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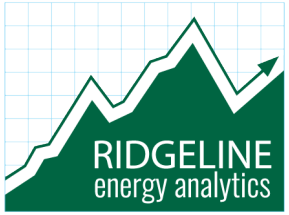
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SERA

CALL FOR ABSTRACTS

DOES IT COMPUTE?

Assessing How Programs for Data Center Customers Can Make a Difference

SPEAKER INTRODUCTIONS

Moderator:
Lauren Gage
Apex Analytics

Aaron Tinjum
Data Center Coalition

Mike Hedlund
E Source

Leila Shokat
Energy Trust of Oregon

Rick Boswell
DNV

Data Centers:

Enabling Global Connectivity & Modern Economic Growth

DATA CENTER COALITION

Data Center Coalition (DCC)

- **Voice** of the U.S. data center industry
- **Advocates** for a business climate, policies, and investments that support the growth and competitiveness of the industry
- **Information Resource** for elected officials, regulators, grid operators, utilities, community leaders, and other stakeholders

DATA CENTER COALITION

DCC Owner/Operator Members

Executive

aws, CloudHQ, COMPASS datacenters, CyrusOne, DIGITAL REALTY, Google

IRON MOUNTAIN DATA CENTERS, Microsoft, NTT, QTS, STACK INFRASTRUCTURE, switch, VANTAGE DATA CENTERS

Board

Aligned Adaptive Data Centers, CORESITE An American Tower Company, edgeconnex, EdgeCore Digital Infrastructure, EQUINIX, Meta, PROLOGIS, STREAM DATA CENTERS

Partner

cologix, Crusoe, OPPIDAN CONNECT DATA CENTERS, PRIME DATA CENTERS, rowan digital infrastructure

General

ada Infrastructure, APPLIED DIGITAL, CORSCALE DATA CENTERS, DATABANK, FLEXENTIAL, ORACLE

POWERHOUSE DATA CENTERS, SABEY Data Centers, SKYBOX DATACENTERS, SDV, T5, TA REALTY, VISA, yondr

DCC Large End User and Associate Members

Large End Users

ANTHROP\C

CoreWeave

OpenAI

Associate (Pre-Operational)

BEACON DATA CENTERS

Beale Infrastructure

CleanArc DATA CENTERS

FLEET DATA CENTERS

NSCALE

MONTERA INFRASTRUCTURE

RELATED DIGITAL

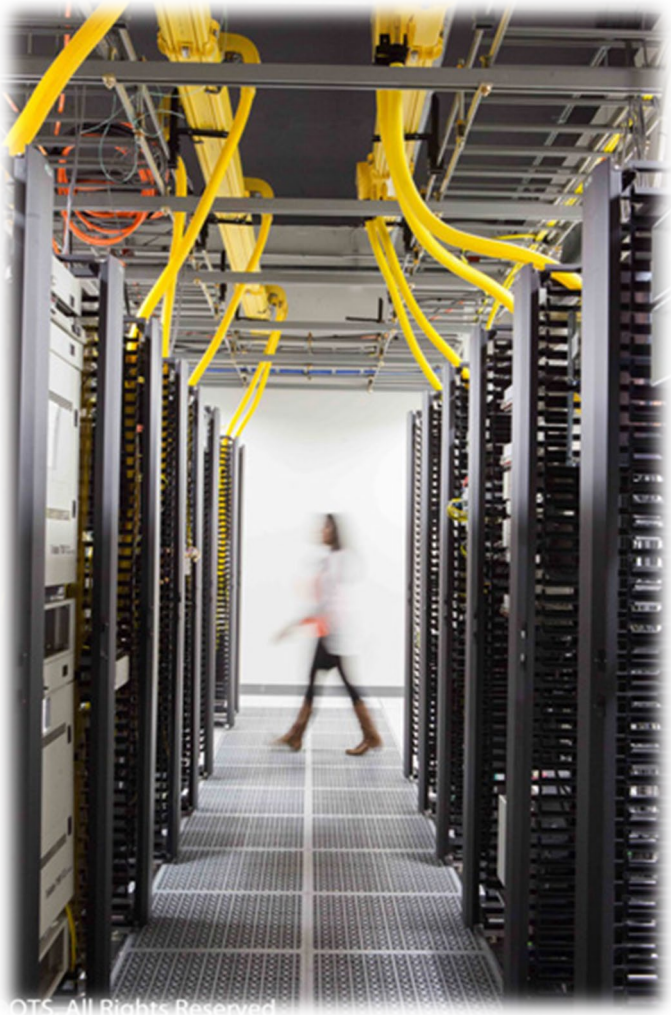
Main Types of Data Centers

- The data center industry is dynamic: many companies, company sizes, business models, facilities, missions, and types of computing operations
- Two main types of data centers
  - **Self-Perform/Enterprise**
    - Business owns/controls servers and peripherals, may own facility
  - **Multitenant and Build to Suit**
    - Facility owner leases to one or more tenants

