BREAKOUT SESSION

Technology: What's New & What's Next?

VAEEC

Technology: What's New & What's Next?

Speakers

Andrew Grigsby, Viridiant

Millie Knowlton, CPower Energy

Richard Anderson, Siemens

Adam Sledd, DEIC (moderator)

Next Generation Heat Pumps: A No-Brainer

Welcome

Since 2006, Viridiant, a 501(c)3 non-profit, has promoted sustainable construction across Virginia, providing technical expertise and verification for *more than 35,000* green-built homes.

Our **Community Energy Services** division was launched in 2020 to provide public education and resources regarding home energy audits, rooftop solar, energy efficient mortgages, and more – especially for folks in the Richmond region.

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2023 Corporate Sponsors

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HUBER ENGINEERED WOODS

Today's Advanced Heat Pumps

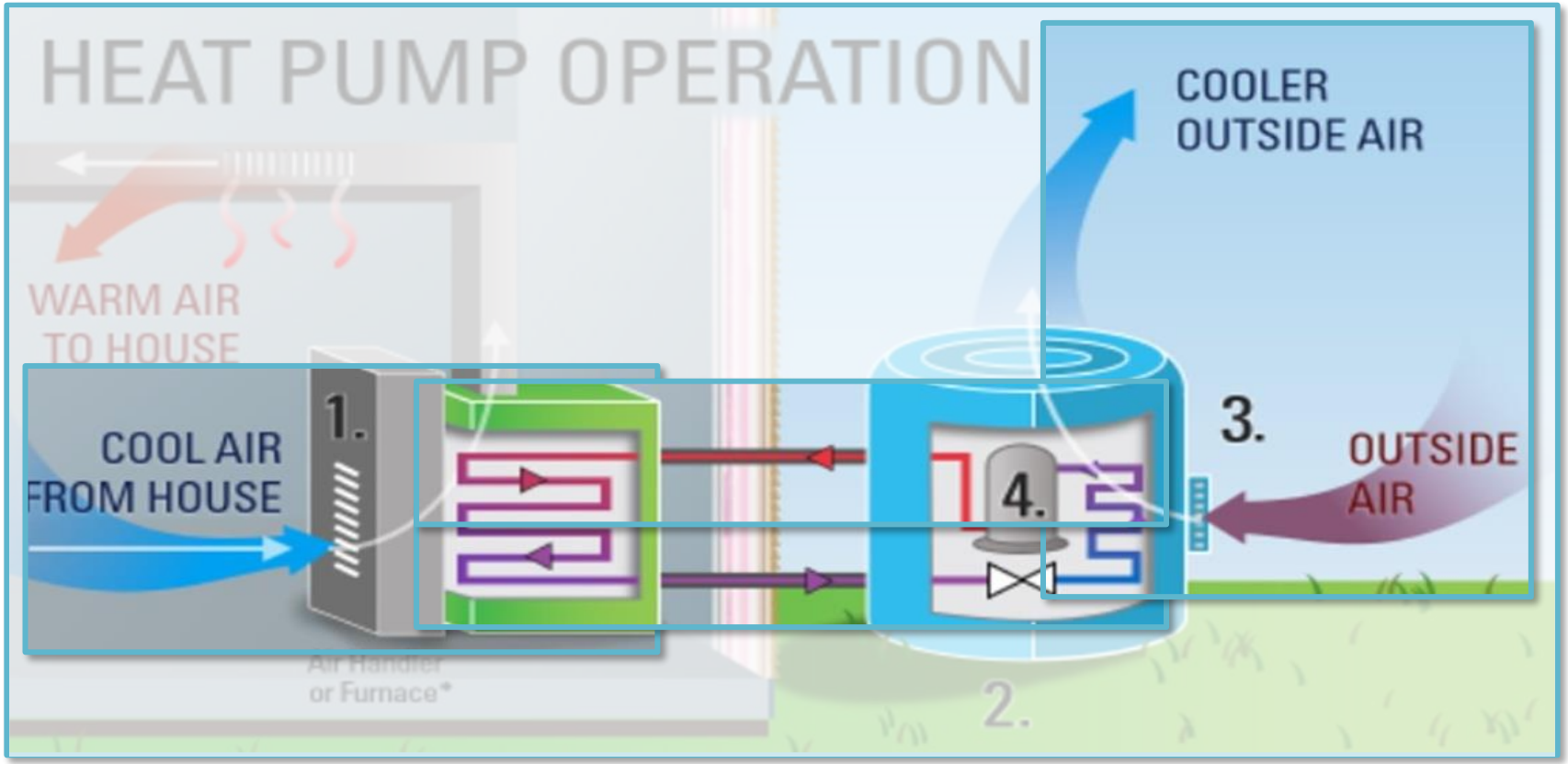
Heat pump technology has improved *dramatically* over the years - and continues to improve.

