Immersion cooling & Open standards

A new era for Data Centers

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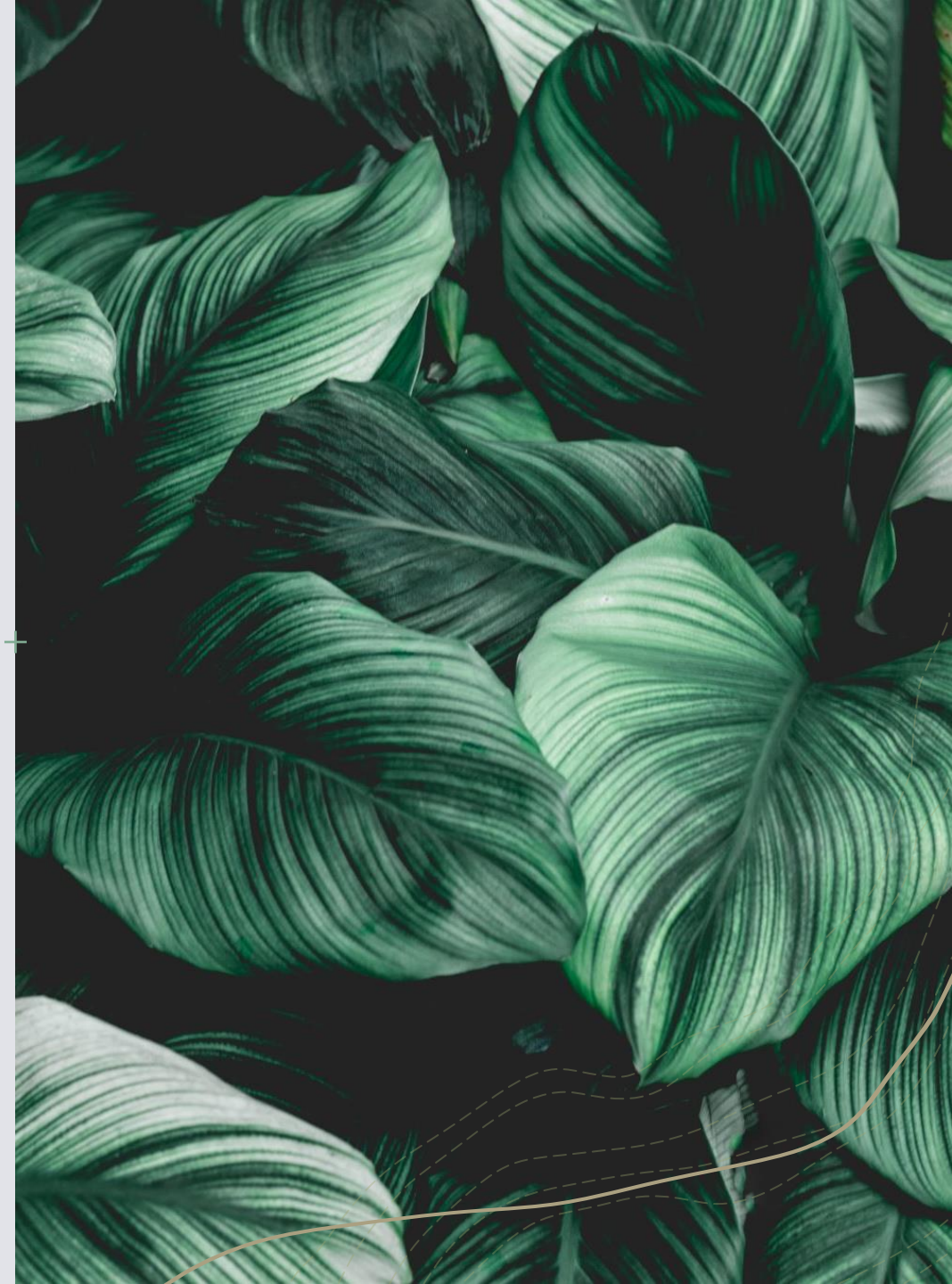

Agenda

- Data Center sustainability metrics
  - PUE
  - Other metrics
- Industry status
- Alternatives to air cooling
  - Direct Liquid Cooling
  - Immersion Cooling
- Why liquid cooling is important
- Immersion Cooling
  - Adaptations/tanks
- Open standards – OCP
- Our work (steps taken and next milestones)
- Benefits

