REVOLUTION COOLING

A PARADIGM SHIFT IN DATA CENTER SUSTAINABILITY

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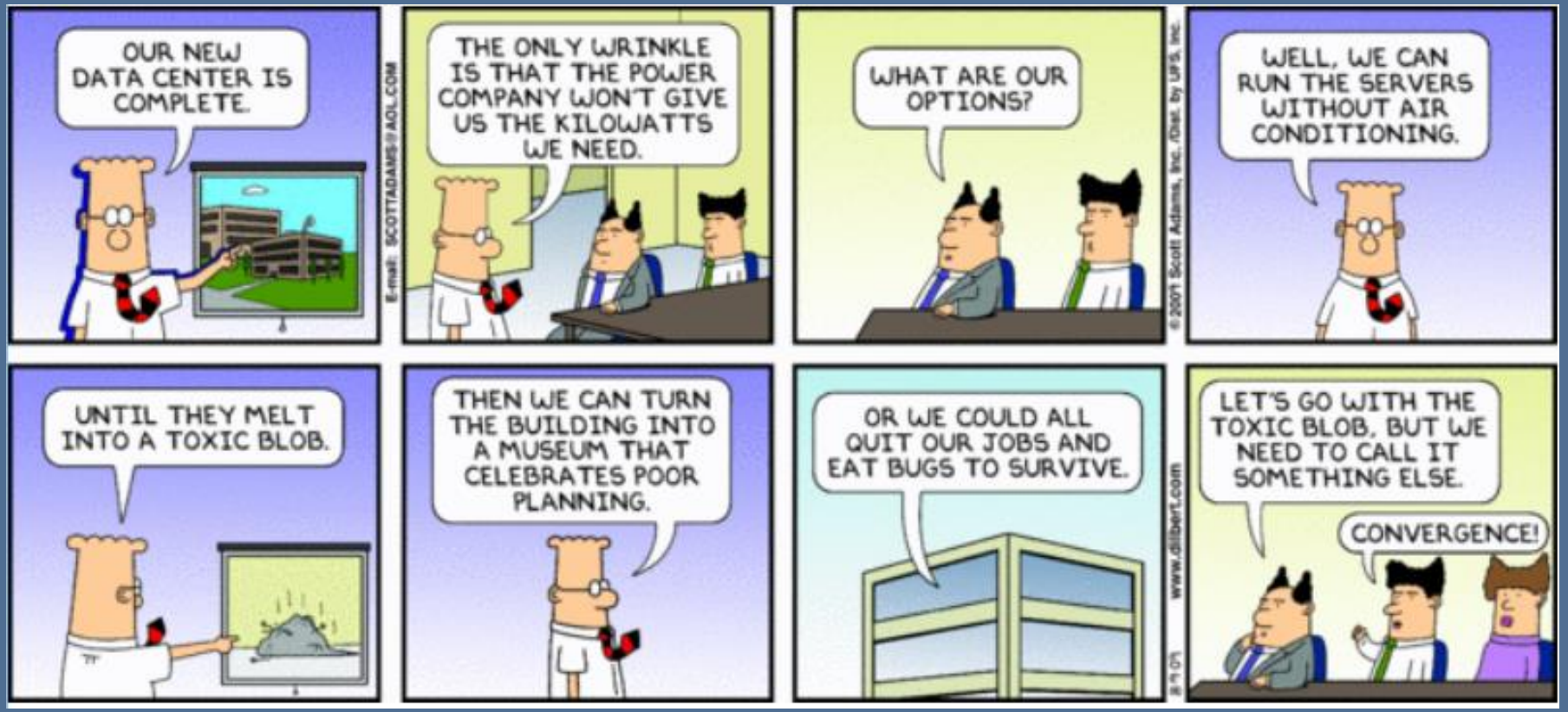
OUR NEW DATA CENTER IS COMPLETE.
THE ONLY WRINKLE IS THAT THE POWER COMPANY WON'T GIVE US THE KILOWATTS WE NEED.
WHAT ARE OUR OPTIONS?
WELL, WE CAN RUN THE SERVERS WITHOUT AIR CONDITIONING.
UNTIL THEY MELT INTO A TOXIC BLOB.
THEN WE CAN TURN THE BUILDING INTO A MUSEUM THAT CELEBRATES POOR PLANNING.
OR WE COULD ALL QUIT OUR JOBS AND EAT BUGS TO SURVIVE.
LET'S GO WITH THE TOXIC BLOB, BUT WE NEED TO CALL IT SOMETHING ELSE.
CONVERGENCE!
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Data Center Density