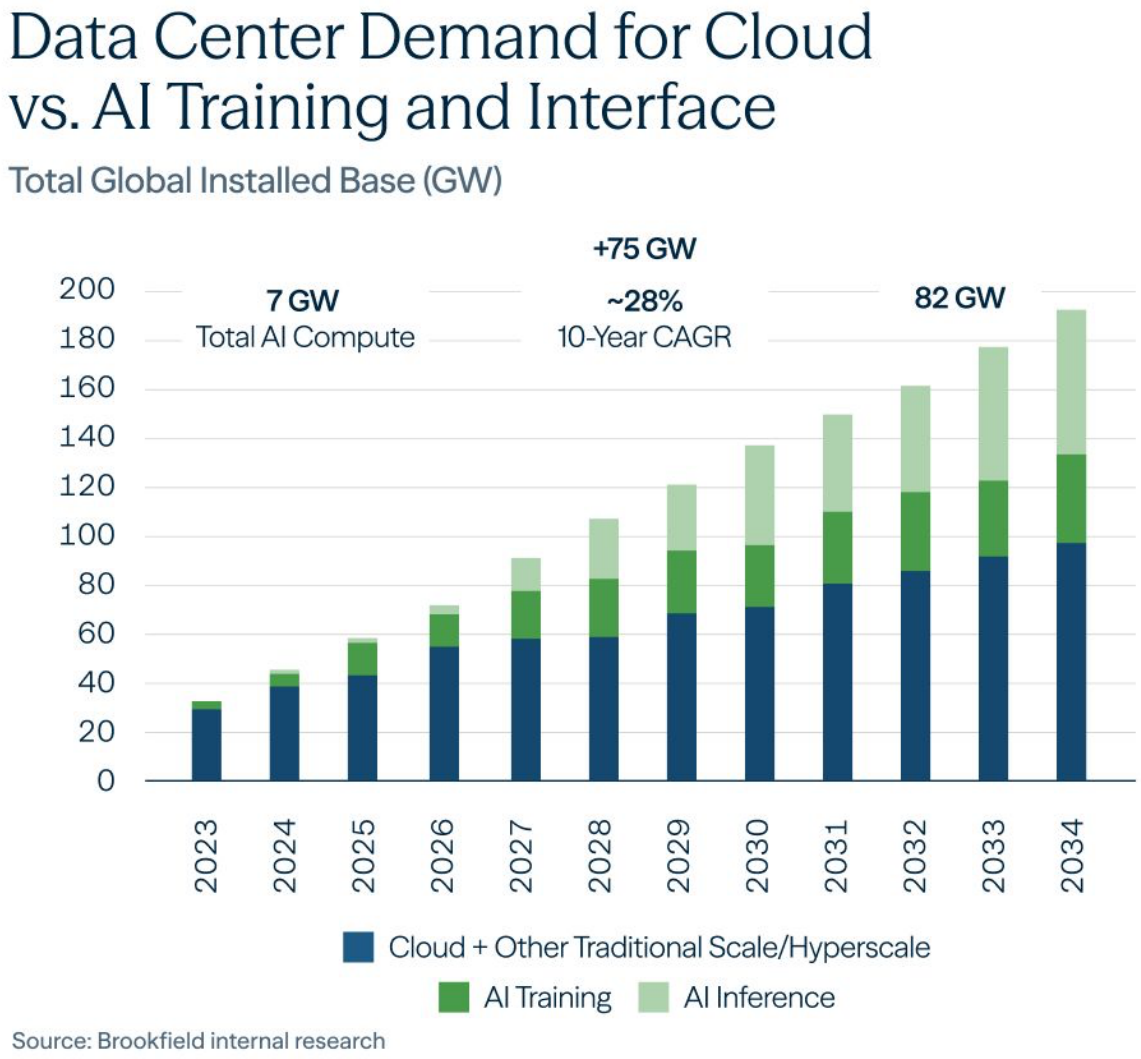
DATA CENTER COALITION

Inside a Data Center

- Building Shell
- Interior Space
- Security
  - Exterior
  - Interior
  - Cyber
- Servers
- Fiber/Networking Connectivity
- Reliable Power 24/7
  - Grid & Backup Generation
- HVAC/Cooling