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NEXT GENERATION DATACENTERS

Data Center sustainability metrics

PUE

WATER USAGE

DENSITY

GREEN ENERGY COEFFICIENT

ENERGY REUSE FACTOR

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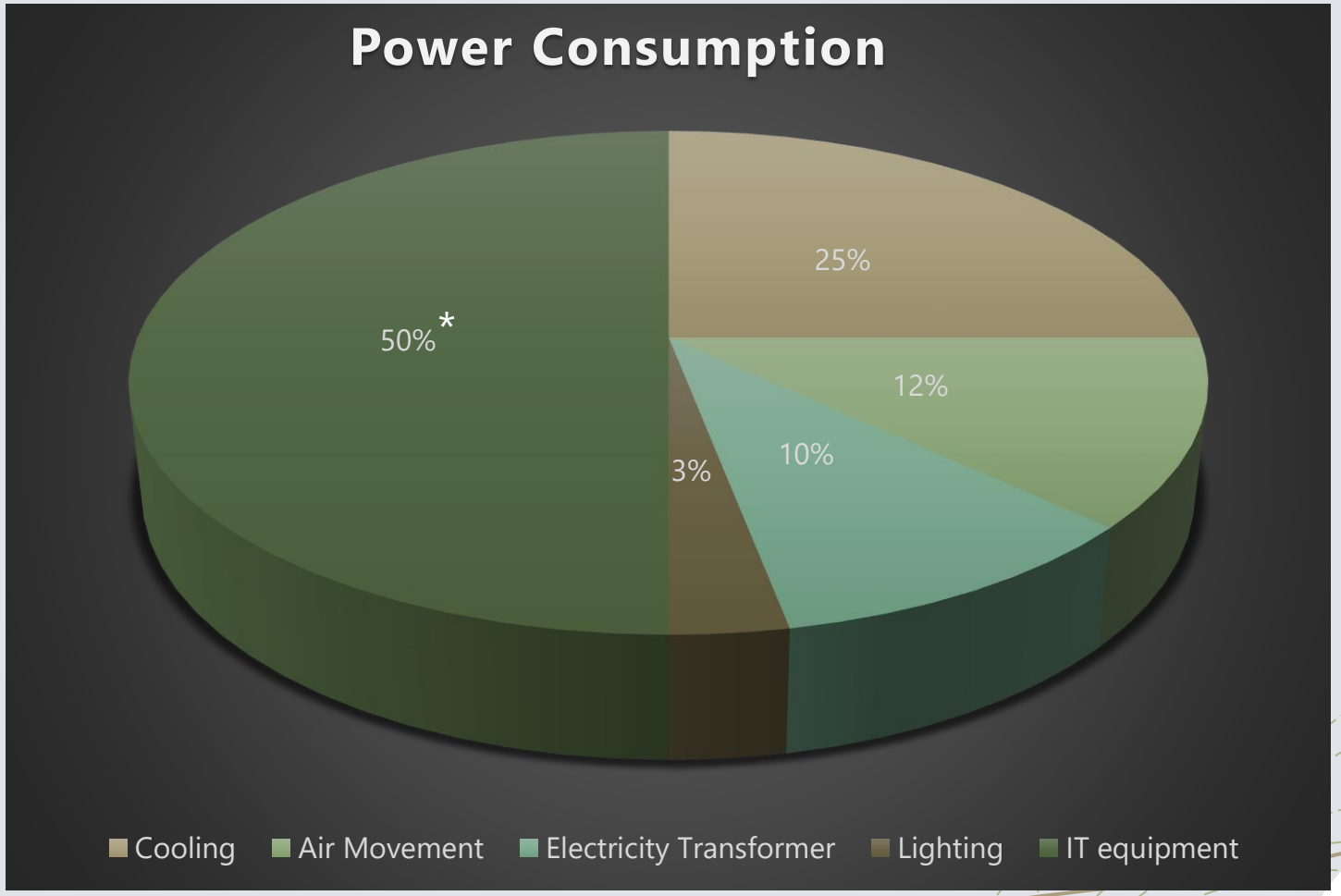
Power Usage Efficiency