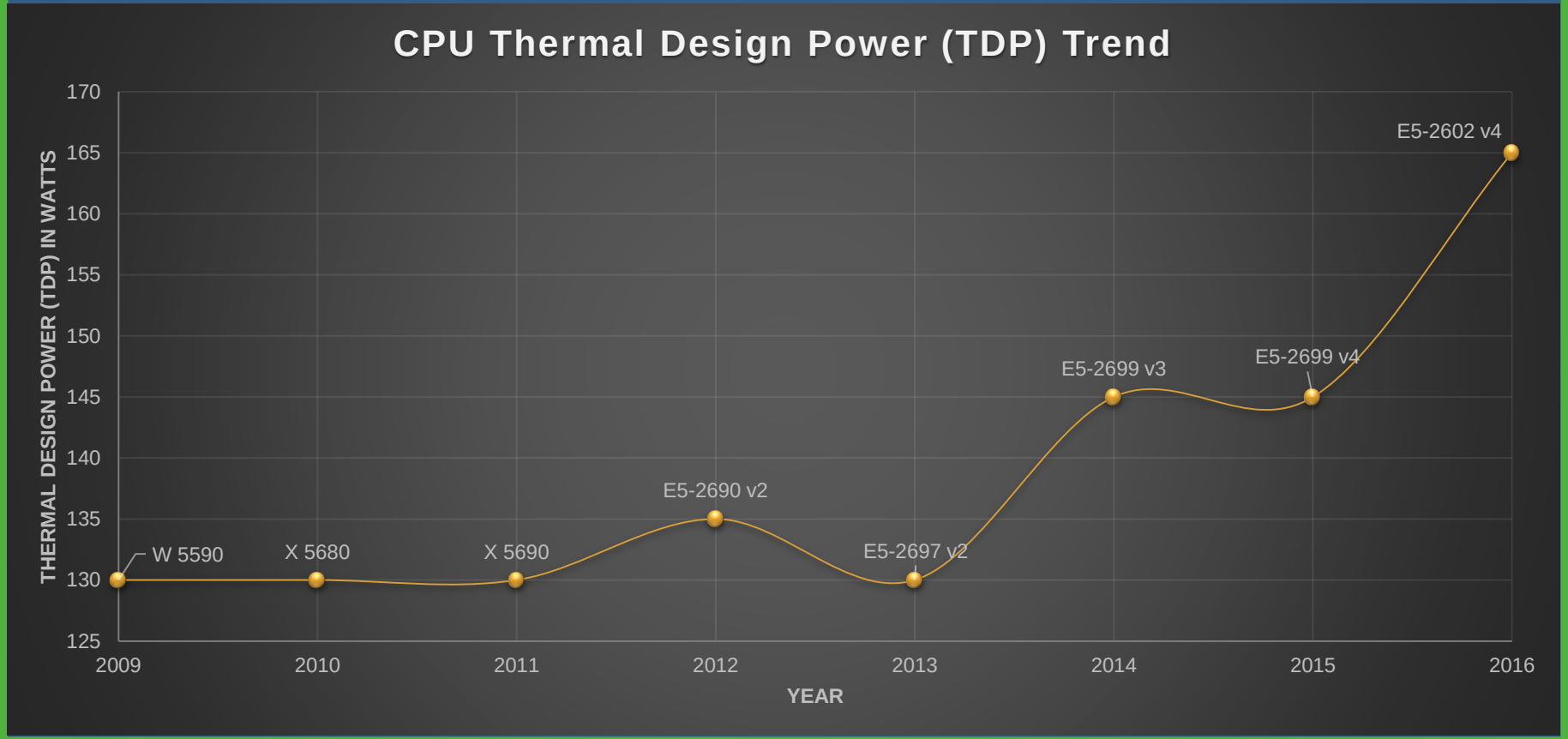
Rack Density kW/Rack

Data Center Density (W/sq ft)

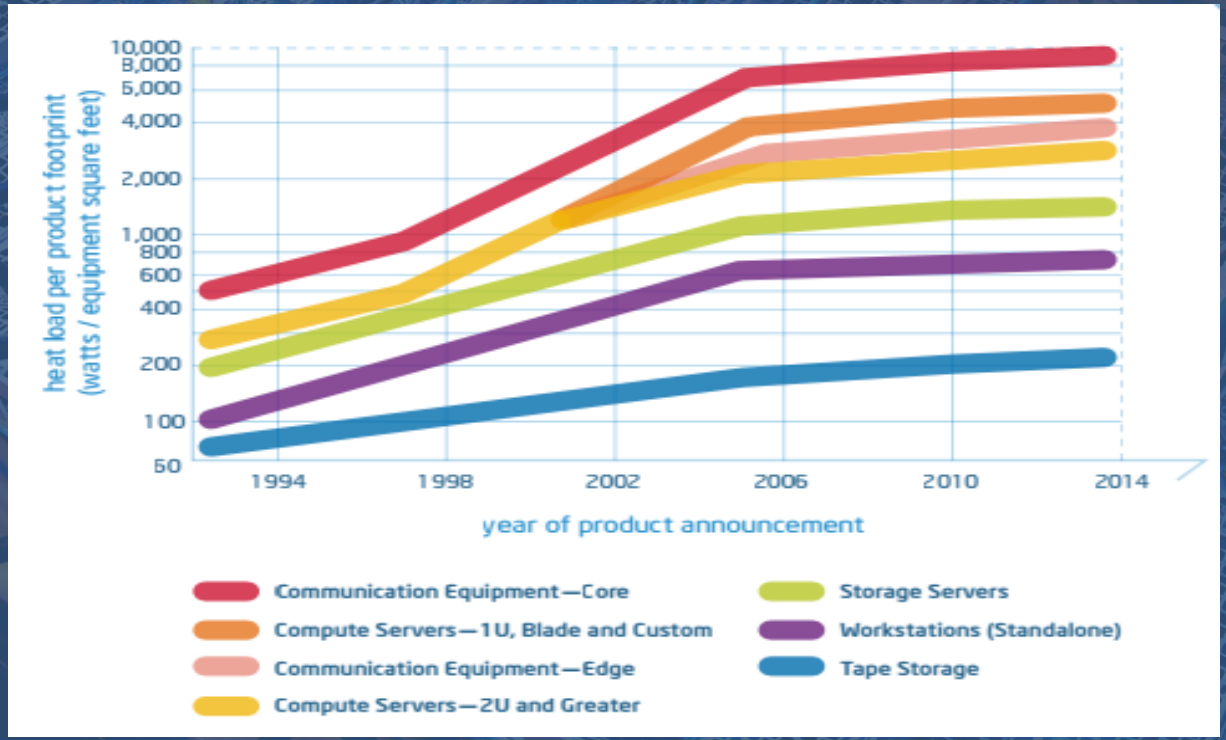
Chip Density –TDP (W)

