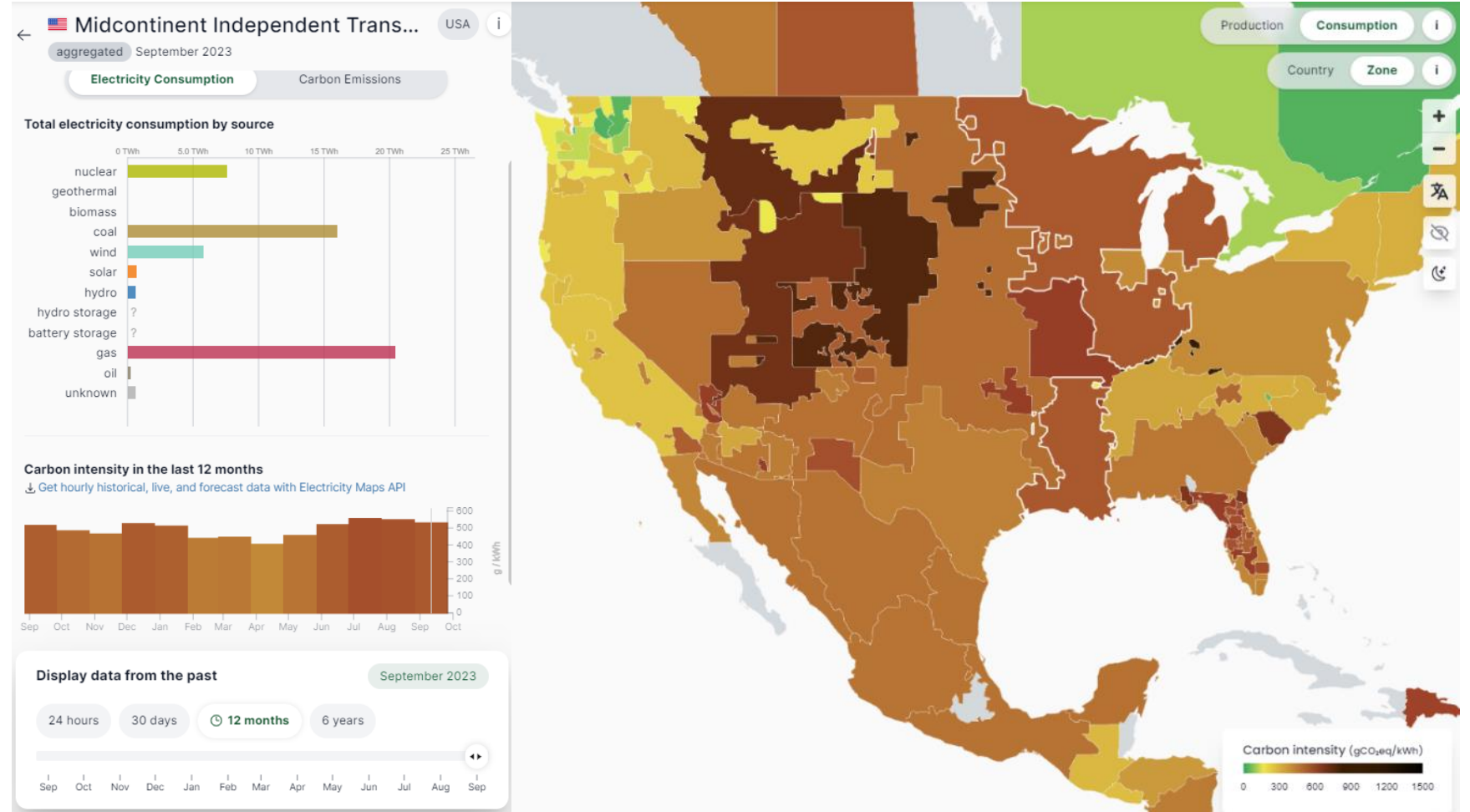## Average Carbon intensity from October 2022 to September 2023 = 71.08 gCo2/KWh/month

- ❖ A typical Data Center Infrastructure would use 1.6MW of power for 1MW of Critical IT load

- ❖ Using Immersion Cooling technology, we could see that number come down to 980KW

- ❖ This decrease would represent a yearly cost reduction of 543K CAD

- ❖ This represents 386T of CO_2 reduced

- ❖ In addition, if heat recuperation is used there would be an additional 490K CAD and 348T of CO_2