$$\text{PUE} = \frac{Total\ Facility\ Power}{IT\ Equipment\ Power}$$

2 < Typical Data Center

Depends on environmental conditions



** Power efficiency of the IT equipment itself is not captured*

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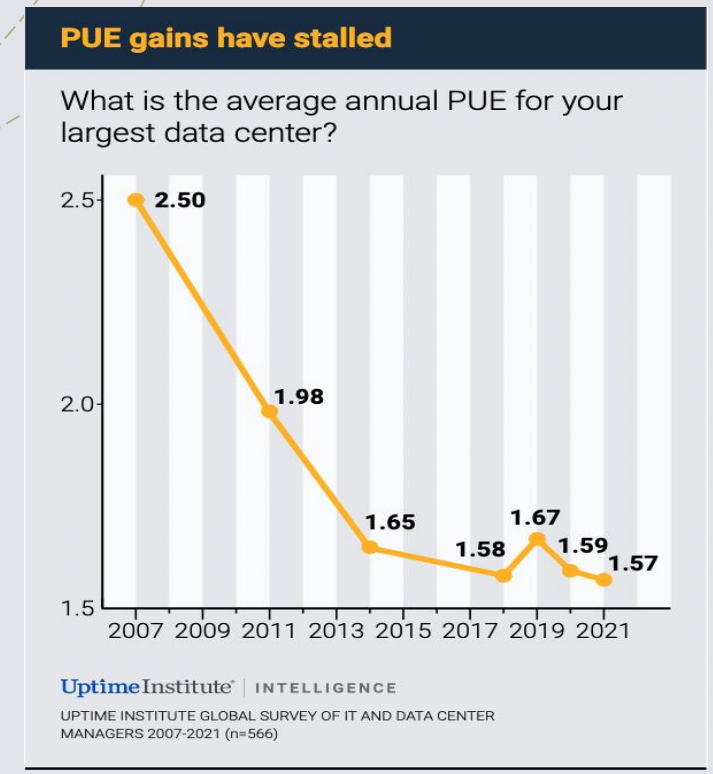
Other metrics

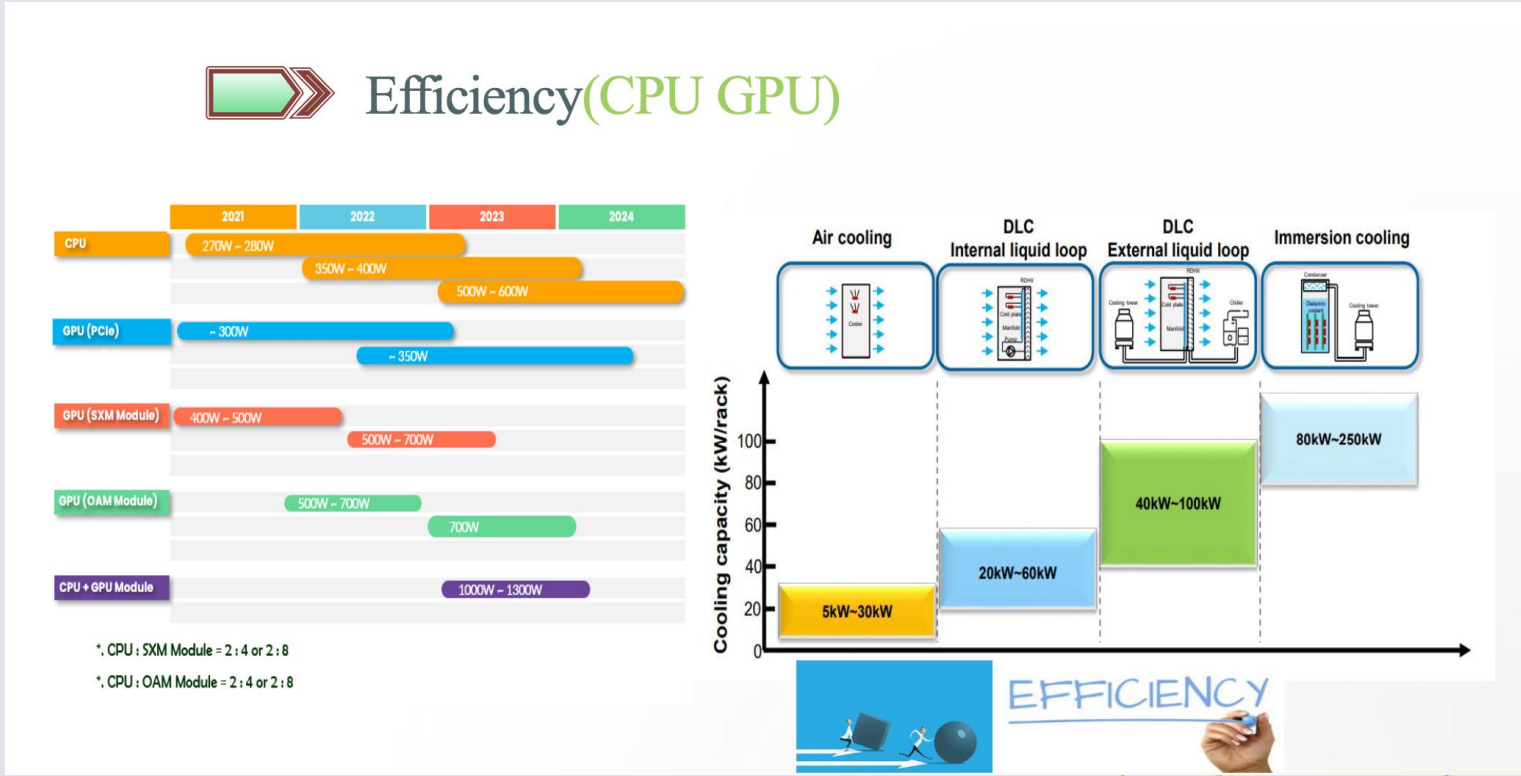
- Water consumption
  - How much water is used in a Data Center for cooling
  - WUE = Data center water consumption (L) ÷ IT equipment energy usage (kWh)
- Density
  - The amount of electrical power dimensioned per rack
  - Function of power availability & cooling system capacity
  - Metered as Kw/rack or Kw/U
- Clean energy co-efficient
  - How much of the energy used in DC comes from green resources
- Energy re-use factor
  - How much of the energy consumed in DC is recovered heat → {many}