Hardware Density (W/equipment sq ft)

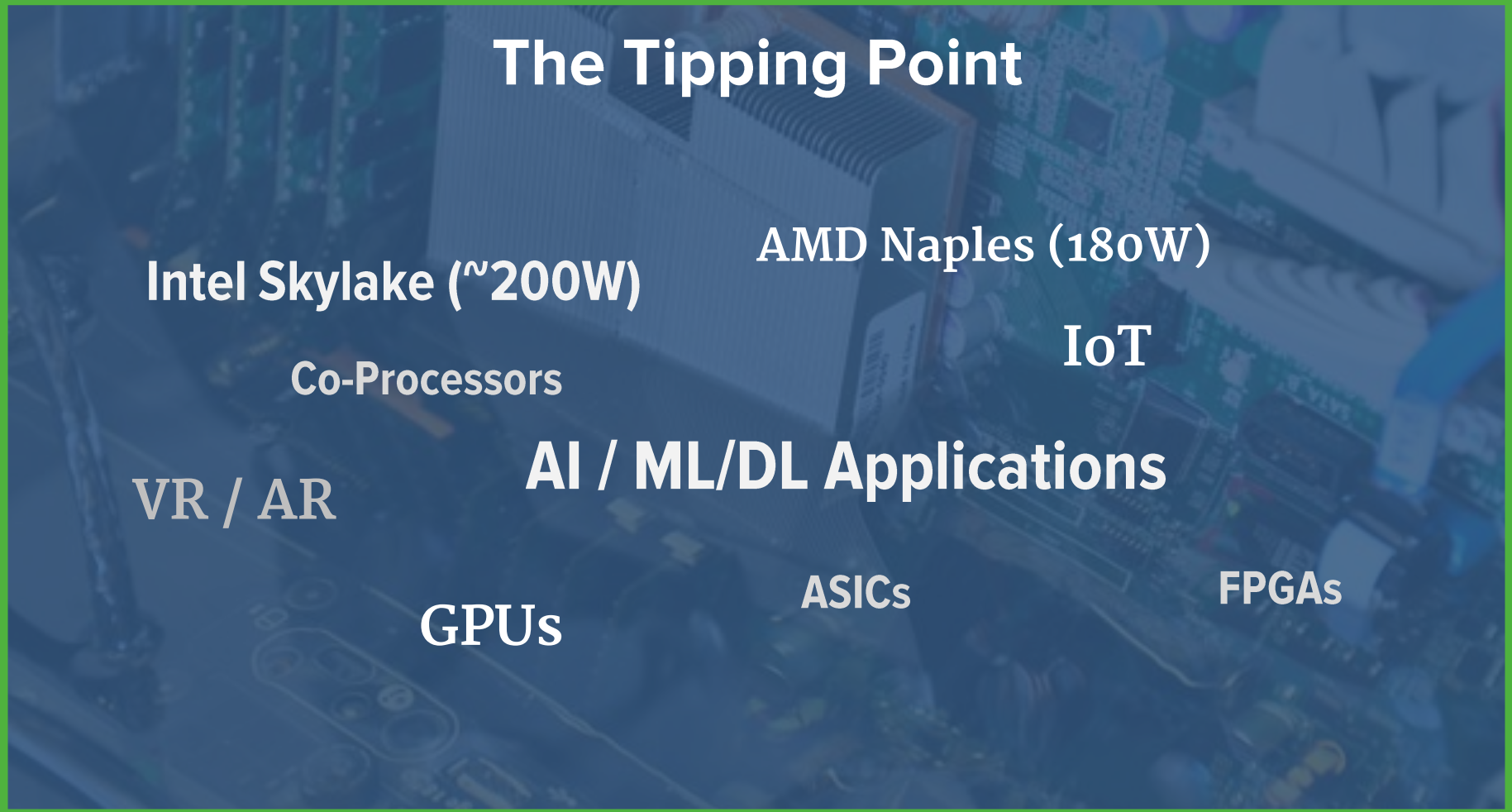
Hardware Density is Rising



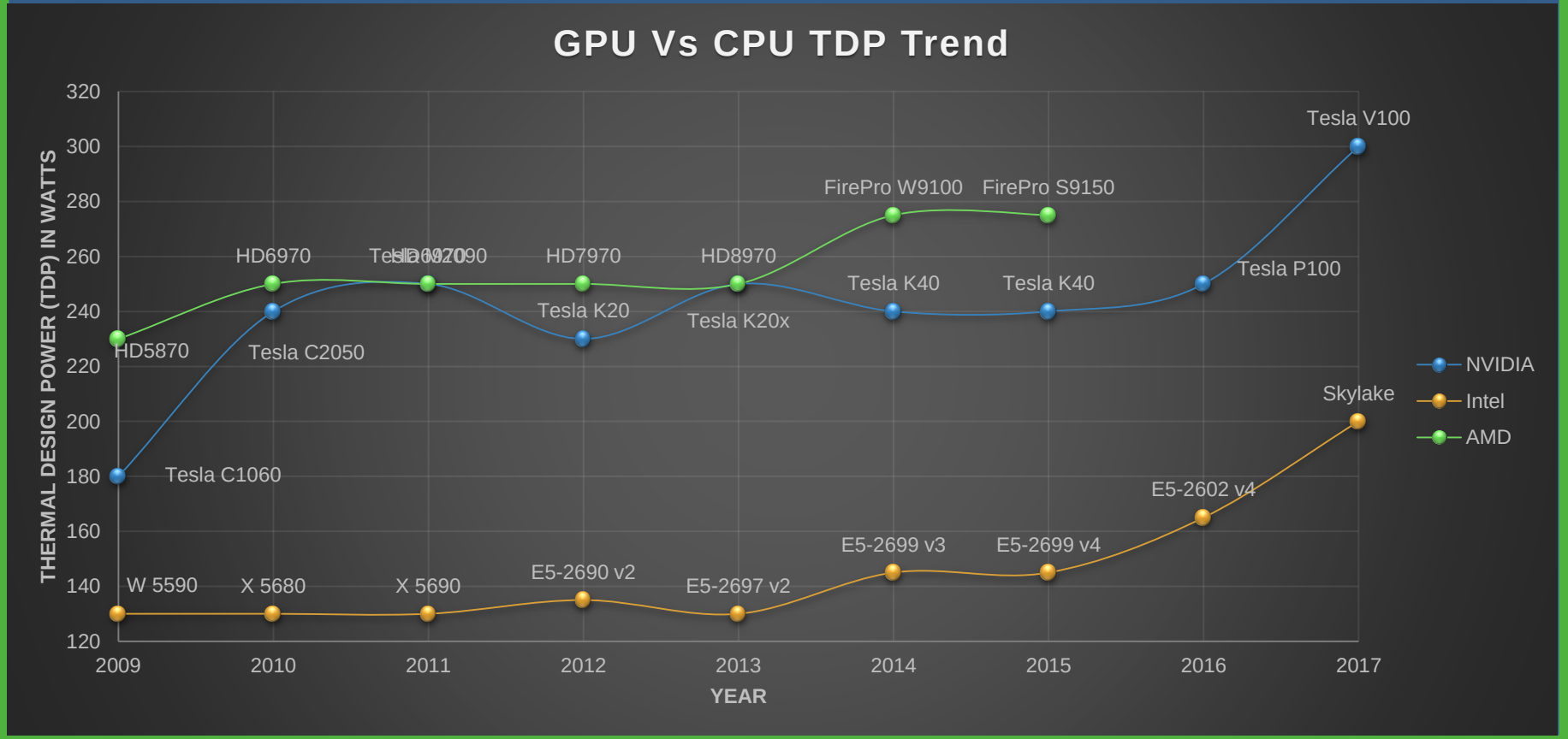
Rack Density Growth Has Been Slower



Source: ASHRAE TC 9.9 equipment power projection


The Tipping Point
Intel Skylake (~200W)
AMD Naples (180W)
IoT
Co-Processors
AI / ML/DL Applications
VR / AR
ASICs
FPGAs
GPUs

Expected Hardware Density



To Put it Into Perspective

AI Work Horse: NVIDIA DGX-1

- 3.2kW per 3U box
- 14 of these servers would take up a full 42U rack and require ~45kW of power
- In a traditional air-cooled data center these 14 boxes would need to be spread across 3 or more racks
- That's a lot of blanking plates!

Source: Nvidia.com

How This Will Affect Costs?

Not Just an increase OPEX but a rise in CAPEX as well:

According to Uptime Institute Average Cost of Building a Data Center is:

- $11.5/W of critical (IT) load

+

- $300/sq ft for site preparation

Source: Uptime Institute White Paper: Cost Model: Dollars per kW plus Dollars per Square Foot of Computer Floor. By W. Pitt Turner IV, P.E. with Kenneth G. Brill

How This Will Affect Costs?

- A 100% increase in Power Consumption would mean an additional $11.5M / MW
  - 3x Space requirement to manage density for air cooling @$300/ sq ft

- And This is for technology that's being deployed right now
- Data Centers infrastructure is designed to last 15-20 years
  - Hardware refreshes every 3-5 years

What Does The Future Hold?

We Can't Predict The Future

"Google Cloud-powered Pokémon Go struggles under heavy demand"

-DatacenterDynamics
12th July 2016

Arizona psychic hit by car says he never saw it coming

JOSIAH DESTIN
THE REPUBLIC | AZCENTRAL.COM

Blair Robertson recalls the moment

"My leg was in the shape of an 'L.' My left foot was on its side and I have no idea how it wasn't snapped off."