Source: www.electricitymaps.com
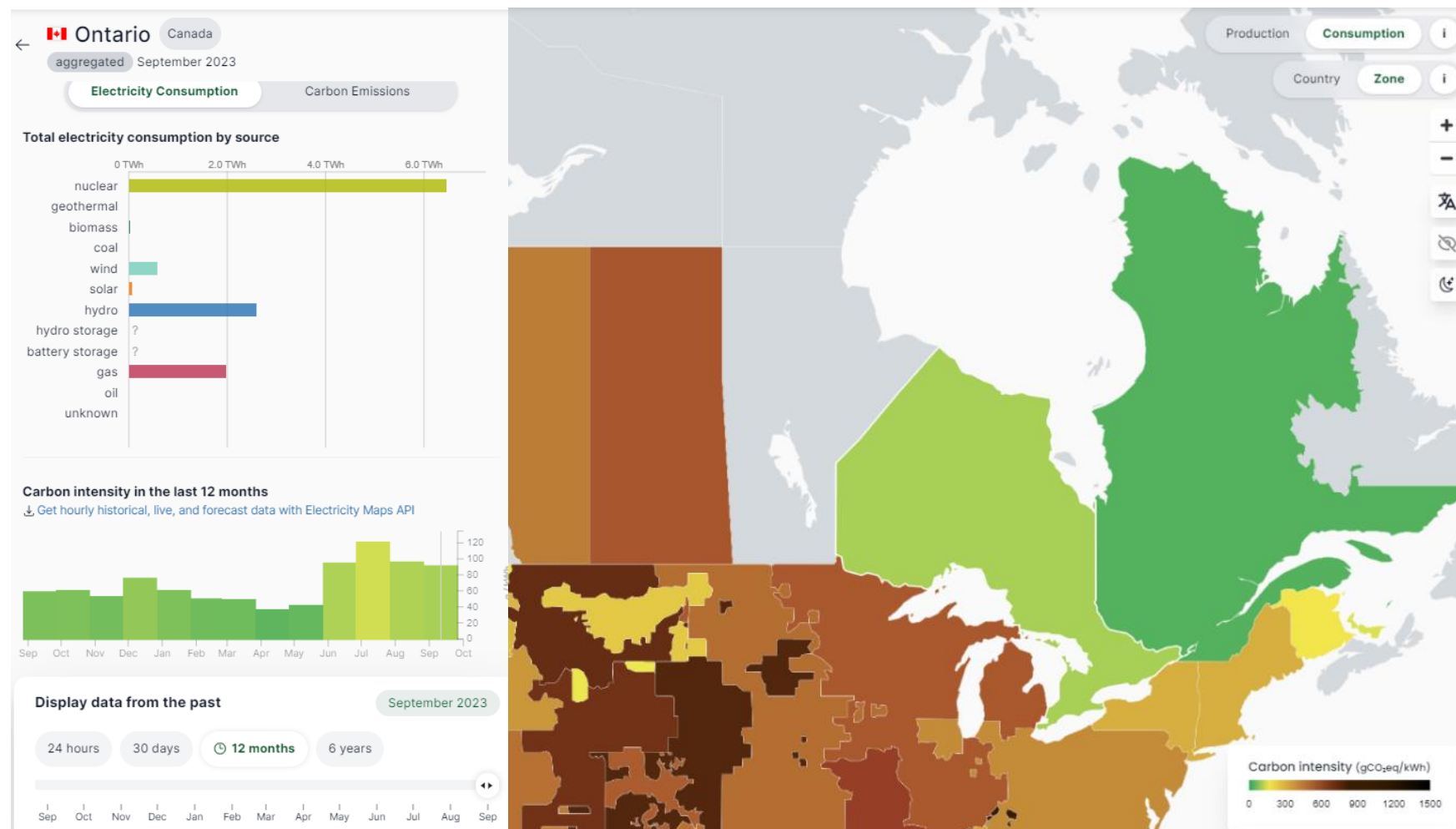
Zone: Midcontinent, USA (MI, MN, WI, IA, IL, AR, LA)