Industry Status

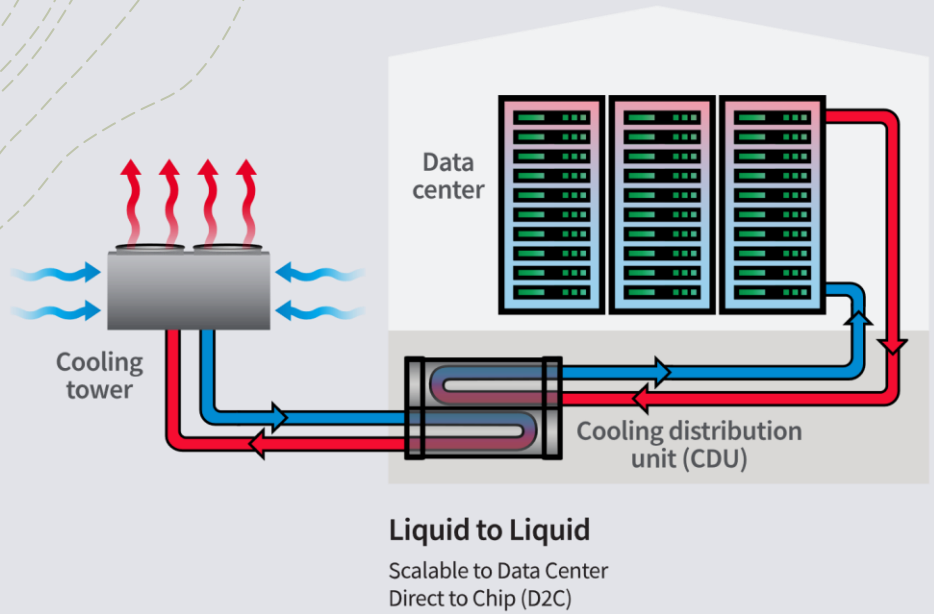
PUE



Density



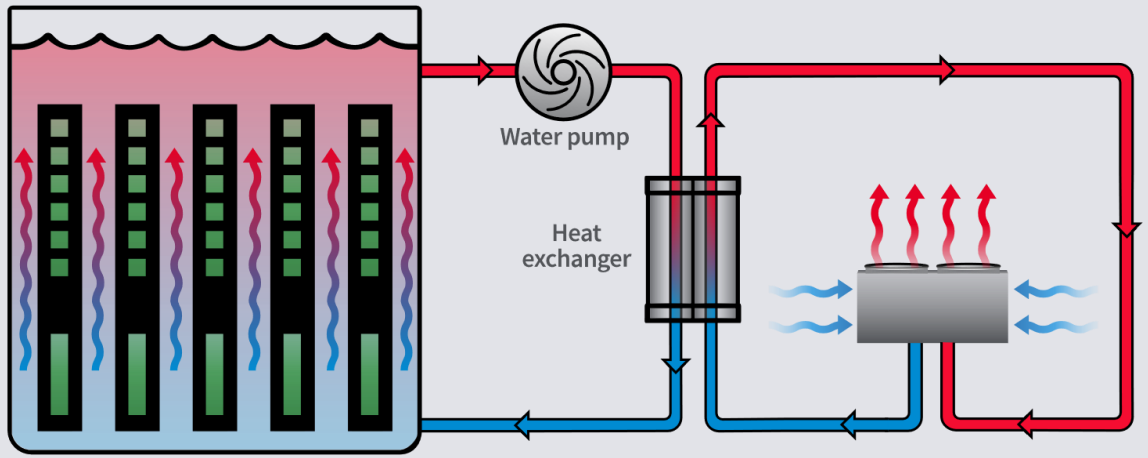
Alternatives to air cooling – DLC



- Direct to Chip (D2C) or Direct Liquid Cooling (DLC)
  - Liquid cooled heat sinks on the hotest componets of the server
  - Still using air cooling for other parts
  - Hybrid solution
- Pros
  - Good performance
  - Near to current DC work culture
- Cons
  - Leakage risky
  - Complex setup in each server

