Data Center Overview

For Oregon Data Center Advisory Committee
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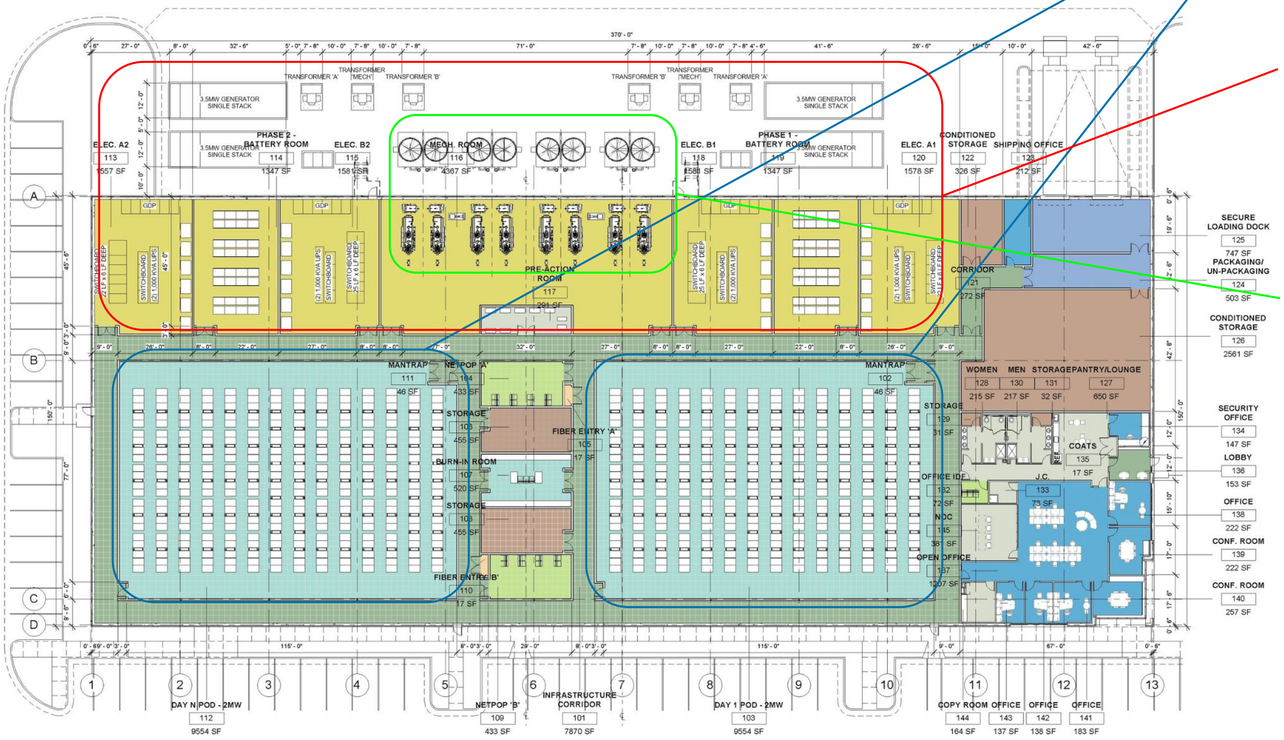
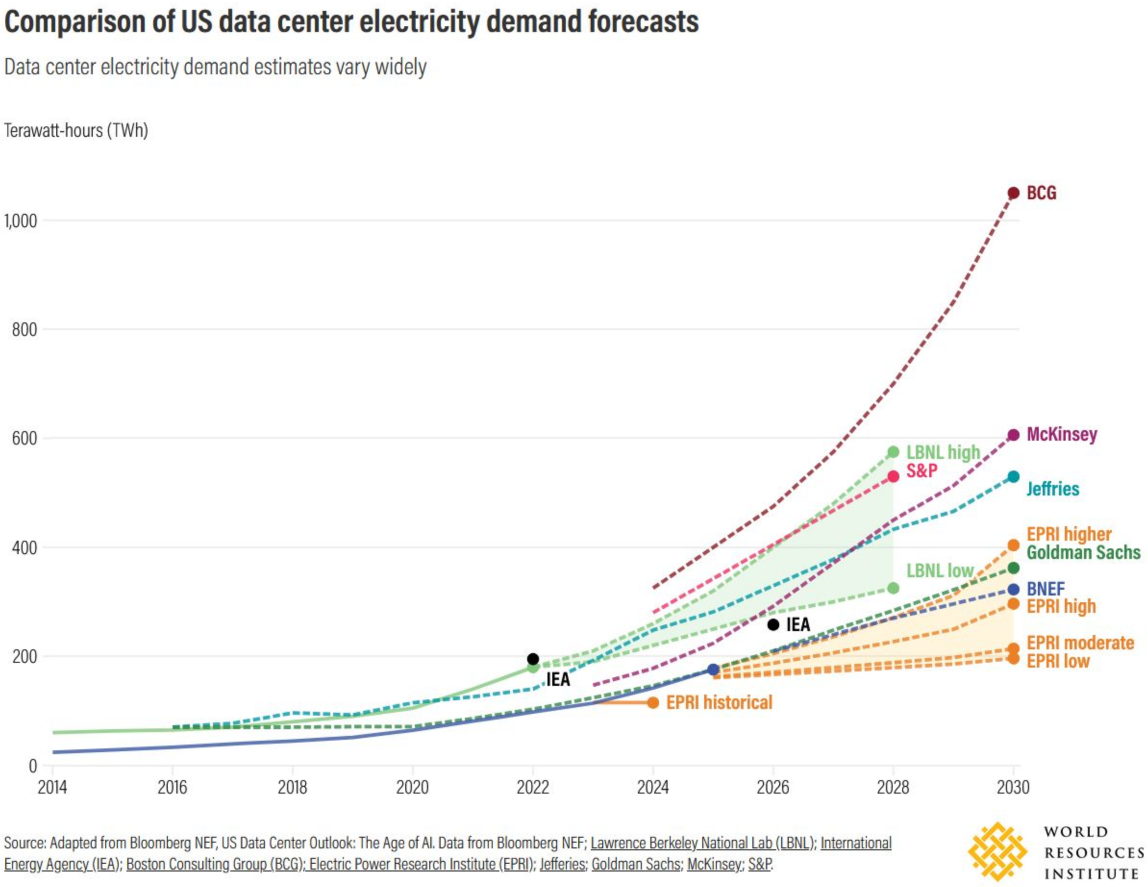
What’s a Data Center?