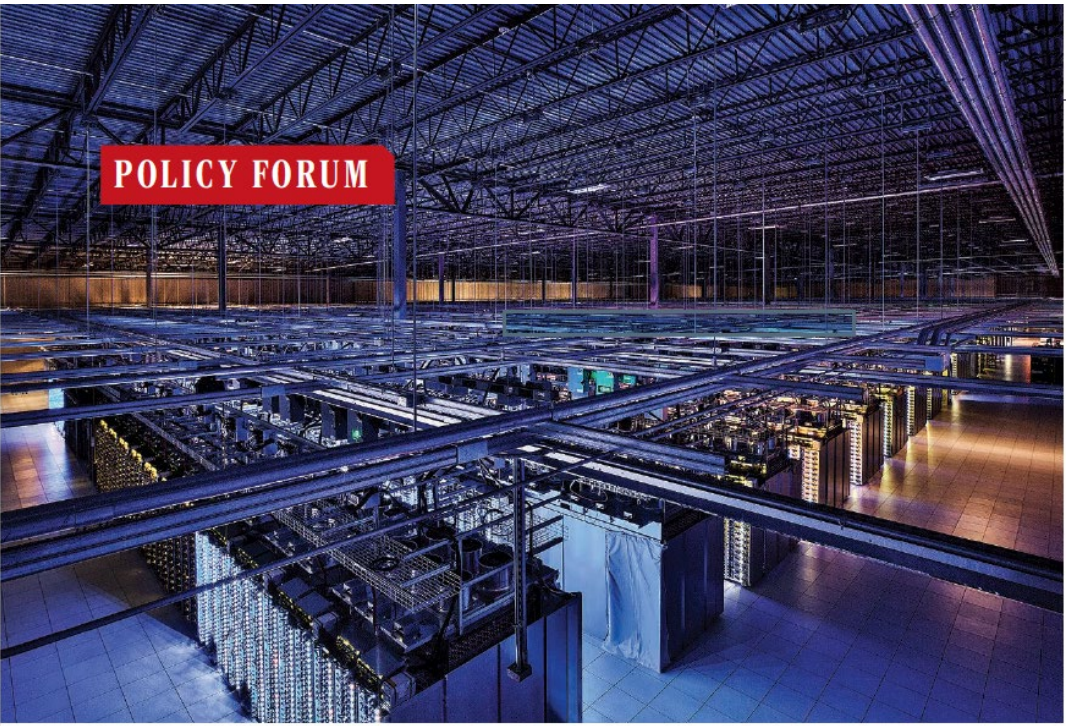


Increasing Global Demand for Data Center Services



Source: Brookfield, LinkedIn, December 2025, https://www.linkedin.com/posts/brookfield_ai-data-center-capacity-is-projected-to-grow-activity-7401670262233911296-vdki?utm_source=share&utm_medium=member_desktop&rcm=ACoAAAV_ci4BPKOJbXob-Y75uZVwxo7IbW0YCow

Data Centers Are Highly Efficient Consumers of Energy



ENERGY

Recalibrating global data center energy-use estimates

Growth in energy use has slowed owing to efficiency gains that smart policies can help maintain in the near term

- Data centers provide greater efficiency and security with computing
  - LBNL: While energy consumption by data centers rose 6 percent from 2010 to 2018, **computing output jumped 550 percent.**
- Incentivized to pursue energy efficiency
  - Virginia JLARC: efficiency gains often unlock more compute, not reduced energy consumption
- Enable energy savings economy-wide
  - Smart thermostats, smart meters, demand response, managed EV charging, grid enhancing technologies, etc.

Source: Science, Recalibrating global data center energy-use estimates, Feb 28, 2020. https://www.science.org/doi/10.1126/science.aba3758 and https://datacenters.lbl.gov/sites/default/files/Masanet_et_al_Science_2020.full_.pdf

Aaron Tinjum

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What industry forecasts and program evaluations reveal about data centers' efficiency potential

Mike Hedlund
Lead Research Analyst, Energy Efficiency Technologies
E Source

Biggest potential likely not in the biggest facilities

	2023 performance		Percentage of total US data center energy use		
Data center type or size	Average PUE	Non-IT energy	2015	2023	2028*
Small *Edge, small and midsize businesses, enterprise branches*	1.91	48%	20%	5%	2%
Midsize *Small and medium colocation, communication service providers, enterprise internal*	1.68	40%	62%	17%	8%
Large colocation			9%	40%	47%
Hyperscale	1.22	18%	9%	38%	43%
AI specialized	1.14	12%			

Source: Shehabi, et al. 2024 United States Data Center Energy Usage Report (PDF). Lawrence Berkeley National Laboratory, 2024.

Note: * = midpoint of high- and low-end forecasts.

- ***Power usage effectiveness (PUE)*** is the ratio of total facility energy use to IT energy use
- ***Non-IT systems***, or "infrastructure," includes HVAC, lighting, building management systems, uninterruptible power supplies (UPSs), and more

Existing programs and measures

- Range of program types and channels
  - Most large projects in broad C&I custom offerings
  - Some segmented programs to isolate costs, impacts, and evaluation recommendations
  - Some prescriptive measures, often most relevant to smaller or older data centers
- Savings estimation methods vary
  - Facility-scale and whole-building projects typically base savings on PUE or ASHRAE 90.4
  - Targeted measures and single-product projects sometimes use deemed savings or TRM formulas
- Frequent changes, difficult to benchmark
  - Great resource: Consortium for Energy Efficiency, Data Centers and Business IT Program Summary

Commonly offered data center measures

- High-efficiency cooling systems
  - Computer room air conditioners (CRACs) and computer room air handlers (CRAHs)
  - Airflow management (e.g., hot aisle / cold aisle)
  - Economizers
- Efficient power equipment
  - Uninterruptible power supplies (UPSs)
  - Rectifiers
- IT measures
  - Server virtualization
  - Server power management software

Challenges for efficiency programs

Savings claims from large data centers are connected to high free ridership (FR) and low net-to-gross ratios (NTG), both in published evaluations and anecdotal discussions.