Today's cold climate models offer

- Super-high efficiency even at very cold outside temperatures
- Durable, soft-starting DC motors and fully variable output
- Ducted and ductless models
- 30% federal tax credit (up to $2000)

A heat pump is now the best option for nearly every new construction or retrofit job.

The Refrigerant Cycle Moves Heat



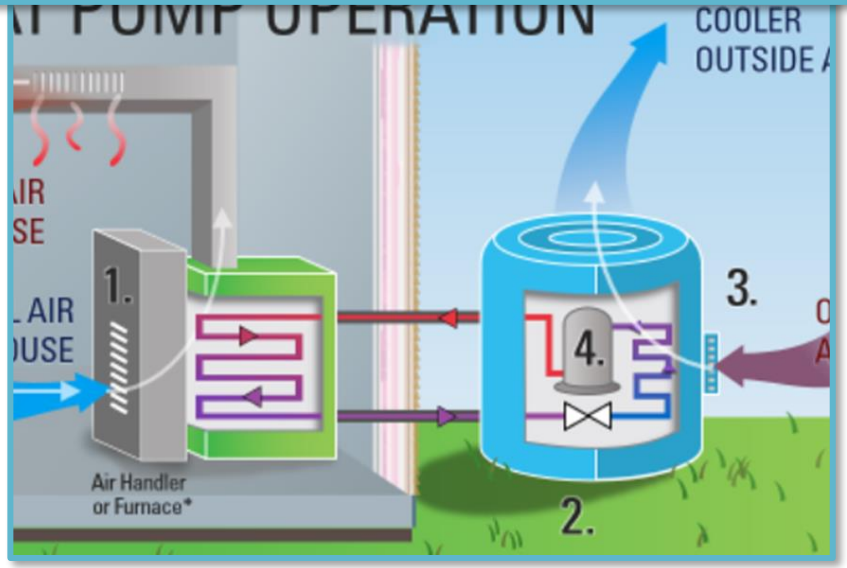
Delivering Heat with 300% (+) Efficiency

1 kWh **creates** 3412 Btus of heat

Electric resistance is 100% efficient at converting electrical energy to heat

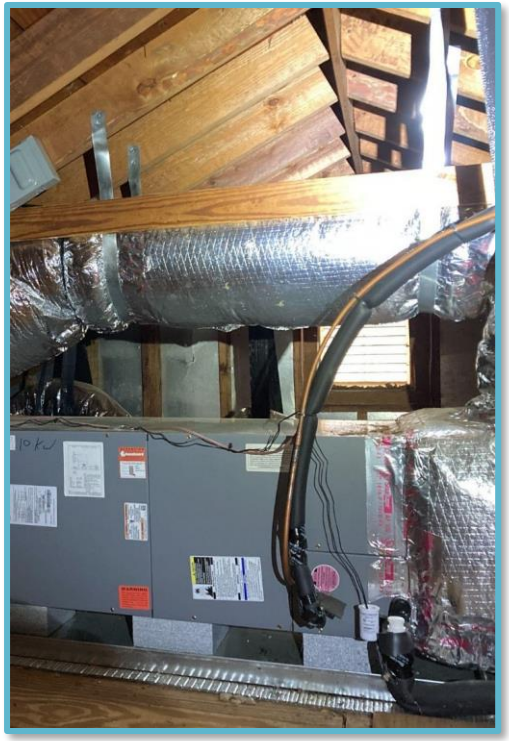
1 kWh **moves** 10,000+ Btus of heat

300% efficient (and better) depending on outside temperatures and other factors



“Legacy” Heat Pumps

- Heating capacity diminishes significantly at colder outside temperatures.
- Electric resistance or fossil fuel “auxiliary” heat is necessary.
- Lowest cost equipment



“Cold/All Climate” Heat Pumps

- Maintains heating capacity at very low temperatures
- No backup heat source needed
- More adaptable to difficult installation conditions
- More even room temperatures
- Improved humidity control
- Better air filtration
- Quietest operation
- Reduced energy use

Comparing Btu Output

How much heat can a heat pump deliver (cost-effectively) when it's really cold outside?