But We Can Future Proof Our Data Centers

What Businesses Need From Their IT Infrastructure

Cost-effective

Future Proof

Scalable

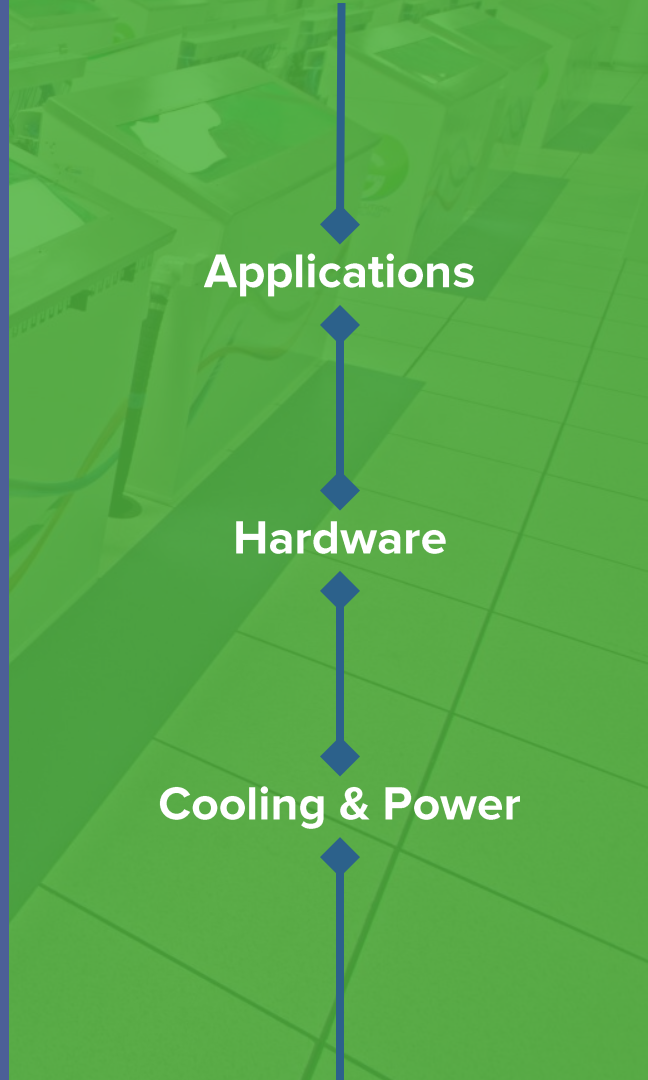
Agile

Resilient

Efficient

IT Defines Everything

- We no longer have the luxury of making facilities decisions in a vacuum.
- Application, hardware, and density roadmaps will define infrastructure needs.
- The boundaries between facilities and IT need to be broken.
- A systems approach towards data center design is the way forward, as has been exemplified by some Hyperscale players