Immersion Cooling

- Servers completely immersed in dielectric coolant, non-conductive
  - Two phase or single phase
  - Dielectric coolant
  - Embeded heat exchanger and redundant pumps
  - Coolant gets cooled by facility closed-loop water piping
  - External dry chiller or cooling tower
  - or other cooling technique applicable (condenser, geothermal installation...etc)



Immersion

Excellent Heat Removal
Immersion (entire system)—From 25kW to 200kW

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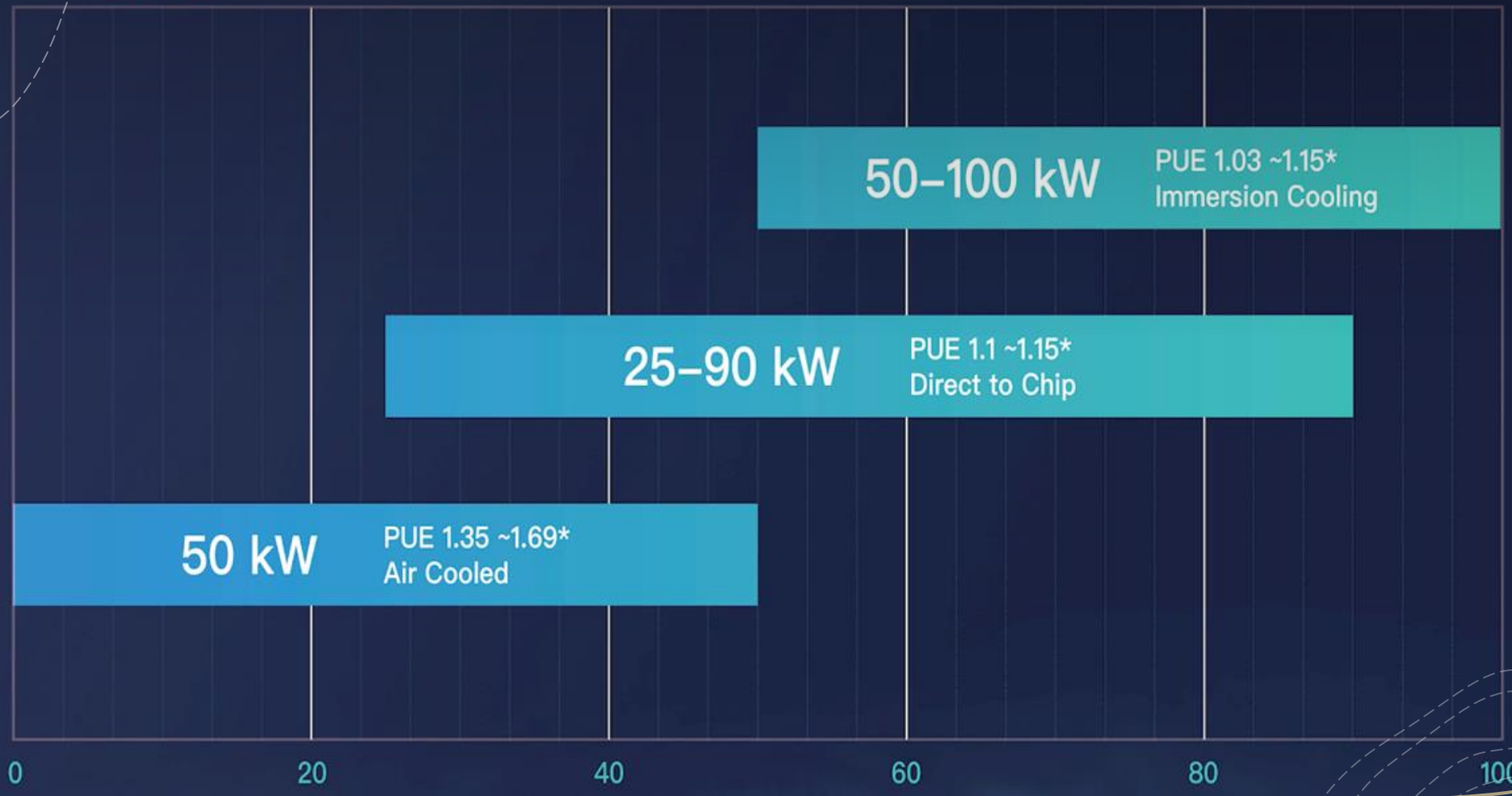
Why Liquid Cooling is important?