A (Smallish) Data Center



- “White space”
  - IT Racks & servers
  - Cable distribution
  - Hot & cold aisles
  - Raised floor?
- Power
  - Transformers
  - Switching
  - UPS
  - Backup power gen
  - Diesel fuel storage
- Cooling
  - Air plenums
  - Fans
  - Cooling towers
- Truck access, loading docks, circulation
- Network Ops Center (NOC)
- Office space
- Security
- Parking

DCs Use a lot of Power



BCG estimates that DCs will use about 1,050 TWh in 2030

McKinsey estimates that DCs will use about 600 TWh in 2030

EPRI estimates that DCs will use about 200 TWh in 2030

DC Efficiency - PUE and WUE

Power Usage Effectiveness (PUE) = Total Facility Power Consumption / IT Power Consumption

- PUE ranges from close to 1.0 ("100% efficient") to close to 2.0 (very "inefficient")

Water Usage Effectiveness (WUE) = Total Facility Water Consumption / IT Power Consumption

- WUE ranges from 0 l/kWH (no water use), 1.8 l/kWH is average, to 3+ l/kWH (high water use)

PUE and WUE are imperfect but are commonly used and are sometimes useful:

- Assumes all IT power is "good", or 100% efficient
- Design vs. actual
- Well defined, but often "inaccurate". Differences in metering locations, time. Frequent fudging.
- Varies over time - minutes as load changes, time of day, seasons: temperature, humidity
- Can't compare across regions & climates
- If IT power drops then PUE and WUE increases, gets worse
- PUE doesn't comprehend use of "waste" heat
- WUE doesn't comprehend water source - potable vs. grey

Recommend not requiring specific PUE or WUE by permit or regulation.

Types of DC - Evolution of DCs

1980s: Mainframes in computer rooms

1990s: Dedicated “Enterprise” Data Center buildings

- Telco, IX, etc. and enterprise DCs
- Servers in racks use kW, DC maybe MW, CRAC cooling, raised floor, PUE close to 2

2000s: Colocation DC Companies, Multi-Tenant DCs (MTDC)

- Enterprise tenant-owned servers in leased space in a MTDC
- CapEx = 10s of $M. Commercial OEM servers. Mostly CRAC cooling & raised floor. Rack power densities in 10s of kWs, big DCs use 10s of MW. PUE=1.3-1.8. Conservative designs sell.

2010s: SaaS, Cloud Computing, Hyperscale Single-tenant DCs

- Enterprise clients buy compute services from “cloud operator” who runs dedicated single-tenant DCs. Maybe owned and operated by cloud operator, maybe by colo DC company.
- Cloud company has brand reputation at stake, has ambitious sustainability goals. Big corp, publicly owned.
- CapEx = 100s of $M to $B. Open Compute servers. Racks on grade. Rack power densities 10s to low 100s of kW, pushing limits of air cooling. Big DCs use 100s of MW. Free air cooling. PUE = 1.05-1.2. More innovation.

2020s: Hyperscale AI DCs

- New phenomenon. Private equity driven, chasing billions of $. Speed is everything.
- Massive campus, 100s of acres. CapEx = 10s of $B. Nvidia GPUs. Rack power densities 600kW in 2027, approaching 1MW by 2030. Liquid cooling. Big DCs use GW, exceeds grid capacity. PUE = who cares?

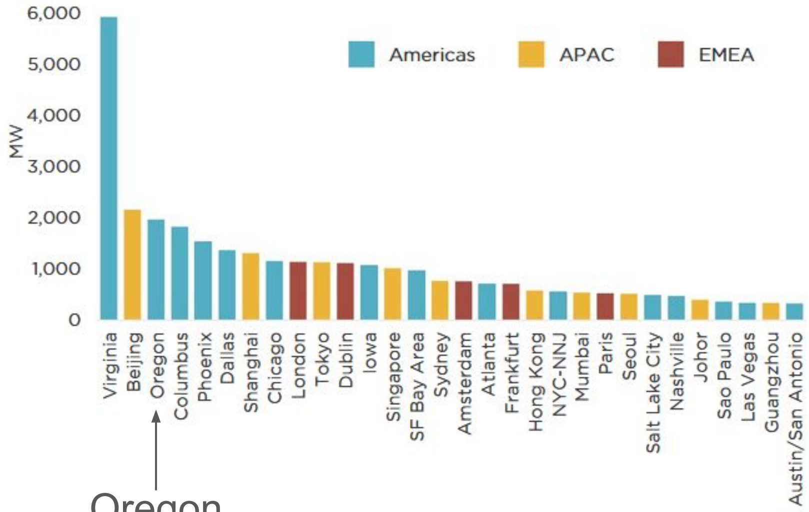
New Phenomenon - Hyperscale AI DCs: Stargate Abilene