Cooling Technologies

Aisle Containment

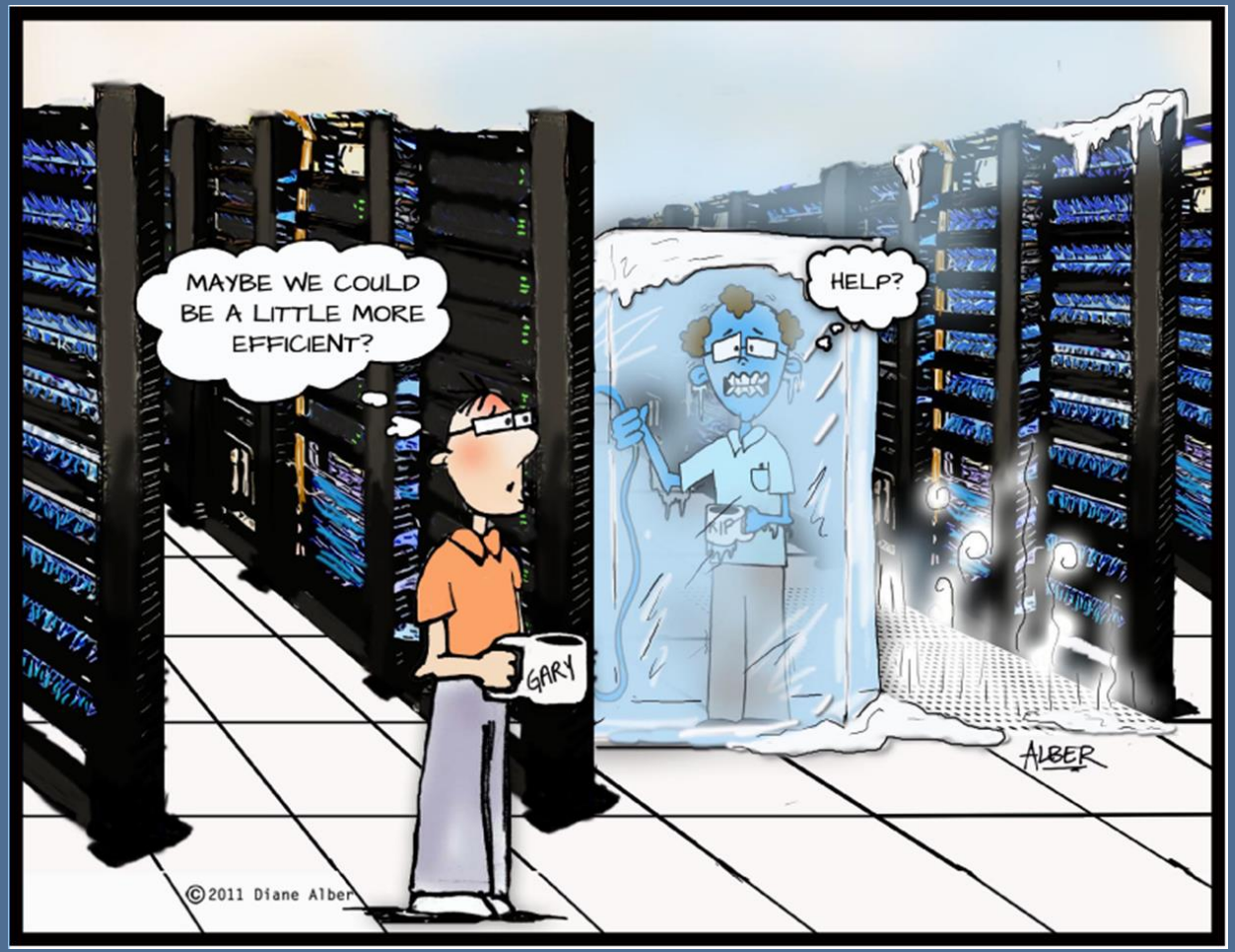
Cold Plate / Liquid to Chip

Rear Door Heat Exchanger

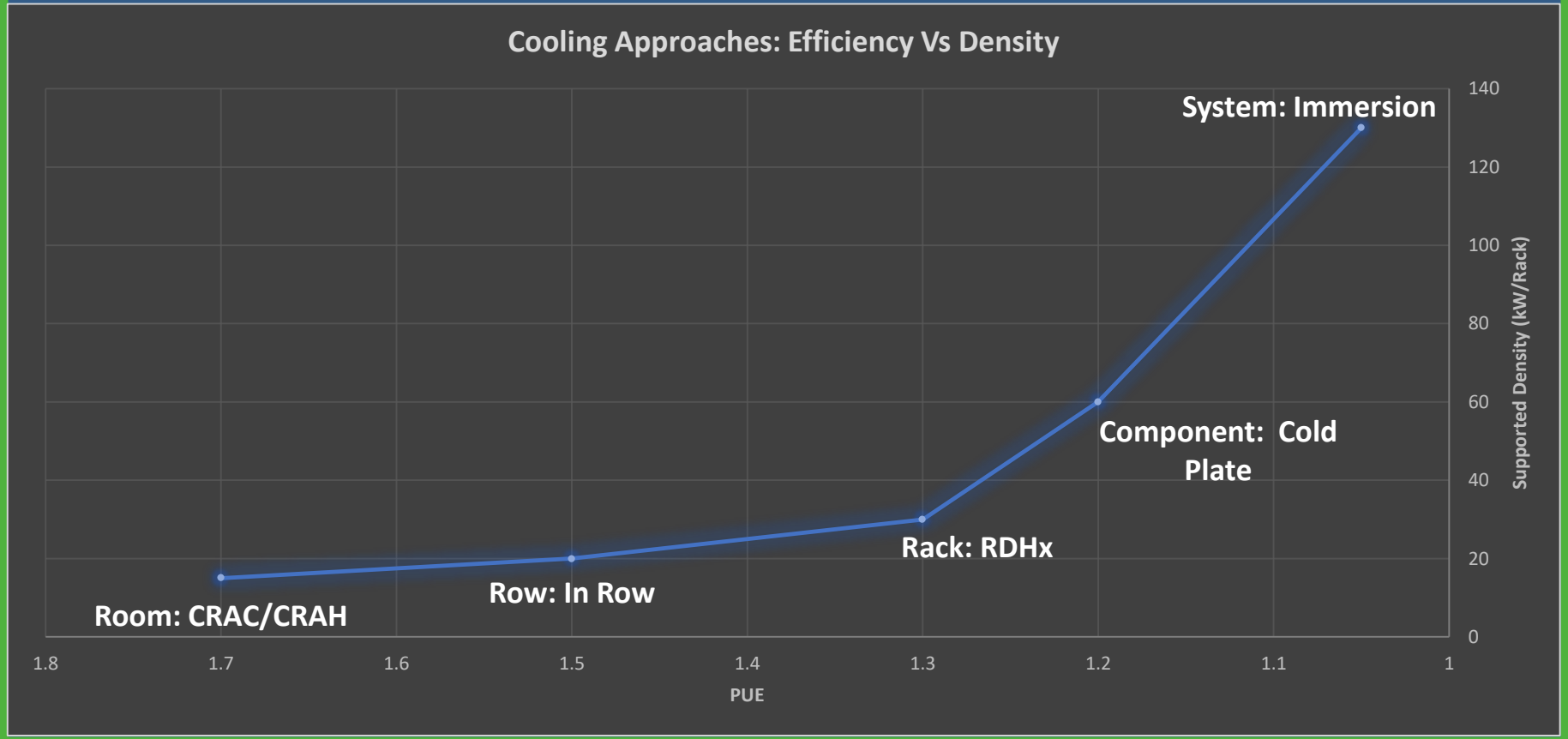
Single Phase Immersion Cooling

Traditional CRAC / CRAH

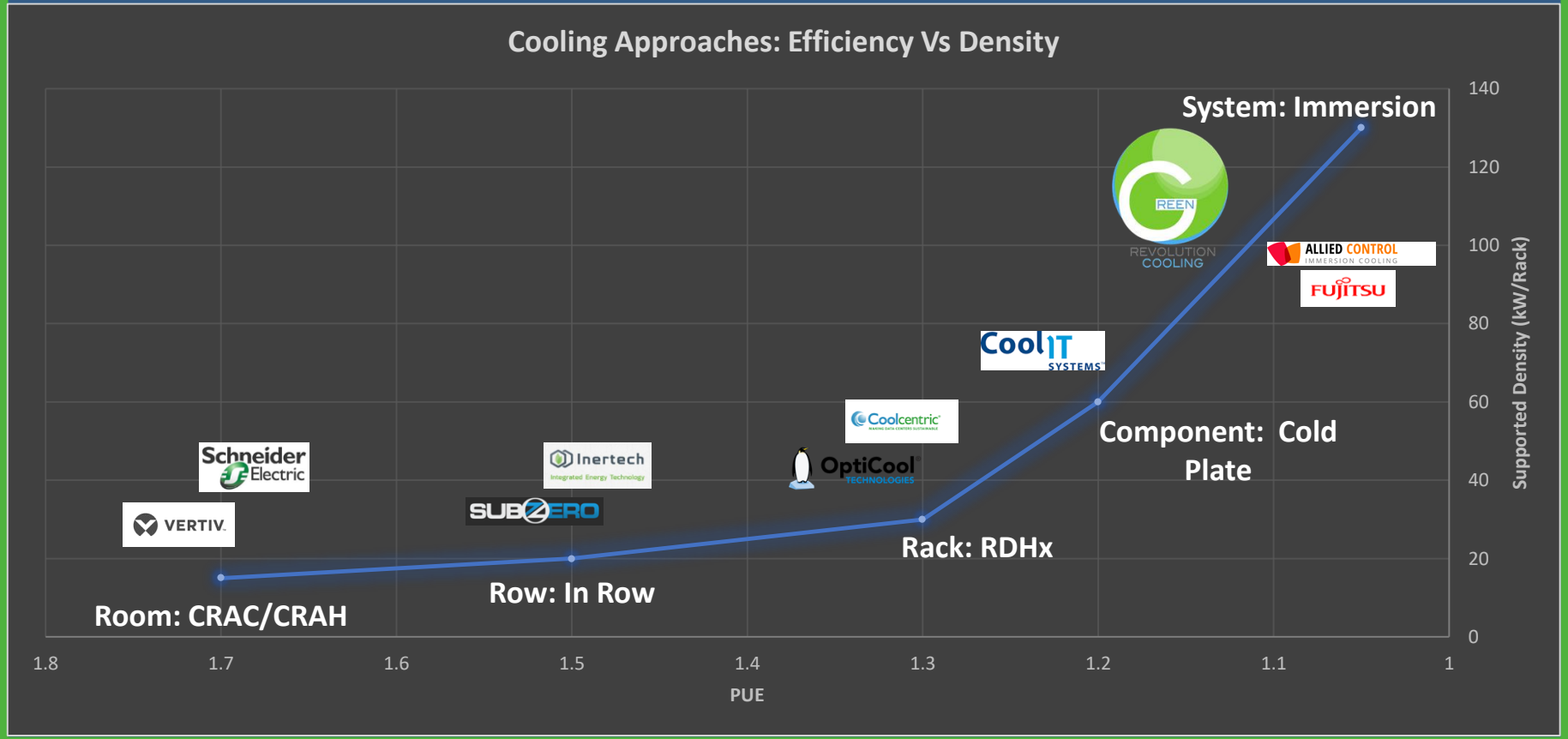
2 Phase Immersion Cooling

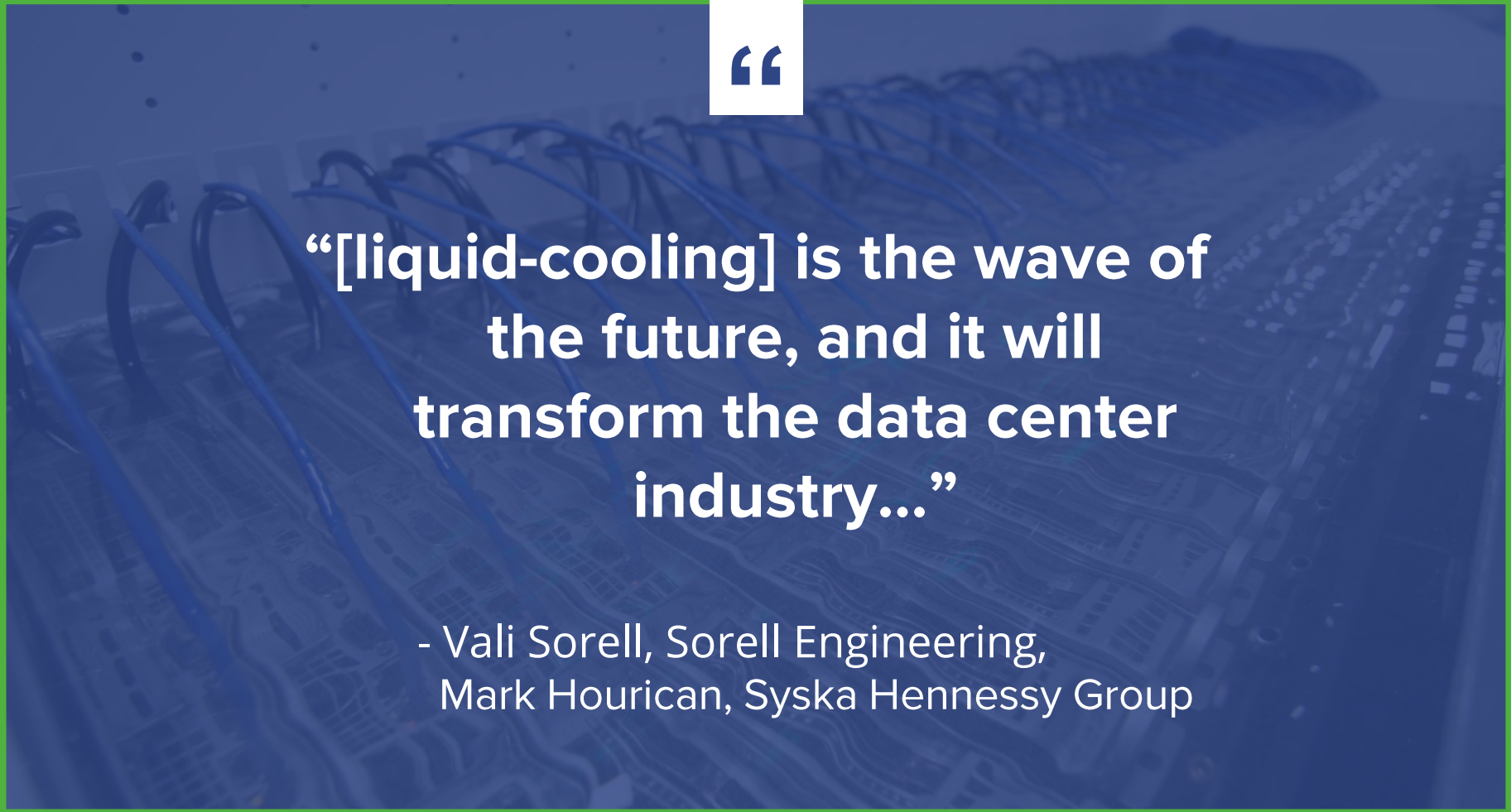

MAYBE WE COULD BE A LITTLE MORE EFFICIENT?
HELP?
RIP
GARY
ALBER
©2011 Diane Alber

Cooling Capacity & Efficiency



Cooling Capacity & Efficiency




“
“[liquid-cooling] is the wave of the future, and it will transform the data center industry…”
- Vali Sorell, Sorell Engineering,
Mark Hourican, Syska Hennessy Group

Choosing What's Right For you

Things to Consider

- Application Roadmap
- Hardware / Density Roadmap
- Efficiency Goals: Energy, Water, Carbon.
- Power & site constraints
- Number of hardware refreshes
- Scalability & Capacity Planning
- Total cost of design, construction, and ownership

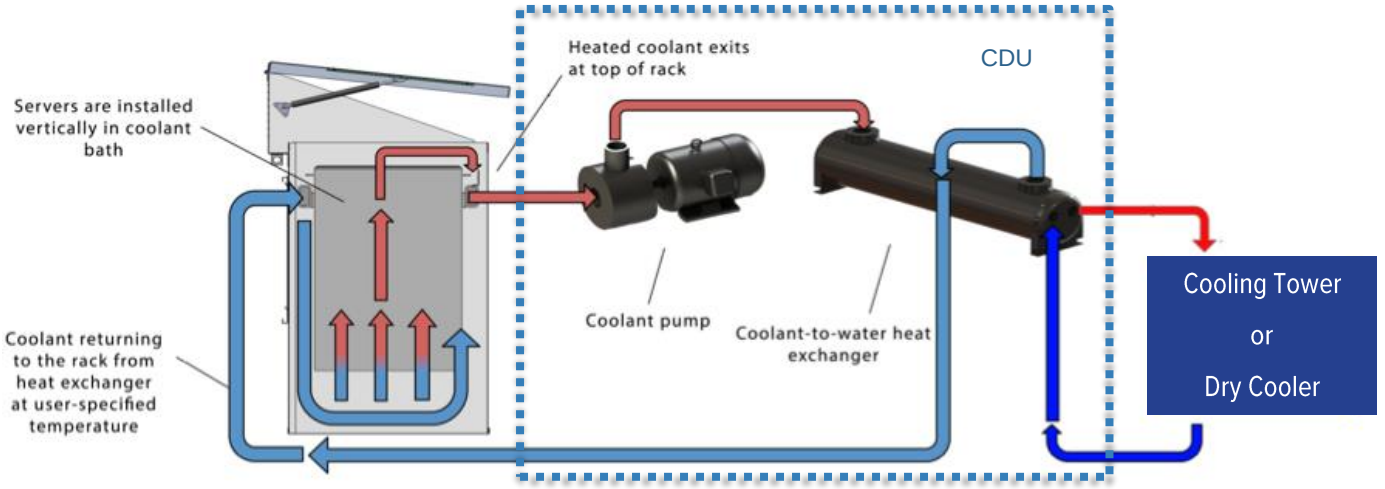
Choosing What's Right For you

Questions to Ask

- What other infrastructure is required? Eg. Chillers, CRACs / CRAHs, air / water treatment
- What does a hardware refresh look like?