Data center program evaluated NTGs

	ComEd		Xcel CO	
Project type	kWh	kW	kWh	kW
New Construction	0.06	0.06	0.09	0.14
Other / Retrofit	0.49	0.40	0.37	0.31

"They usually already have a plan in place as far as what they want, and they're not really going to deviate from that."

–Xcel Energy trade partner interview about national and multi-facility data centers

- ***ComEd, 2024:*** Guidehouse, Net-to-Gross Research Results for the ComEd Custom Program and Data Center Subprogram (PDF)
- ***Xcel Energy Colorado, 2025:*** EcoMetric, Colorado Data Center Efficiency Product Evaluation (PDF)

What can incentive programs do?

"Data centers are not just a major load growth story. They are testing whether energy efficiency programs can update and modernize their processes quickly enough to remain relevant, credible, and impactful."

–Andrea Salazar and Jared Casey, Michaels Energy. Powering Smart Growth: Energizing Future Data Centers with Adaptive Program Design (PDF)

Explore new efficiency metrics

- PUE:
  - Valuable for smaller and older data centers
  - Less useful for new hyperscale facilities
- New metrics may create new opportunities:
  - ASHRAE 90.4
  - DCRE: Data center resource effectiveness
  - ITWC: IT work capacity

Pursue existing data centers or innovative measures at new ones

- Existing building commissioning:
  - Monitoring-based commissioning (MBCx)
  - Recommissioning (RCx)
- Waste heat reuse
- Load flexibility
- Emerging technologies and innovative pilots

Consider new approaches and incentive models

- Budgets and first cost are not a key hurdle for data center developers
- Hurdles include:
  - Time to power
  - Interconnection requirements
  - Community relations and public sentiment

Thanks for listening.

Mike Hedlund
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Data Center Impact Evaluations