- Stargate project (multiple campuses) may be a $500B CapEx, backed by OpenAI, Oracle, Softbank, Nvidia. 7-10GW of power.
- Abilene is flagship campus. 800 acres, 3 million sf,1.2 GW power. Built by Crusoe Energy.
- 6000 jobs during construction, 300 during operation
- First buildings powered within 1 year of breaking ground

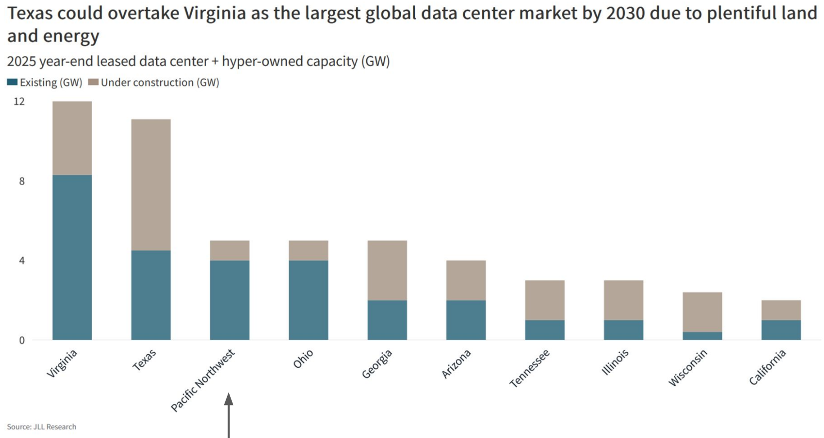
Oregon is currently a leading DC Market

Oregon or NW is currently #2 or #3 US market but TX is building faster!

DC Markets by 2025 Operational Load



Oregon

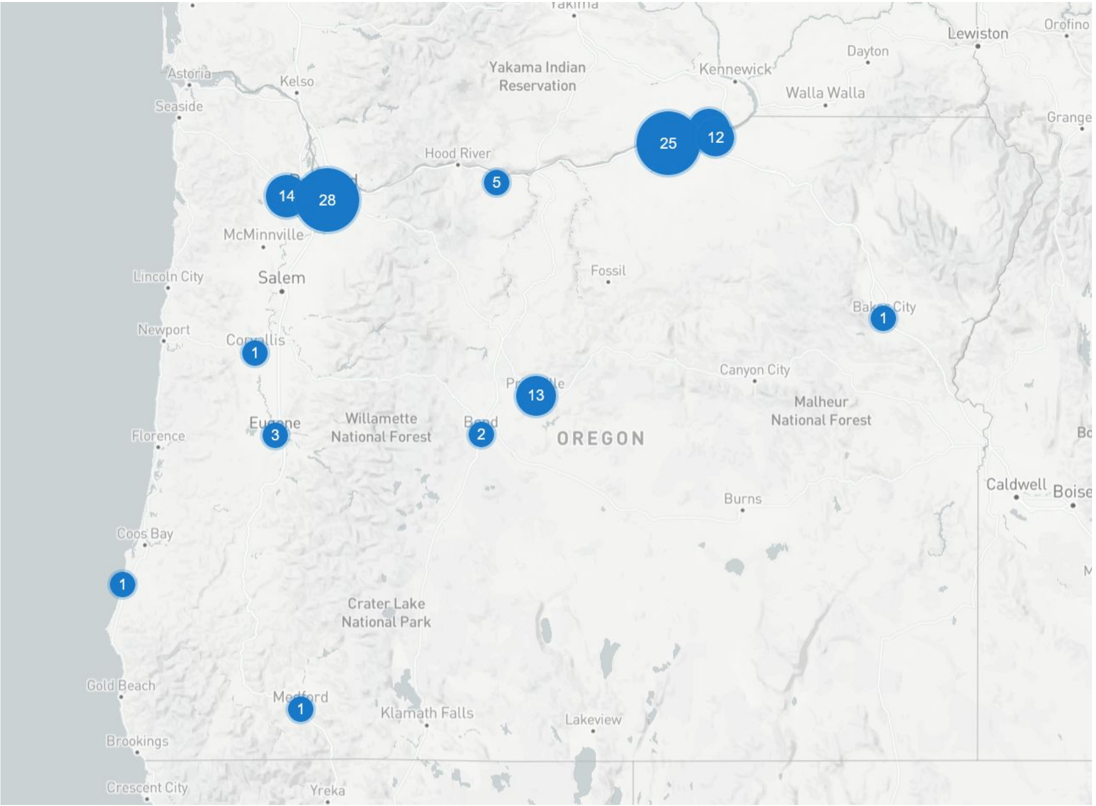


Pac NW

Source: Cushman and Wakefield, DataCenterHawk, and DCByte

Source: JLL Research, North Am. DC Report - 2025 Year End

123 DCs in Oregon



~10 IX and telco DCs in cities

~42 Data Center Company-owned DCs

- Digital Realty, STACK, Aligned, QTS, NTT, Flexential, others in Hillsboro and PDX

~61 Cloud Hyperscale DCs:

- AWS in Boardman, Hermiston, Umatilla
- Apple and Meta in Prineville
- Google in The Dalles

No (0) AI DCs?