- What happens in the case of a leak?
- What does serviceability look like?


“Within 5 years, 10 on the outside, there will be no alternative to immersion cooling”
- Dr. Satoshi Matsuoka,
Tokyo Institute of Technology

Oil Immersion Cooling – How It Works



How GRC Can Help

Cost-effective

- Enables build out @ <$5/W
- Eliminates Chillers, CRACs, CRAHs, raised floors, etc.
- Downsize power infrastructure

Future Proof

Scalable

Agile

Resilient

Efficient

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Future Proof

- **High Density Support: Customer achieved over 130kW/ rack**

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Agile

Resilient

Efficient

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Future Proof

- High Density Support: up to 130 kW / rack

Scalable

- **Economies without scale**
- **Each rack is a micro data center (fully integrated)**
- **Build as you go**

Agile

Resilient

Efficient

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- **6-8 weeks to deploy**
- **Plug and play infrastructure**
- **Flexible platform supports any OEM**

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Resilient

- **Oil protects servers from dust, moisture & oxidation**
- **Build anywhere**
- ***Insource* Edge & core**

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Efficient

- **1.02 PUE**
- **10-20% server load reduction**
- **Total peak and average power reduction of ~50%**

How GRC Can Help

Our system as a whole consumes less power than the server fans we turn off!

Cost-effective

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Efficient

- 1.05 PUE
- 10-20% server load reduction
- Total peak and average power reduction of ~50%

Global Installed Base

Select List of Public Installations

“With GRC’s submersion technology we are able to push operational limits of our GPU-based SuperServers even further while reducing overall energy requirements.”

“Immersion-cooled systems do not require chillers, CRAC units, raised flooring, etc. This method has the potential to cut in half the construction costs…”

“We saturated the power envelope by putting twice as many systems as we would normally have, if it had a normal way of cooling”


What We Build Today, Will Support The Technologies of Tomorrow.
Let's Make IT Limitless!

Questions?

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