Outdoor Temperature (°F)	0	10	**17**	20	30	40	**47**		
Legacy Btu/H	8,790	11,850	**14,000**	14,480	16,570	20,210	**23,200**		
All-Climate Btu/H	24,000	24,000	**24,000**	24,000	24,000	25,000	**26,000**	26,000	28,000
All-Climate *Efficiency*	*185%*	*223%*	***243%***	*261%*	*299%*	*346%*	***385%***	*391%*	*391%*

2-Ton heat pump (12,000 Btu per ton)

Heat Pump Water Heaters: so much better, but kinda tricky…

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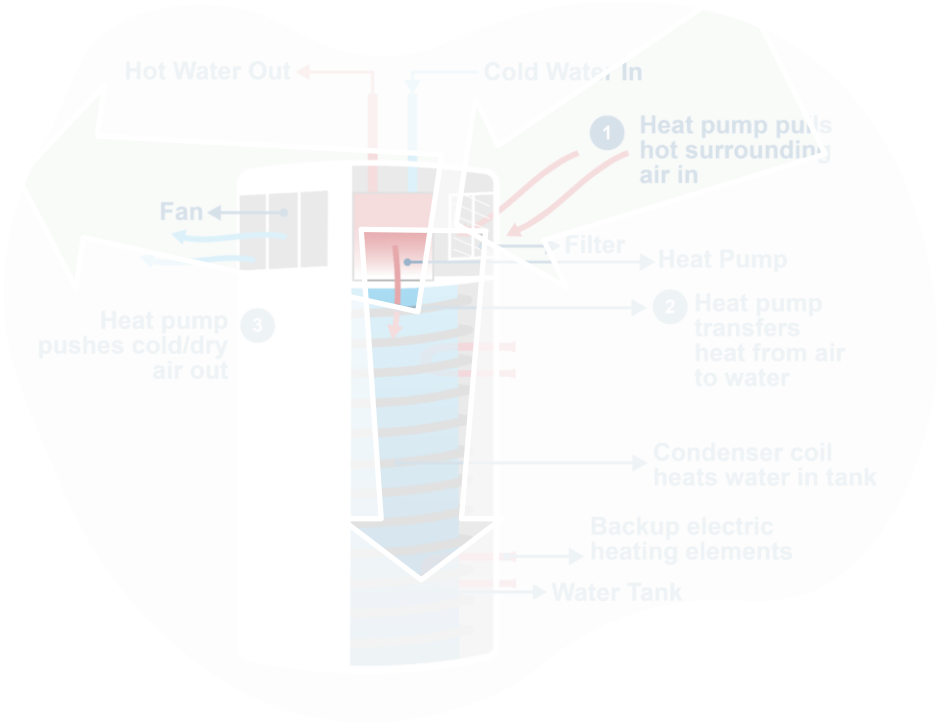
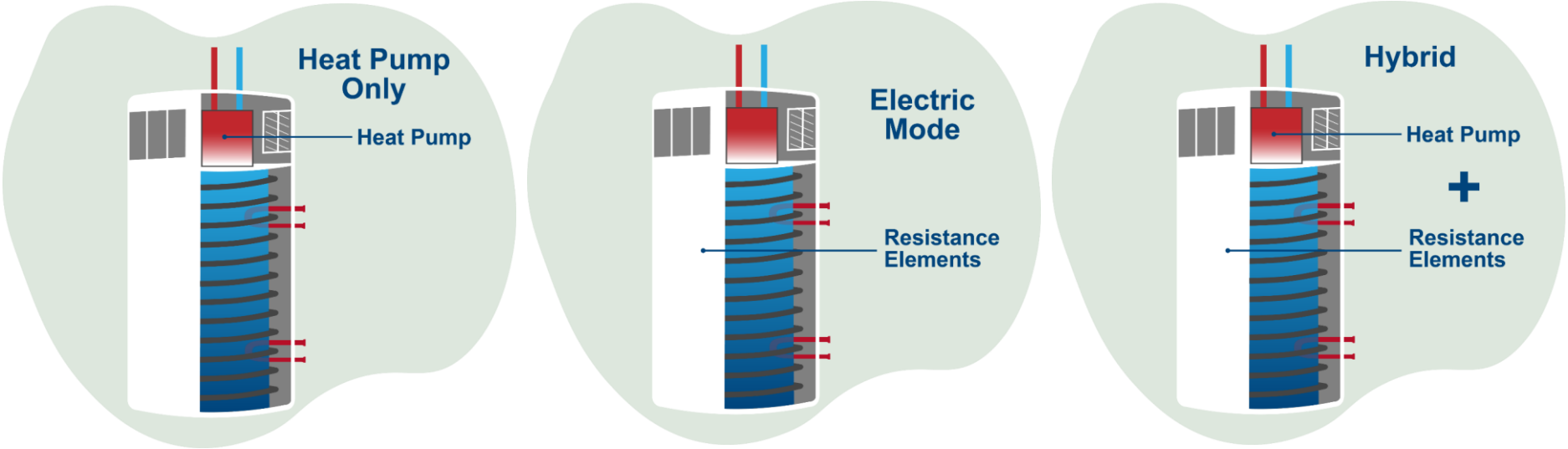
How a HPWH Works