Source: datacentermap.com, Feb. 2026

DC Cooling & Water Use

Trad Data Center Cooling - Power/Water trade-off

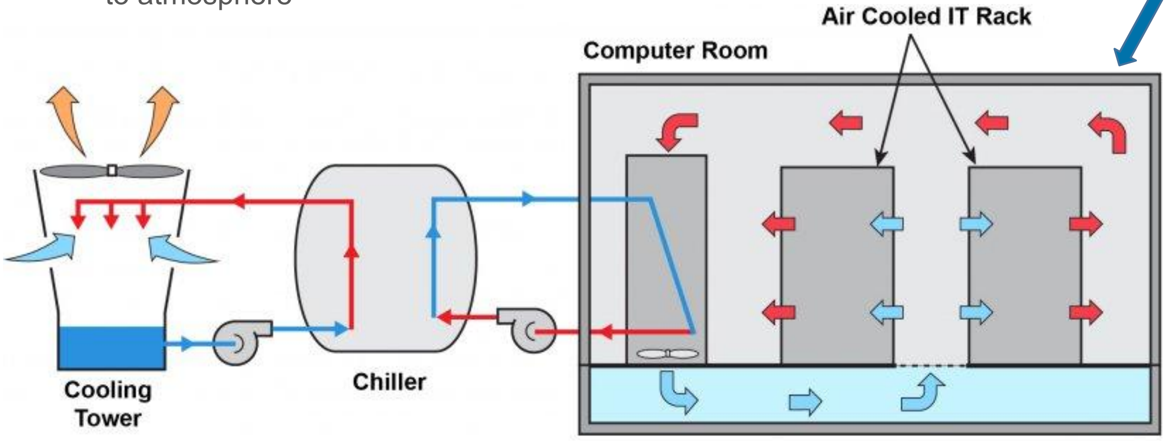
Indirect use for cooling power plants

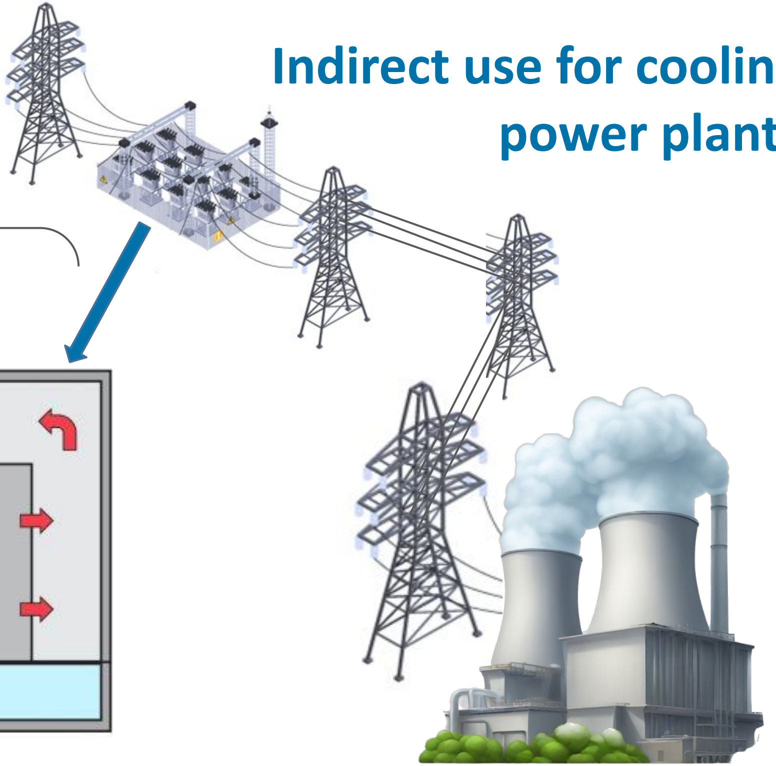
Heat Rejection

Water evaporation to atmosphere

Heat Collection

Closed loop of refrigerant

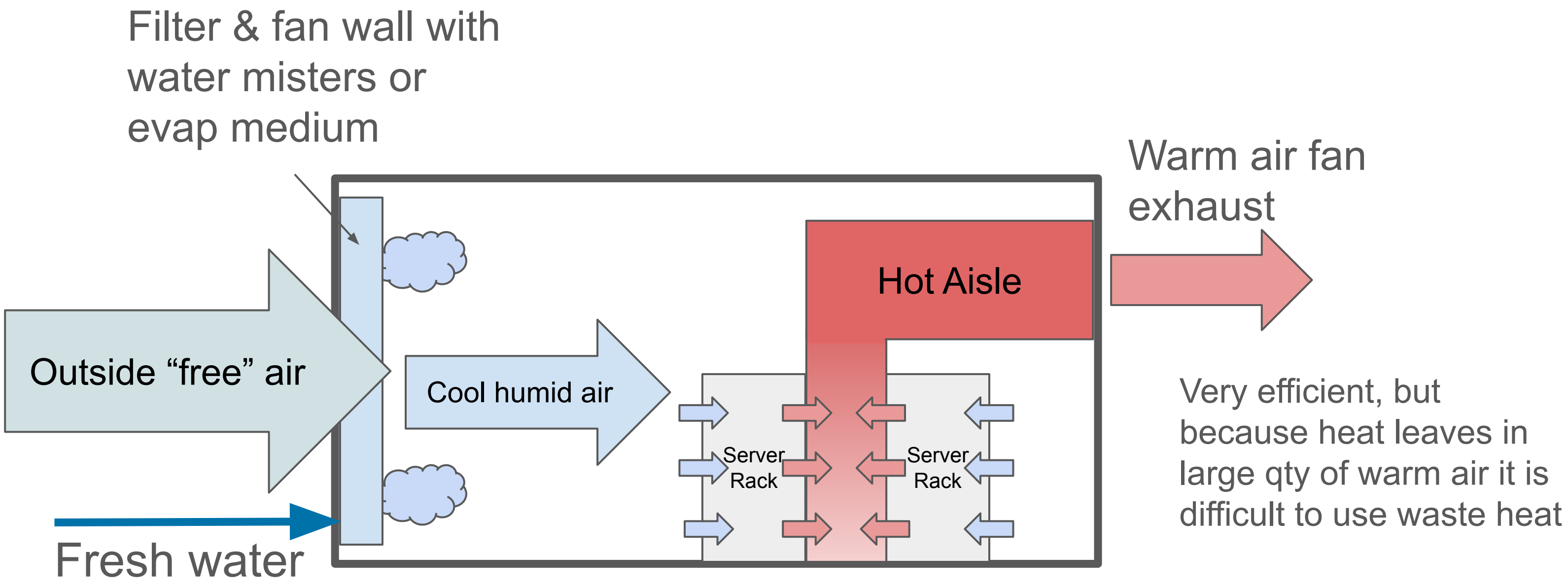




PUE = 1.3 to 1.8, can use millions of gal of water per day

Source: Julie Bolthouse, Piedmont Env. Council

Free Air Cooling - Cloud hyperscale in cool-ish climate

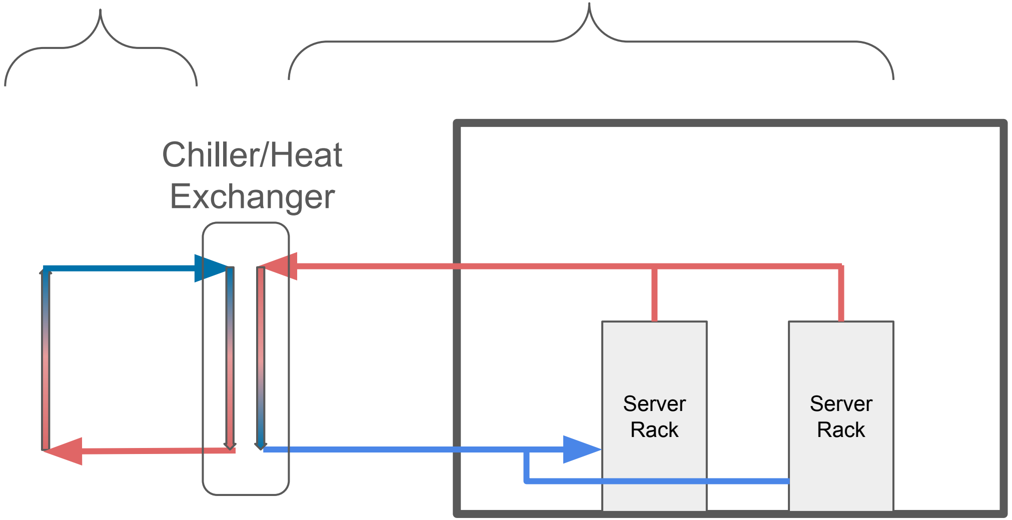


PUE=1.05 to 1.2, water use varies by temp/season but generally low

Liquid Cooling - AI loads

Heat Rejection   Heat Collection - Closed loop of liquid to rack

Reject heat to:
- Cooling tower
- Dry radiator
- Body of water
- Aquifer

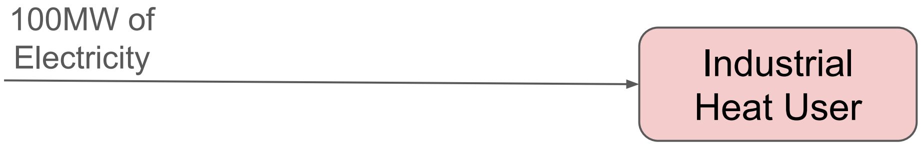


Common liquid cooling approaches:
- Liquid to rack rear door
- Liquid to chip
- Immersion of entire server in liquid bath

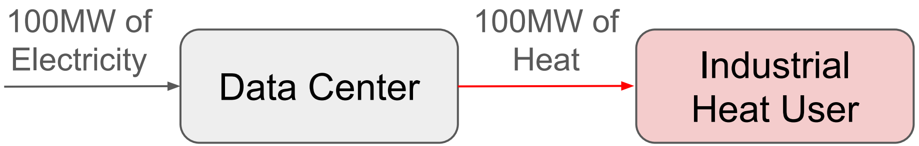
PUE=1.05 to 1.2, water use depends on heat rejection approach
Easier to use waste heat because it is more concentrated

Use of Rejected Heat

Before DC



Using Heat from DC



The DC uses no power and no carbon, or the heat user pays nothing for heat!

Challenges:

- DC heat is often low temp - requires equipment ($) to make it useful
- Difficult to find someone nearby who needs that much heat. Complicates DC siting.
- Complex contracts.
- DC must reject heat 100% of time. Therefore will require a back-up heat rejection system.
- DC cooling system and heat user need to be designed for heat re-use - difficult and expensive to add later. Who pays?