Lessons learned from evaluating a new construction data center program

August 13th, 2026

EnergyTrust of Oregon

Program history and structure

2009 – 2010
First few data center projects

2012
First baseline developed

2013
Second baseline developed

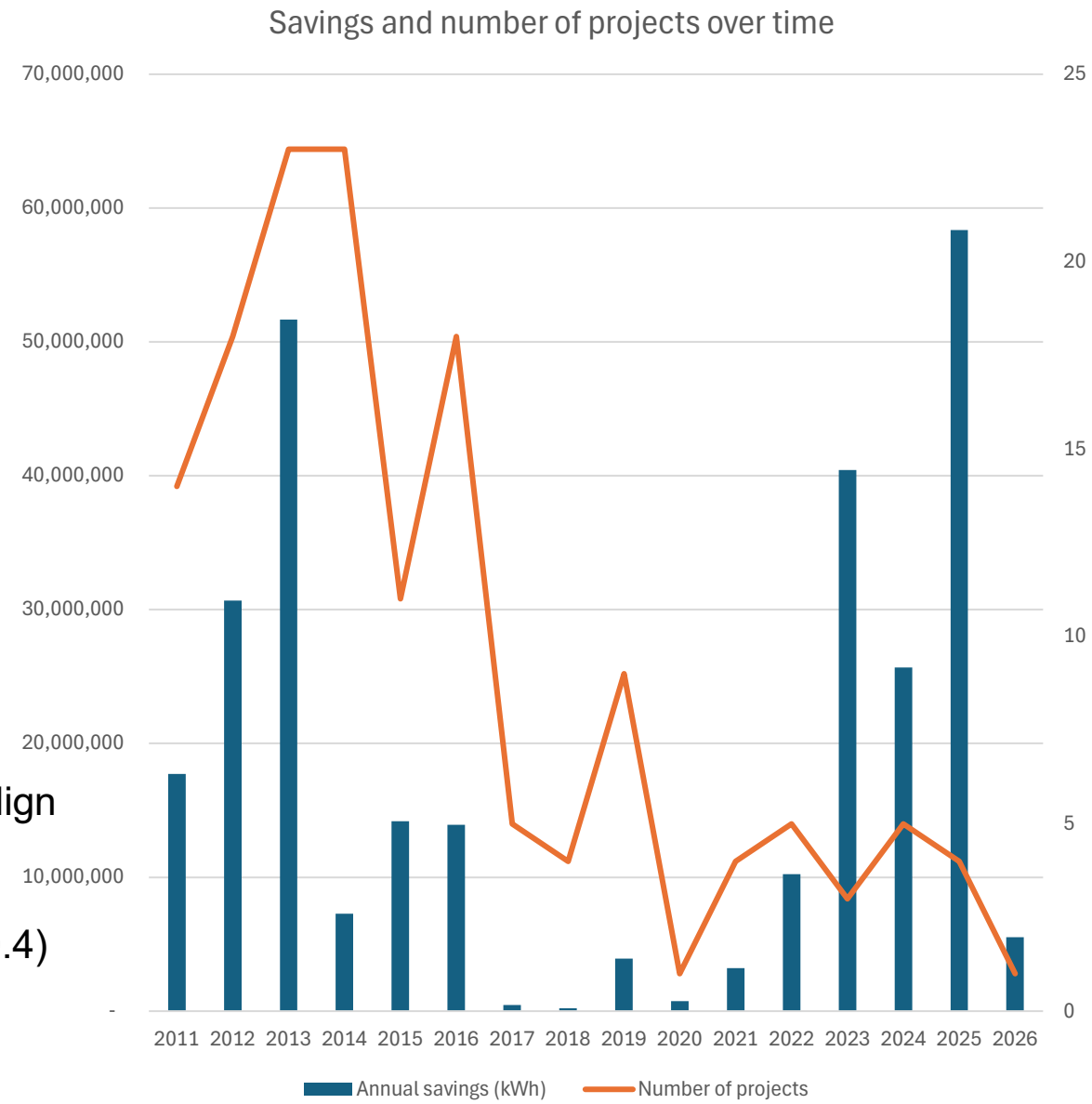
2014 - 2015
Updated program offering

2016
Third baseline

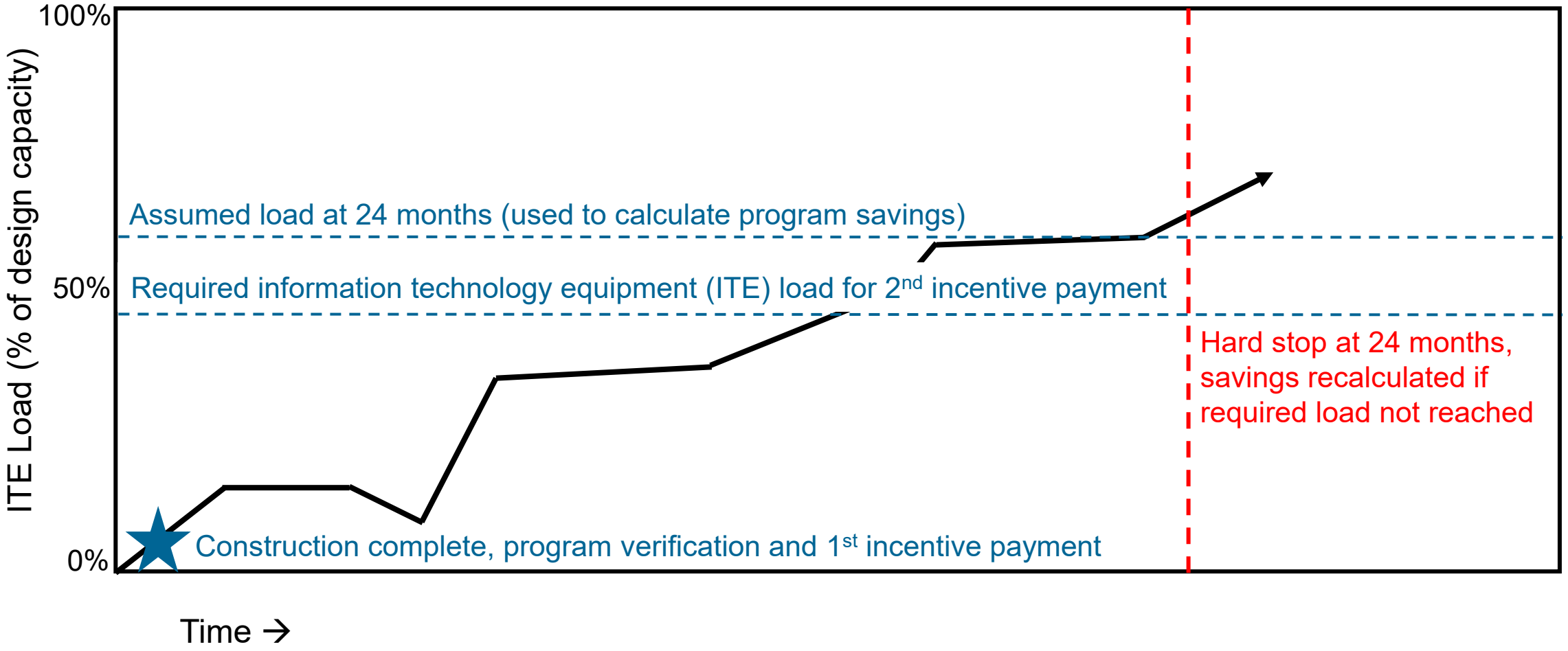
2019
Review of offering and baseline assumptions