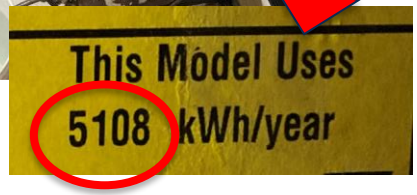
HPWH Technology Description

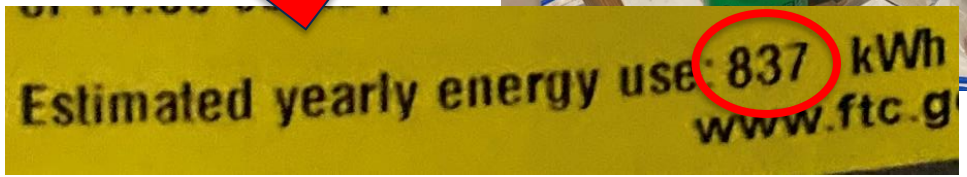
Three different operating modes



HPWH Technology Description

Grigsby Household Water Heater Replacement: August 2023





837/5108=0.16

5x more efficient – with a larger tank

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non-profit organization committed to supporting sustainable building processes through education, consultation, and certification

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Dynamic Scheduling for DER Optimization

10/2023

6.3 GW
of DER Capacity

60+
local energy solutions offered

20+
years of experience

~20,000
sites across the U.S.

Leading, National DER Monetization and Virtual Power Plant Provider

24x7x365
dispatch

2,400+
loyal customers

$1 Billion
paid out to customers in grid revenue since 2015

286,000 metric tons of CO2 avoided through DR solutions, equivalent to **317 million pounds of coal**

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We help energy users unlock the value of their Distributed Energy Resources to provide the grid with reliable, dispatchable resources when and where it's needed most.

CPower – What we do

We maximize the value of our customers' distributed energy resources

Distributed Generation

Maximize resilience and shorten the payback period of solar, wind, and other

Demand Response

Get paid for helping the grid by reducing load.

EnerWise® Site Optimization by CPower

EnerWise Site Optimization

CPower's AI-driven EnerWise Site Optimization engine helps manage and monetize DERs across multiple energy markets and utility.

Peak Demand Management

Lower your capacity charges by reducing energy when the grid is peaked.

Energy Storage

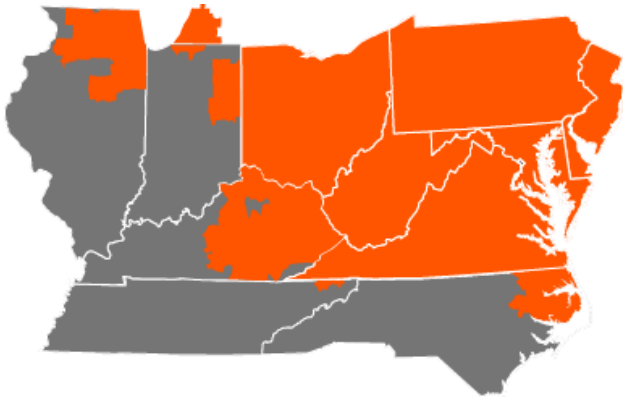
Turn on-site capacity into revenue.

Energy Efficiency

Monetize permanently reduced demand.

We match the needs and capabilities of organizations with the needs of the grid to maximize their energy savings, increase revenue and support a safe, reliable energy grid.