Heat Users:

- Wood drying kiln, plywood curing
- Pre-heat fuel, waste or biomass incineration
- Recycle glass, alu, thermoplastics
- Cement plant
- Greenhouse
- Fish or lobster farms (crab?)
- Municipal residential heating
- Swimming pool
- Water desalination
- Chemical processes
- Direct Air Carbon Capture (future)

DC Site Selection

Site Selection Priorities Vary by DC Type

Multi-tenant DC

- Where tenants want it, usually close to the eyeballs
- Cheap grid power, maybe renewable energy
- Good fiber internet
- Easy permitting, tax breaks
- Workforce, liveable community
- Low risk

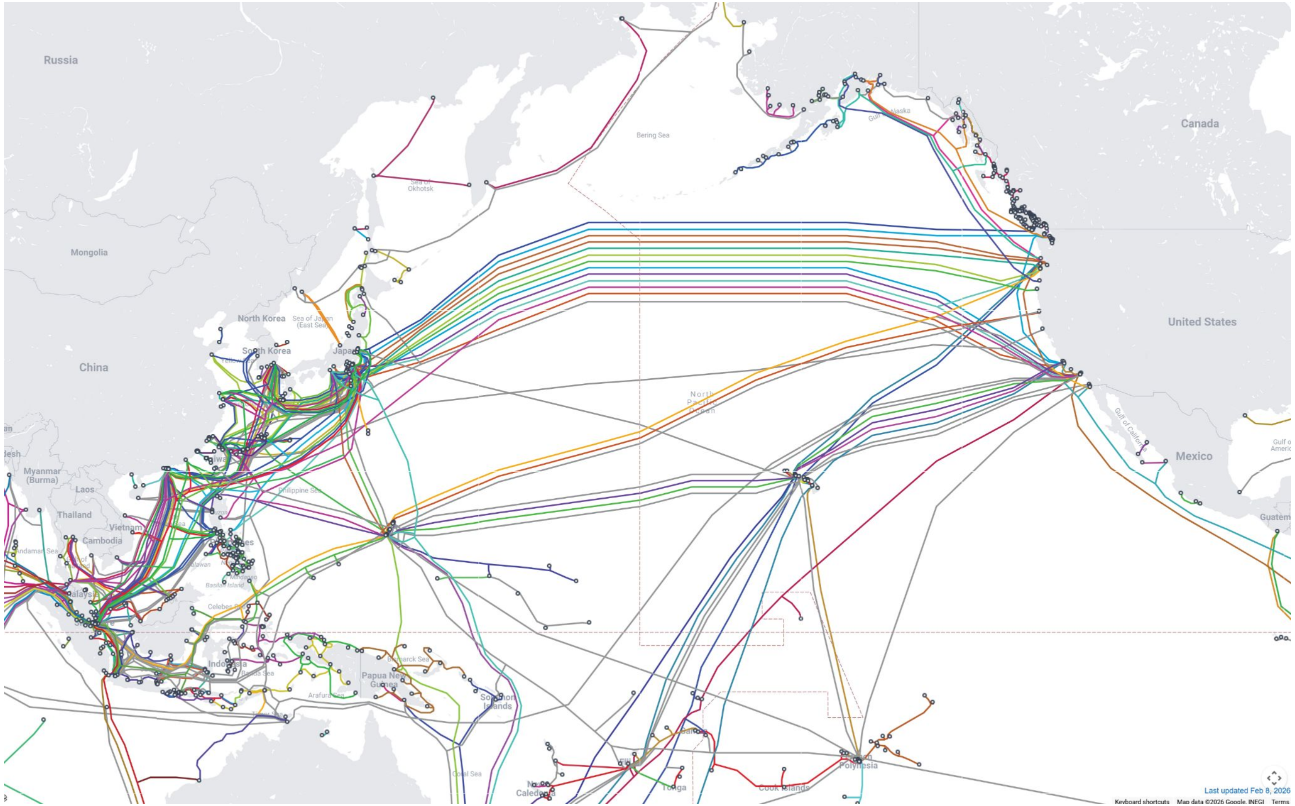
Cloud Hyperscale

- Cheap and available low carbon grid power (RE may be obtained through PPA)
- Good fiber internet
- Tax breaks
- Reliable permitting, community acceptance

AI Hyperscale

- Fast permitting of massive campus
- Access to Huge power but if that isn't readily available, then …
- Fast permission to provide their own power (air permits)

Oregon has good access to APAC fiber



The following subsea cables from Asia land in Oregon:

- Southern Cross (2000), Tata TGN (2002), and Hawaiki (2018) land in Hillsboro
- Transpacific Express (2008) lands in Nedonna Beach
- FASTER (2016) lands in Bandon
- New Cross Pacific (2018) lands in Pacific City
- Jupiter (2020) lands in Cloverdale
- Bifrost (2021) lands in Winema