2020-2022
Development and launch of current offering

2026
Update to baseline to align with current energy code (AHSRAE 90.4)



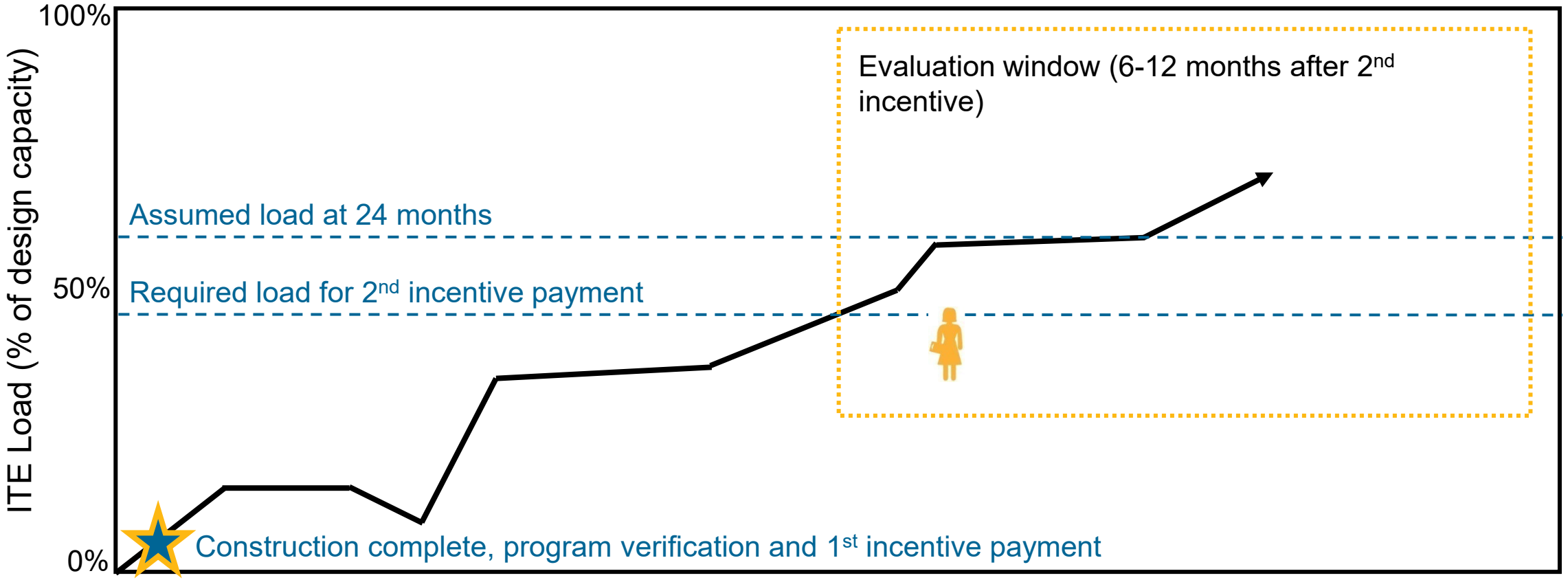
New Buildings Data Center Program – imaginary project



Important features of the program:

- **Partial load assumption** for savings claim and incentive calculation
- **Phased incentive payments and savings claim** to reduce program risk

New Buildings Data Center Program – imaginary project

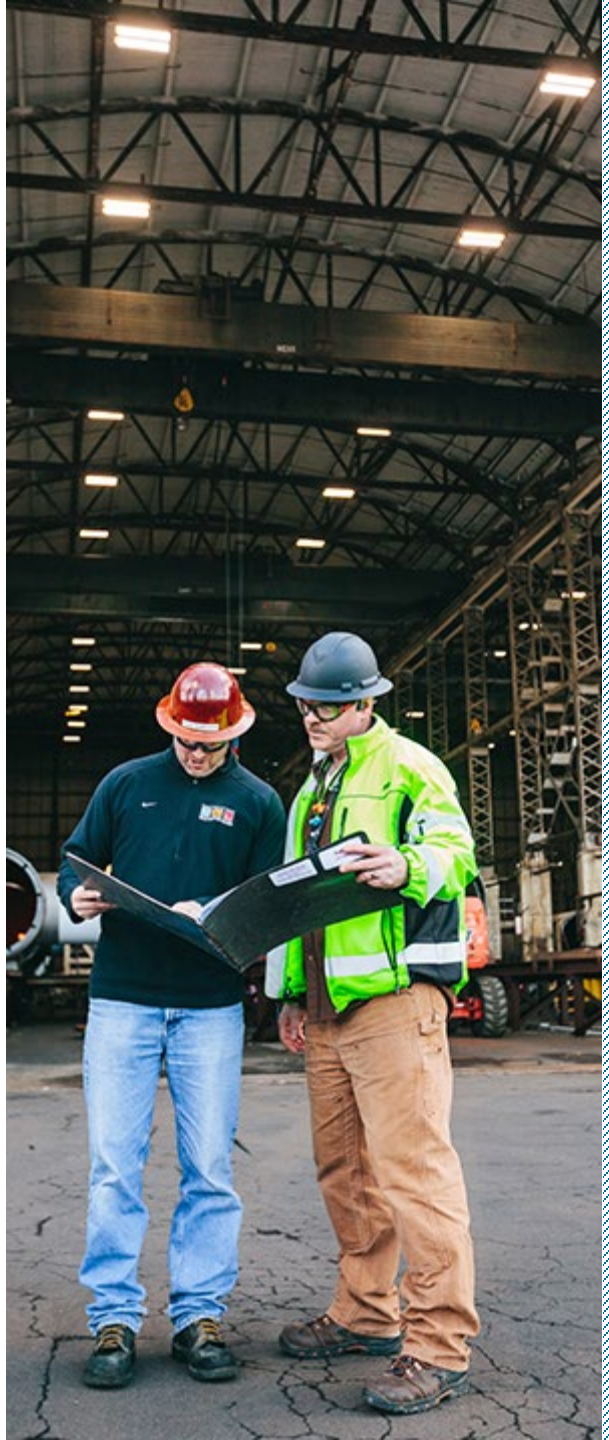


Activities in evaluation window:

- Warm hand-off from program account manager
- Obtain relevant data from site
- Conduct impact evaluation

What we are learning

- Risk of losing contact with sites
  - *Close collaboration with program account managers*
- Sites are sensitive about data sharing
  - *Evaluator presence at initial site visit to set expectations*
- Some sites ramp up ITE load faster than expected
  - *Observe load for 6-12 months after end of program engagement*
- Opportunities for continuous improvement
  - *Identifying systems that are not performing as expected*
  - *Learning about common project pitfalls in real time*
  - *Understanding ITE load ramping trends*



Thank you

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EnergyTrust of Oregon

WHEN TRUST MATTERS

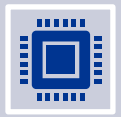
IEPEC: Does it Compute?

Rick Boswell, Principal Engineer, DNV

13 August 2026

Limitations in Market Information

Growing body of information on data centers is available from a wide range of sources, but there are a few key gaps.



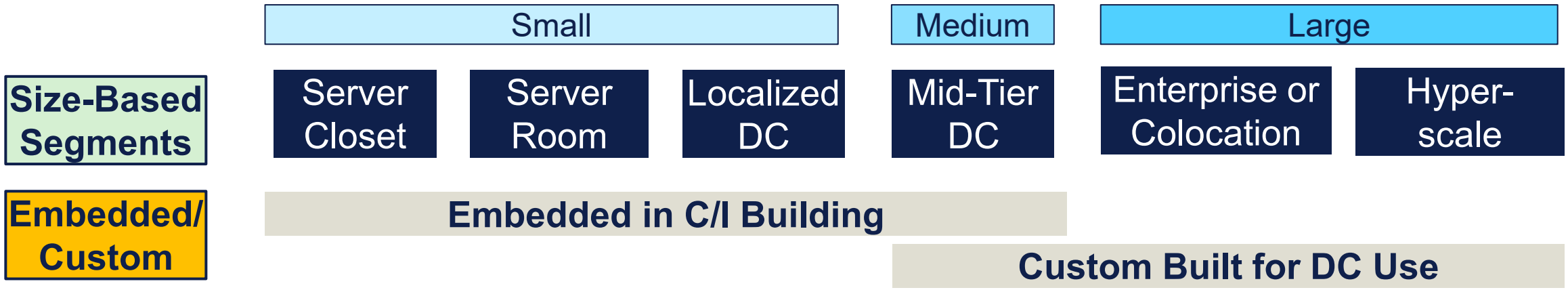
Virtually no independent observations of the installed base of equipment by efficiency levels and major technology options. We have anecdotal information on larger data centers from operators and designers. 2014 NEEA Commercial Building Stock Assessment surveyed small data centers

With the exception of ENERGY STAR® servers, little information publicly available information on sales and market share of major equipment components

Most regional market studies and program evaluations are dated. 2018 – 2019 is the last period covered and there have been huge changes in the market and technology since then.

No documentation of data center participation in demand response programs. Anecdotal information suggests it is very infrequent.

Data Center Types: Size and Embedded v. Custom



Motivators for EE

- Availability of “low-hanging”, cost-effective measures are potential motivations (embedded)
- Significant cost savings
- Meet ESG and GHG reduction commitments

Barriers to EE

- Highly dispersed among the larger C&I building stock
- Responsibility for operations often not well-defined
- Embedded data centers use a relatively small part to total facility energy requirements and costs
- Many key components, such as cooling, air handling, power conditioning may not be under the user’s control
- Industry is concentrated, competitive, secretive.

Data Center Energy Efficiency Program Experience

Relatively few programs designed specifically for data centers

Participation by data centers in energy efficiency programs has been low

Ex Ante savings are relatively modest

Realization rate findings are highly variable

Illustrated Tour of Data Center Types and Components

Server Closet

Size	Up to 200 sf
Number of Servers	1 – 5
Power Management Systems	Limited back-up power systems
Typical HVAC System	Uses building systems. No environmental controls for closet

Server Room

Size	200 – 500 sf
Servers	5 - 25
Power Management Systems	Limited back-up power. Usually Uninterrupted Power Supply Units
Typical HVAC System	Uses building systems. Some may have supplemental dedicated capacity for the room

DNV

Localized Data Center

Size	500 – 1,000 sf
Servers	25 – 200
Power Management Systems	Some power redundancy, including uninterruptible power supplies
HVAC	Dedicated capacity including overhead or underfloor air distribution, in-room AC. Temperature and humidity are controlled

Mid-tier Data Center

Size	1,000 – 5,000 sf
Servers	200 – 2,000
Power Management Systems	Redundant power supply systems
HVAC	Dedicated capacity including overhead or underfloor air distribution, efficient water-cooled chiller, variable speed fans. Waste heat containment systems in place. Temperature and humidity are controlled

Large Enterprise & Colocation Data Centers

Size	10,000 – 100,000 sf
Servers	Thousands
Power Management	Redundant power supply and cooling systems
HVAC	Efficient systems featuring waste head containment, economizers, VFD fans, water-cooled chillers. efficient water-cooled chiller, variable speed fans.