DER Opportunities in PJM



PJM Market Programs	▪ Capacity Performance (CP) ▪ Synchronized Reserves (SR) ▪ Real-Time and Day-Ahead Economic (LMP) ▪ Frequency Regulation (FR) ▪ Energy Efficiency (EE)
On-Bill Programs	▪ Coincident Peak Management (5CP) ▪ Transmission Peak Management (NSPL) ▪ Demand Charge Management ▪ Energy Savings (TOU or Index) ▪ Backup/resiliency

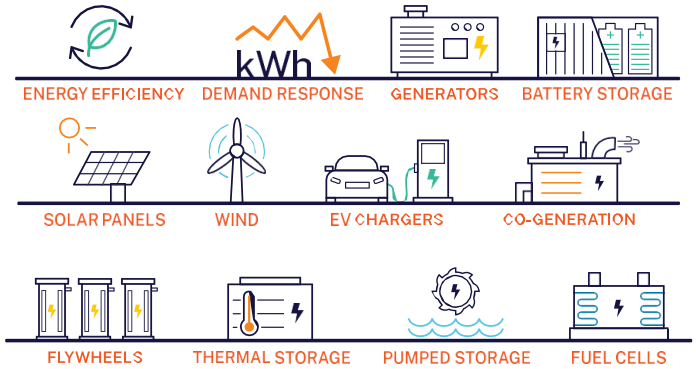
Distributed Energy Resources

Distributed Energy Resources (DERs) are any assets that consume, generate or store electricity, and that can respond to a signal. These can be generation assets like back up generation, solar, co-gens and storage, but also include energy curtailment. Any asset that can deploy energy when called on can generally participate in demand management programs.

Demand Response, Peak Demand Management, and Energy Efficiency Programs

FACILITIES

+



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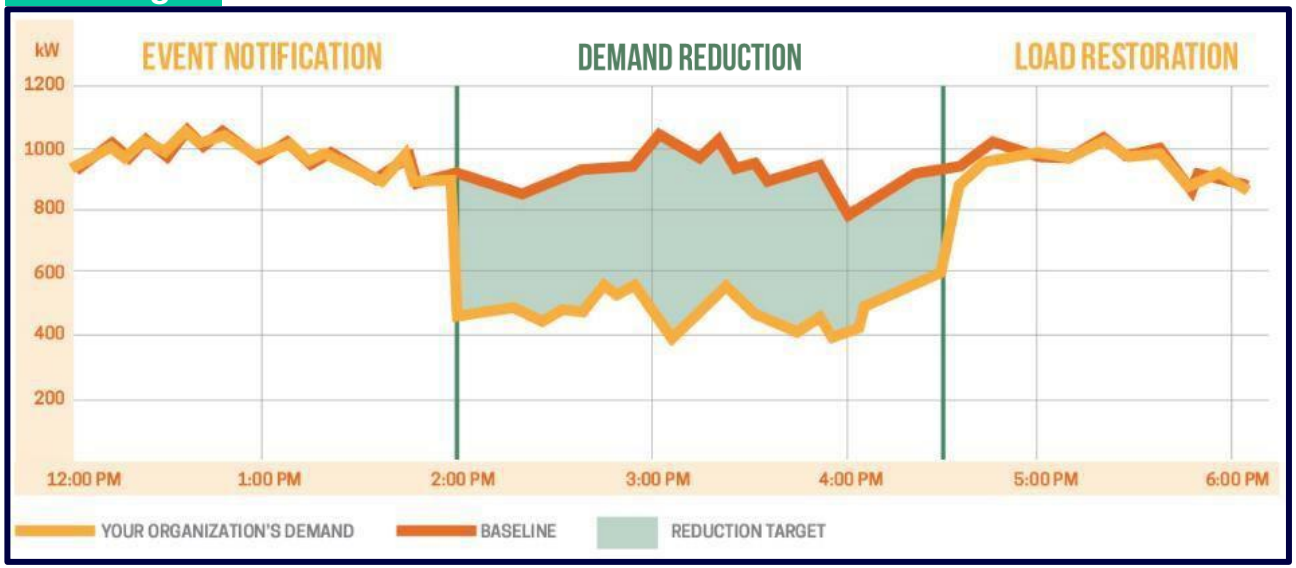
Savings

Earnings

DER Optimization can look like Grid Service Participation (or “demand response”)…

DR helps reduce demand when the grid is stressed, or the price of energy is high

Earnings



When the grid is stressed or the price of energy is high, demand response rewards participants who can reduce their demand with financial incentives based on their amount of load reduction.