Plus 4 cables to/from Alaska

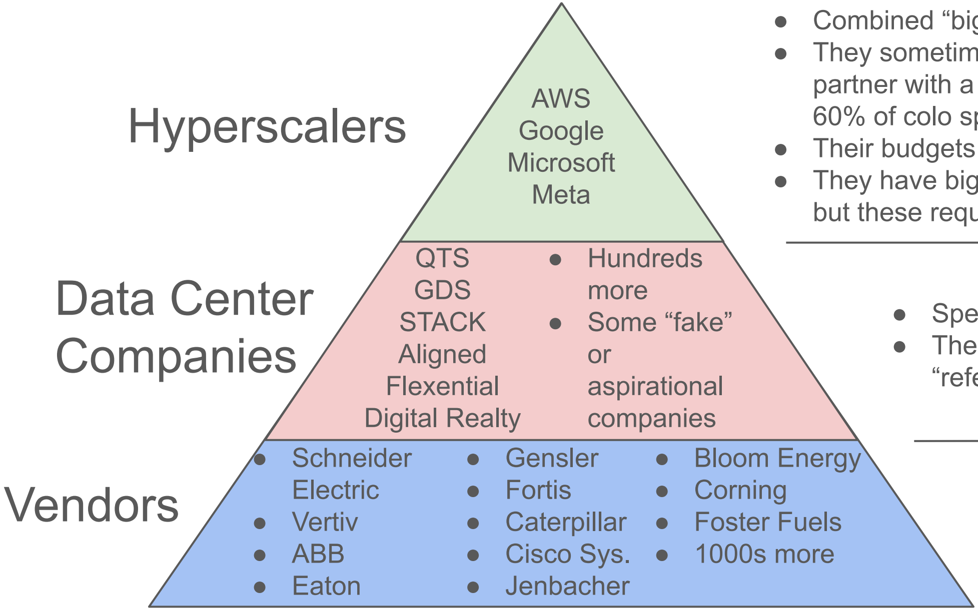
Source: submarinecablemap.com

Oregon's Strengths

- Existing DCs - data gravity is in our favor
- Low carbon and low cost hydro power
- Existing wind & solar energy
- Good fiber connections to APAC
- Vast land
- Ocean - opportunities for heat rejection
- Potential for geothermal power?
- Communities that want economic development, may be welcoming, provide tax breaks

The Biz of DCs

Hyperscalers are the top of the food chain



- Combined “big 4” budgeted 2026 CapEx > $600B (not including Stargate)
- They sometimes directly design, build and operate their own DCs, sometimes partner with a DC company to build and/or operate a DC, and they lease about 60% of colo space
- Their budgets and their requirements drive the industry
- They have big public brand recognition and equally big sustainability commitments but these requirements are often not passed down to their leased fleet

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- Specialized. Design, build and operate DCs for others
- They generally build what the customer wants. Some have consistent “reference designs” and established supply chains.

- Make and sell IT gear, generators, power & cooling equip, design and consulting services, building materials, etc.
- Vast supply chain, lead times may be years. Often the limiting factor in build time.

Data Center Companies are the Hub of the DC Industry

- DC companies design, build and operate DCs for others. Their biggest customers are the hyperscalers. Some focus on building and operating DCs for multiple tenants (MTDC, colocation) using a standard design, some focus on building DCs for single tenants, in which case the tenant probably dictates much of the design.
- Most have little public brand recognition. Operators in Oregon include Digital Realty, STACK, Aligned, QTS, Flexential, NTT, GDS, Digital Fortress.
- Almost all are privately held by PE firms, funded by pension funds, sovereign wealth funds, etc. A few are REITS (Digital Realty, Equinix, Iron Mtn).
- Big business - $10B to $40B developments are announced weekly. Aligned was recently sold for $40B.
- For the last 2 years DC vacancy rates have been less than 2%. Most good DC companies are tapped out. This sector is driving the global economy.
- DC companies are private and secretive. They are under NDAs with their hyperscale customers and often make deals hidden behind shell LLCs, require utilities to maintain confidentiality on their power and water use and rates.
- Their leases with hyperscalers and other customers are private and not consistent. Sometimes the tenant negotiates power rates and sources with the utility, sometimes they buy power from the DC company, sometimes with separate metering, etc. Often difficult to know who is responsible for what.

Potential Impacts of DCs

Potential Positive Impacts of DCs

- Tax revenue: property tax, sales tax, payroll, etc.
- Jobs: 100s or 1000s during construction, 10s or 100s in operation
- Philanthropic support: community facilities, schools, sports teams, workforce training programs, etc.
- Prestige: high profile development, high tech, “be a player in building the new economy”, don’t be left behind
- Potential for a DC to be a “grid Samaritan”, providing reliable and low cost power to community, ability to curtail their use and run on backup when grid is stressed.
- Possible community use of DC heat

Potential Negative Impacts of DCs

- Local impacts
    - Quantifiable impacts: air pollution, water use, noise, traffic, increasing utility cost to cover new transmission, competition for resources (power, water, land) for other development
    - **Cultural impacts: land use/industrialization, community divisions over values ($ vs. rural quiet), influx of new people, DC secrecy causes community mistrust, frustration over tax rate inequity, economic disruption, potential corruption of local gov**
- State/Regional impacts: GHG emissions, air pollution, water stress, new power generation & transmission
- Key question: How many DCs does this community want/need/tolerate? Often a couple DCs are very helpful (if you don't live next door), and too many are a problem.