* Estimated data



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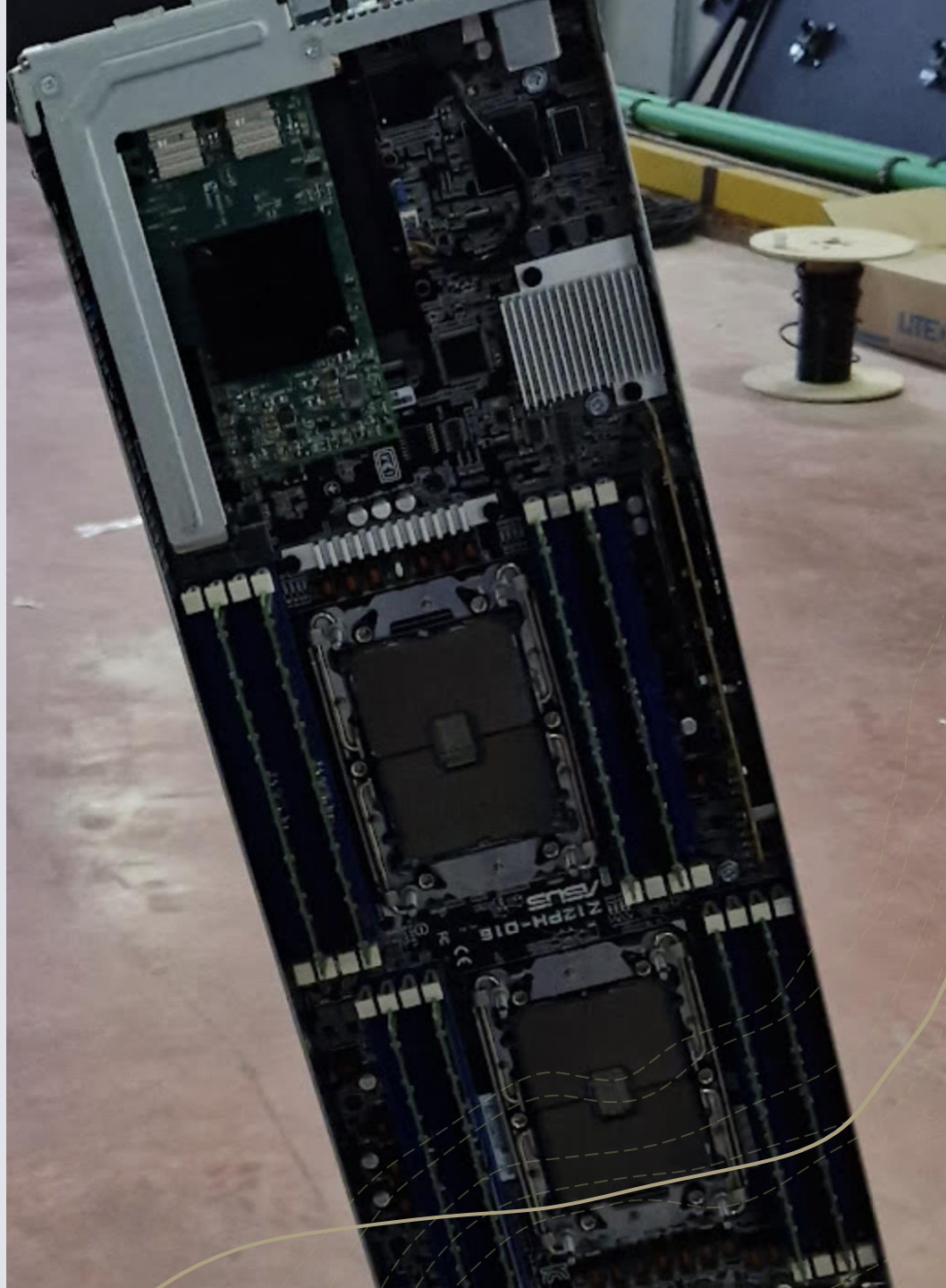
Immersion Cooling adaptations

- Servers:
  - No fans & air corridors
  - No heat sinks or redesigned for higher viscosity
  - No thermal paste - use indium folio
  - Design should allow coolant circulation (avoid heat caves)
  - Front I/O as possible
  - Denser
  - Use copper for connectivity or
  - Keep optical links out of oil



Immersion tanks (single phase)

+ Open bath
+ Internal or external CDU
+ 1+1 pumps for redundancy
+ Support from 6 OU to 44 OU
+ Status monitoring and reporting
+ Dry zone for non-immersive components
+ Power Management

Open Standards

Opencompute.org:

- The Open Compute Project (OCP) is a collaborative community focused on redesigning hardware technology to efficiently support the growing demands on compute infrastructure

Driven by hyper-scalers: **Google, Meta, Intel, Microsoft, AWS**

Mission:

- We believe that openly **sharing** ideas, **specifications**, and other intellectual property is the key to maximizing innovation and reducing complexity in tech components.