DR generally falls into three categories: Capacity, Economic, or Ancillary.

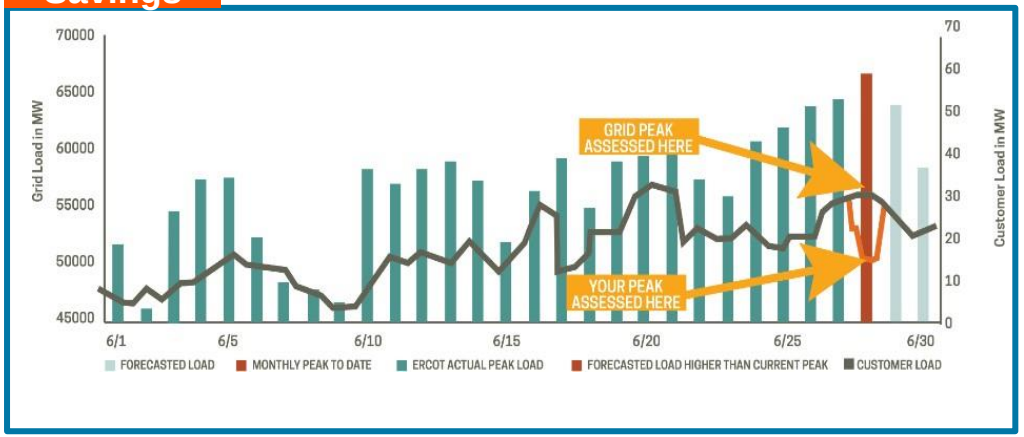
Distributed generation can be used in many programs.

Or Like On-Bill Cost Avoidance…

DER Optimization reduces charges on your electric bill, including monthly demand charges, retail energy charges, and coincident peak charges like CapTag and Transmission Peak

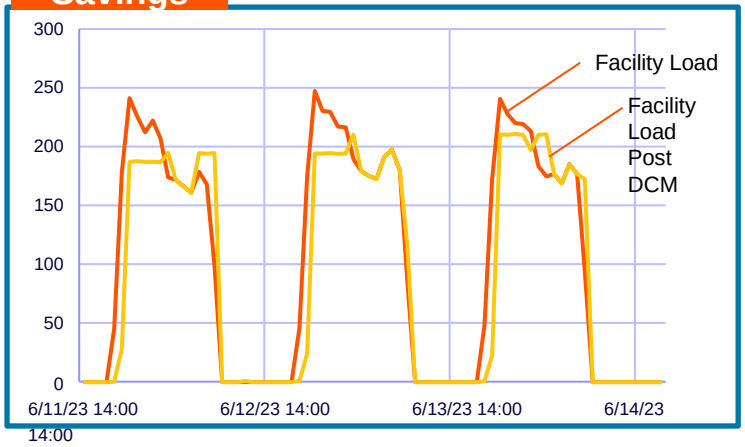
Coincident Peak Management, also known as cap tag management