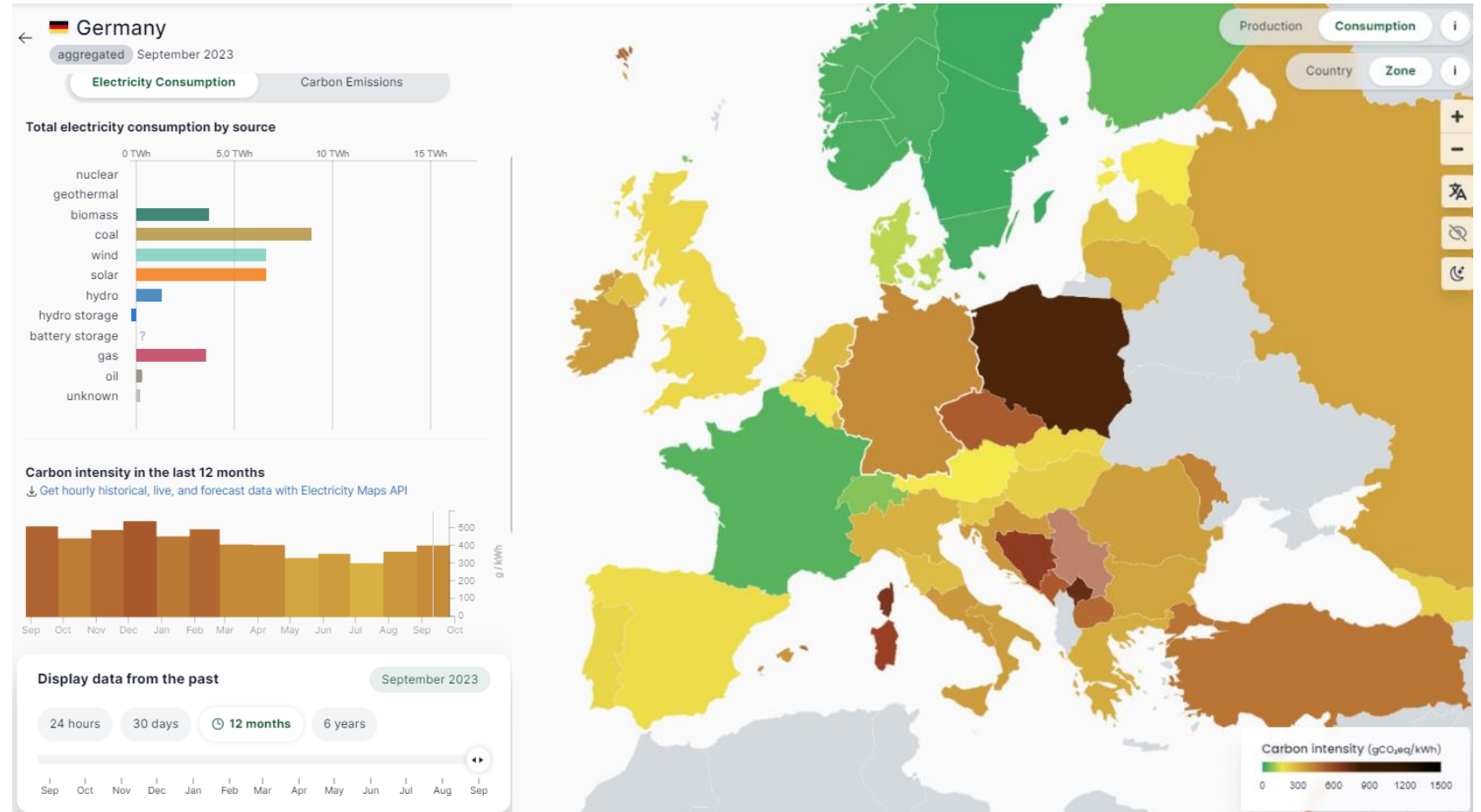## Average Carbon intensity from October 2022 to September 2023 = 499.50 gCo2/KWh/month

❖ A typical Data Center Infrastructure would use 1.6MW of power for 1MW of Critical IT load with Immersion Cooling this comes down to 980KW

❖ This decrease would represent a yearly cost reduction of 869K USD

❖ This represents 2713T of CO2 reduced

❖ In addition, if heat recuperation is used there would be an additional 784K USD and 2448T of CO2

Germany

Average Carbon intensity from October 2022 to September 2023 = 417.75 gCo2/KWh/month

❖ A typical Data Center Infrastructure would use 1.6MW of power for 1MW of Critical IT load with Immersion Cooling this comes down to 980KW

❖ This decrease would represent a yearly cost reduction of 2.27M Euro

❖ This represents 2269T of CO2 reduced

❖ In addition, if heat recuperation is used there would be an additional 1.8M Euro and 1793T of CO2

Source: www.electricitymaps.com

THANK YOU