Tenets:

- Efficiency
- Impact
- Openness
- Scalability
- Sustainability

Result: Driving market towards common standards on building Open Data Centers

OCP Workgroups

Rack & Power

- Open Rack Specs (ORV3)
- Common Power Supply Unit - PSUs
- Common Battery Backup Unit
- Connectors
- Busbars

https://www.opencompute.org/wiki/Open_Rack/SpecsAndDesigns

Cooling Environments / Immersion (all 12)

- Fluids and materials
- Immersions Requirements
- Power Distr. in Immersion
- HW mgmt. for Liquid Cooling
- …

https://www.opencompute.org/wiki/Cooling_Environments/Immersion

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Ecosystem

Server vendors	Provide Immersion Ready servers
Power Supply Vendors	Provide PSUs / BBUs OCPv3 compliant
Networking vendors	Provide Immersion Ready ToRs
Solution Providers	Build experience Best practices

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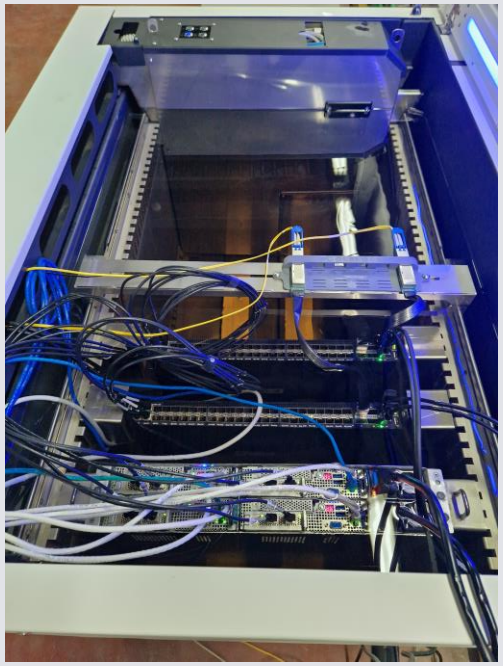
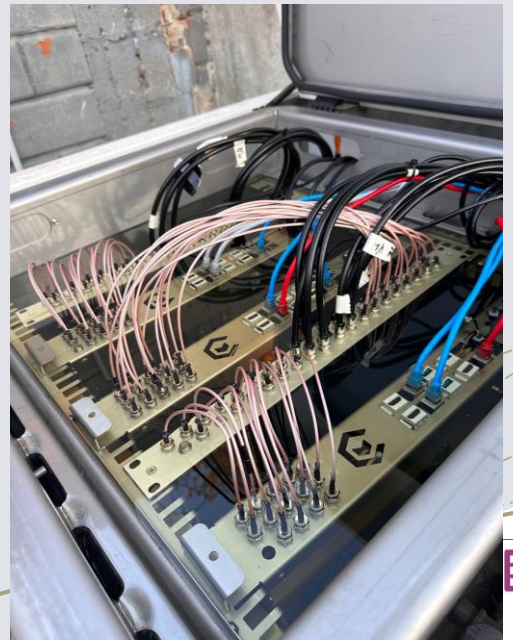
Steps taken

- Archemedes
  - ❑ Indoor system usind facility water (closed loop)
  - ❑ Immersed CDU (1+1)
  - ❑ 21”
  - ❑ 20RUs & 44RUs form factors
  - ❑ 25KWatt and 50KWatt capacity for IT equipment
  - ❑ OCP compliant (ORV2 & ORV3) and legacy installations
- Athena
  - ❑ Outdoor system
  - ❑ Using condenser for cooling
  - ❑ 21”
  - ❑ 6RUs & 10RUs form factors
  - ❑ 5KWatt and 8KWatt capacity for IT equipment
  - ❑ OCP compliant (ORV3) and legacy installations