Path Forward for Oregon

Future Trends

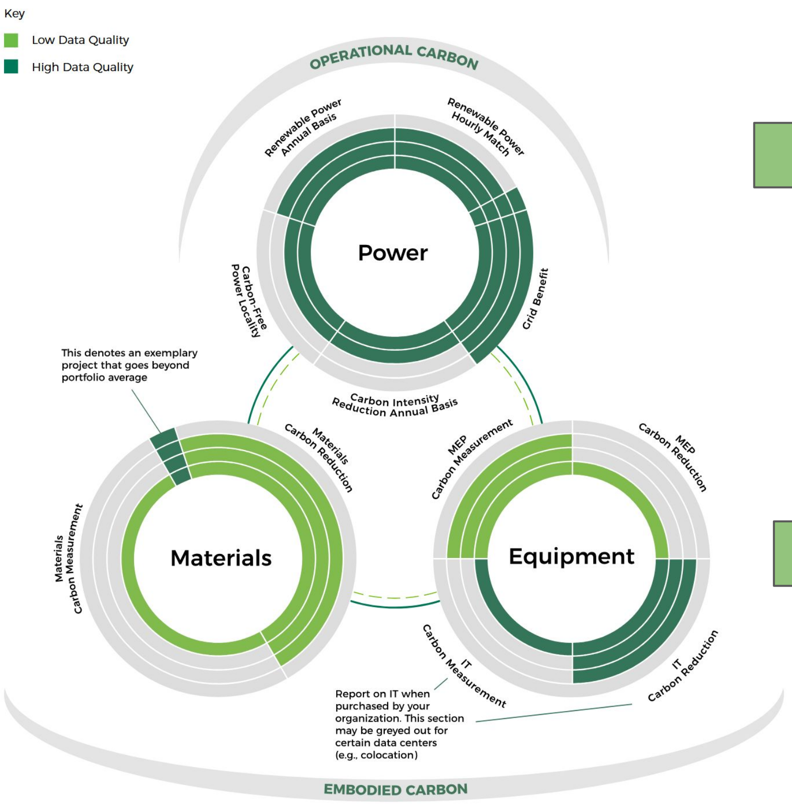
- MASSIVE campuses (Stargate, Meta Alabama, Microsoft Iowa, etc.), can exceed grid capacity
- Private power, “behind the meter” power - new fossil fuel or existing legacy nuclear
- Development of “power zones” in remote areas, new dedicated DC cities
- Demand for power is overshadowing sustainability goals
- Organized community resistance, esp in communities with too many DCs (NoVa), and places with massive DCs proposed (Indiana)
- Hyperscalers becoming more sensitive to community impacts, developing policies committing themselves to transparency of impacts, not raising utility prices for locals, not seeking tax breaks, etc. Example: Microsoft Data Center Community Pledge.
- Siting to take advantage of “stranded” RE, but getting difficult to find, mostly tapped out
- Energy storage as an adjunct to renewables. Use of hydrogen for energy storage, powering DCs.
- Small Modular Reactors (private and utility owned) coming in 2028-2030
- DCs in space
- Quantum computing may change the nature of DCs in the future

Questions for Oregon

- Opportunity for DC development in communities that need economic development. But, it will change them - they must want it. We must do an exceptional job of engaging the community, listening. State role?
- There are no Stargate developments in the NW. Might there be? However, the scale of their ambitions may be too much for Oregon. Suggest engaging trad hyperscalers (AWS, Microsoft, Google, Meta) and experienced DC companies (STACK, Aligned, Vantage, QTS, EdgeConnex, etc.).
- They will want to build FAST. Are we willing to relax state GHG goals temporarily? Could we enable initial temporary use of on-site power with a time limit to convert to low carbon energy plus storage? They may be willing to build their own on-site power gen.
- Can we find places with stranded wind or solar energy? Wave energy? Geothermal? Encourage battery or other storage? In a welcoming community?
- Depending on location, consider requiring minimal water use. This may require more power but OK if it is RE.
- An AI DC will likely use liquid cooling. Explore innovative uses of “waste” heat. Likely will require co-development. Reject to ocean? Farm fish, lobster, crab?
- Consider possibility that the bubble bursts. We don’t want a hi-tech ghost town.

Best Practices - iMasons Climate Accord Maturity Model

climateaccord.org



Power MM

Criteria	Definition	Maturity Level 0	1	2	3	4
Renewable Power – Annual Basis	Annual power usage covered by renewable energy market-based procurement on a kWh basis	Grid-source power	40-59% renewable supply	60-79% renewable supply	80-99% renewable supply	100% renewable supply
Renewable Power – Hourly Match	Annual power usage coinciding with location-based renewable energy supply on an hourly basis by kWh	Not considered	20-39% hourly match	40-59% hourly match	60-79% hourly match	≥80% hourly match
Carbon-Free Power Locality	Location of carbon-free energy supply relative to data center facility	Not considered	Same region	Same interconnected grid	Within 100 miles	Collocated
Carbon Intensity Reduction – Annual Basis	Carbon intensity of overall power usage compared to grid as measured on an annual basis (excluding offsets)	Not considered	40-59% lower carbon intensity than grid	60-79% lower carbon intensity than grid	80-99% lower carbon intensity than grid	Carbon-free operation
Grid Benefit Refer to Appendix B: Definitions for qualifying grid benefit measures	Proportion of overall energy use exported to grid, captured and reused waste heat, or curtailed as part of demand response	No grid benefit	1-2%	3-5%	6-9%	≥10%

M&E MM

Criteria	Definition	Product Category	Maturity Level 0	1	2	3	4
Embodied Carbon Measurement	Scope & quality of portfolio embodied carbon measurement	Materials	Not measured	Spend-Based	20% Measured (not via spend)	80% Measured (not via spend)	100% Measured (not via spend)
		MEP Equipment	Not measured	Spend-Based	20% Measured (not via spend)	80% Measured (not via spend)	100% Measured (not via spend)
		IT Equipment	Not measured	Spend-Based	20% Measured	80% Measured	100% Measured
Embodied Carbon Reduction	Reduction of embodied carbon relative to industry baseline	Materials	Set public goals, establish reduction strategy	1-15%	16-30%	30-45%	≥45%
		MEP Equipment	Set public goals, establish reduction strategy	1-10%	11-20%	21-30%	≥30%
		IT Equipment	Set public goals, establish reduction strategy	1-10%	11-20%	21-30%	≥30%

DC ESG Reporting Frameworks

There are many facility and company reporting schemes, including:

- LEED and GBI building certifications
- Carbon reporting
- Several DC “Efficiency” certifications
- European Union mandatory reporting - complex, in flux, but mandatory
- GRESB Data Center ESG Benchmark - coming into operation in 2026

Don’t create another one!