Hyperscalers

Size	20,000 – 500,000 +sf
Servers	Thousands
Power Management	Multiple redundant power management systems
HVAC	Efficient systems featuring waste head containment, economizers, VFD fans,efficient water-cooled chiller, variable speed fans.

Even bigger facilities on the drawing board

Artist’s rendering of planned 2 GW data center in Louisiana, developed by Meta in partnership with Entergy, which will supply power from natural gas plants. Meta also has bilateral Power Purchase Agreements (PPAs) with local renewable power facilities and is purchasing carbon offsets.

Potential Energy Efficiency Measures & Challenges

Potential EE Measures for Small Data Centers

Measure name/description	System energy savings, %	Cost
IT Equipment Systems		
Server virtualization – division of physical server into multiple unique virtual servers by means of a software application	30%	**L**
Energy-efficient IT equipment – use of servers, storage devices, and network components that exceed ENERGY STAR® efficiency standards.	30%	**M**
Improved server power management – use of built-in features, software, or other tools	10-20%	**L**
Cooling and Air Handling Systems		
Adopt ASHRAE thermal guidelines – to maintain a temperature close to the upper-end of the ASHRAE range of 64–81°F for data centers.	Varies	**L**
Implement aisle separation and containment systems – to separate cold air supply from hot exhaust air from server racks	40%	**M**
High efficiency direct expansion (DX) cooling units – exceeding efficiency standards, such as ASHRAE 90.1.	Up to 50%	**M**
Airside economizer – cools a data center by bringing in cool air from outside and distributing it to the servers.	20% - 50%	**M**
Variable speed fan control - Variable speed drives on CRAH and CRAC fan motors.	25%	**L**
Power Conditioning and Distribution Systems		
High efficiency modular uninterruptible power supply (UPS) – system built with multiple independent power modules that can be added or removed as needed	5%	**M**

Potential EE Measures for Large Data Centers

Measure name/description	System energy savings, %	Cost
Information Technology Equipment Systems:		
All IT equipment measures are Standard Industry Practice for mid-sized and large data centers	N/A	**N/A**
Cooling and Air Handling Systems		
Adopt ASHRAE thermal guidelines – to maintain a temperature close to the upper value of the ASHRAE recommended range of 64–81°F for data centers.	Varies	**L**
Increase server inlet air temperature – to reduce cooling requirements; savings potentially offset by higher fan speeds	5%	**L**
Waterside economizer – uses the evaporative cooling capacity of a cooling tower to produce chilled water without compressors.	15%	**H**
Evaporative Cooling System - cools air by passing it through wet pads or filters, where water evaporates, absorbing heat from the air and thus lowering its temperature.	40% to 50%	**M**
Install In-rack or In-row cooling - cooling unit is directly integrated into a server rack, providing a highly localized and precise way to cool IT equipment.	10%	**H**
Rear Door Heat Exchanger - radiator-like door is attached to the back of a server rack, directly removing heat from the exhaust air of the servers by transferring it to a coolant like chilled water.	50%	**H**
Liquid cooling - is a method of using a liquid coolant to absorb and remove heat from electronic components in servers.	30%	**H**
Power Conditioning and Distribution Systems		
DC power supply system – delivers direct current (DC) electricity to IT equipment, potentially reducing distribution losses	5%	**H**
Advanced submeter – a specialized electrical meter that provides real-time energy consumption data for components, allowing precise monitoring and identification of energy inefficiencies	5%	**H**
High efficiency distribution transformers - takes the high voltage electricity from the grid and steps down with minimum energy losses.	2% - 3%	**M**

Common Evaluation Challenges

- **Defining the baseline** - Establishing what energy use would have been without the measure can be difficult. What is industry standard practice (ISP)?

- **Misaligned or reduced occupancy** - A server operating at 20% utilization today may operate at 60% utilization next year, making post-installation measurement difficult to interpret.

- **Measuring Non-Energy Benefits** - Data center projects can generate benefits beyond electricity savings such as reliability, reduced maintenance, and better thermal management.

As a result, evaluators typically rely on a combination of:

- Site-based metering
- Engineering analysis
- Manufacturer performance data
- Operational trending
- Calibrated simulation
- Custom M&V plans rather than standard deemed approaches.

Measure Challenges

Measure Type	Primary Evaluation Challenge
Server virtualization	Establishing workload-equivalent baseline
Server replacement	Technology advancement vs. program impact
Variable-speed fans/pumps	Interactive cooling effects
Airflow management	Isolation of savings from concurrent changes
Economizers/free cooling	Weather normalization
Liquid cooling	Lack of historical performance benchmarks
UPS upgrades	Measuring losses under variable loading
Data center controls	Persistence and attribution of operational savings

Thank you!

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QUESTIONS?

REMINDER TO SUBMIT YOUR ABSTRACT