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Operation

Indoor

50 KW immersion setup in Athens (SNC2)

ASUS immersion servers

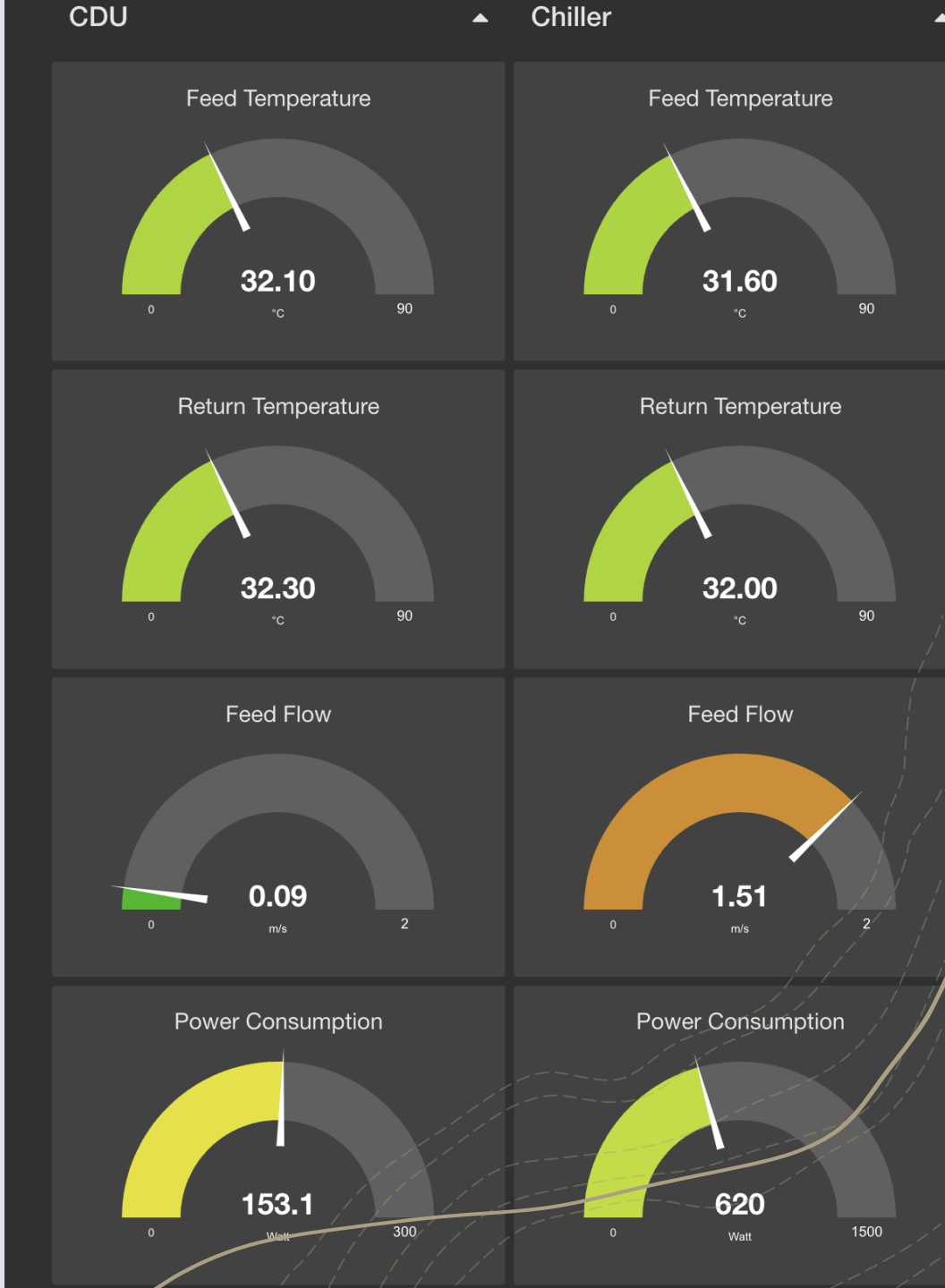
Dell networking (2 x ToR)

HCI Cloud Infra (Proxmox + Ceph)

Outdoor

Under the tower signal processing

Conversed off-the-self servers



Next product development steps

New heavy load cluster with high end CPUs + GPUs (on going)

Complete new iteration on tank design (on going)

Full ORV3 compatible

Integrated PSUs & BBUs for full standalone applications

Improve serviceability and ease of management

Build and test remote standalone application (Atlantis) close to Points of Interest (resources or customer)

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Benefits

- PUE close to 1.1 equals to 83% less energy for cooling (comp to 1.6)
- Far quicker DC infrastructure
  - Simpler construction
  - Tested legacy components
- 30% extension to electronic equipment lifetime
- Better performance (Higher clock speed)
- Data Center in a Tank
- Simpler heat reuse applications

Questions

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