Savings

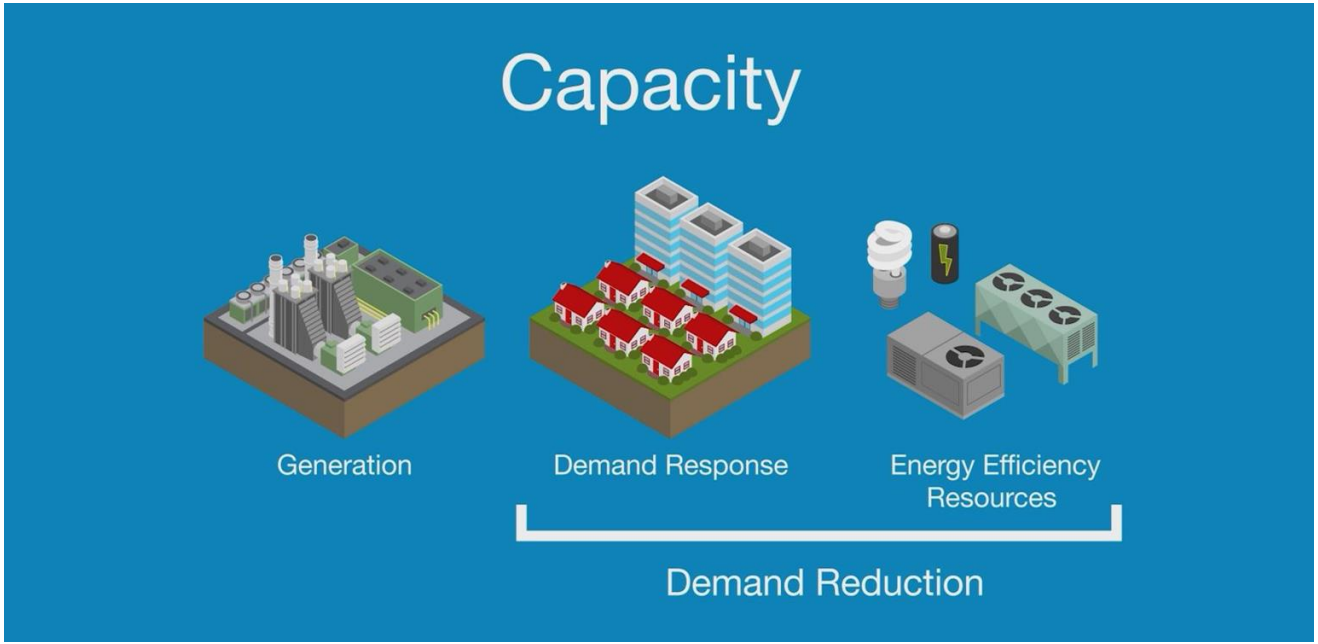


Site-level demand and energy savings

Savings



Energy Efficiency as a Resource



Energy Efficiency is also a resource to the electric grid.

Source: McKinsey.

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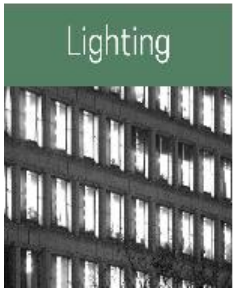
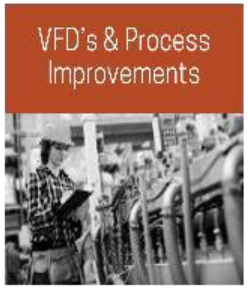
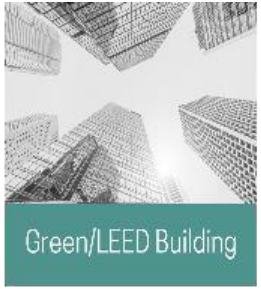
Monetizing Energy Efficiency

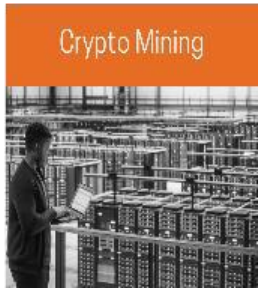
Energy efficiency projects create savings AND create revenue streams

Typical EE Eligible Projects









In PJM, EE permanent demand reductions can be monetized in the same capacity markets as a demand response resource. This means **projects can receive capacity payments (revenue)** in addition to the energy savings [illegible]d.

Qualification Process

1. Coordinate with Market Participant
2. Implement Energy Efficiency project
3. M&V to confirms savings
4. Demand reduction monetized in PJM Market

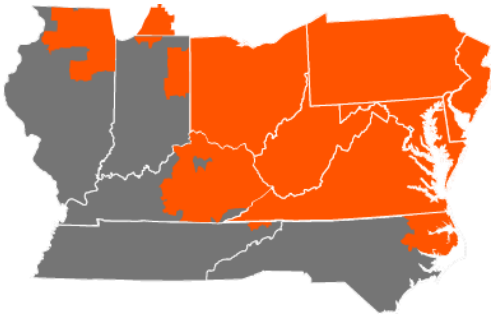
PJM Program Stacking

Stacking Programs Maximizes DER Earning Potential

Program Stacking =

- Capacity Performance DR +
- Energy Efficiency +
- Economic RT DR +
- Synchronized Reserves +
- Frequency Regulation =

Stacked Earnings



Stacking Key Takeaways:

- PJM generally allows for program “stacking”, meaning, the same kW and asset can be utilized to participate in multiple programs.
- This allows for multiple revenue streams to be realized from the same energy assets.

DER Value Examples

Crypto Mining (West Penn Power)

- Load-only
- Programs: Capacity Performance, Synchronized Reserve, RT and DA Economic, Coincident Peak Management (PLC)
- % Revenue Added by Optimization: 55%

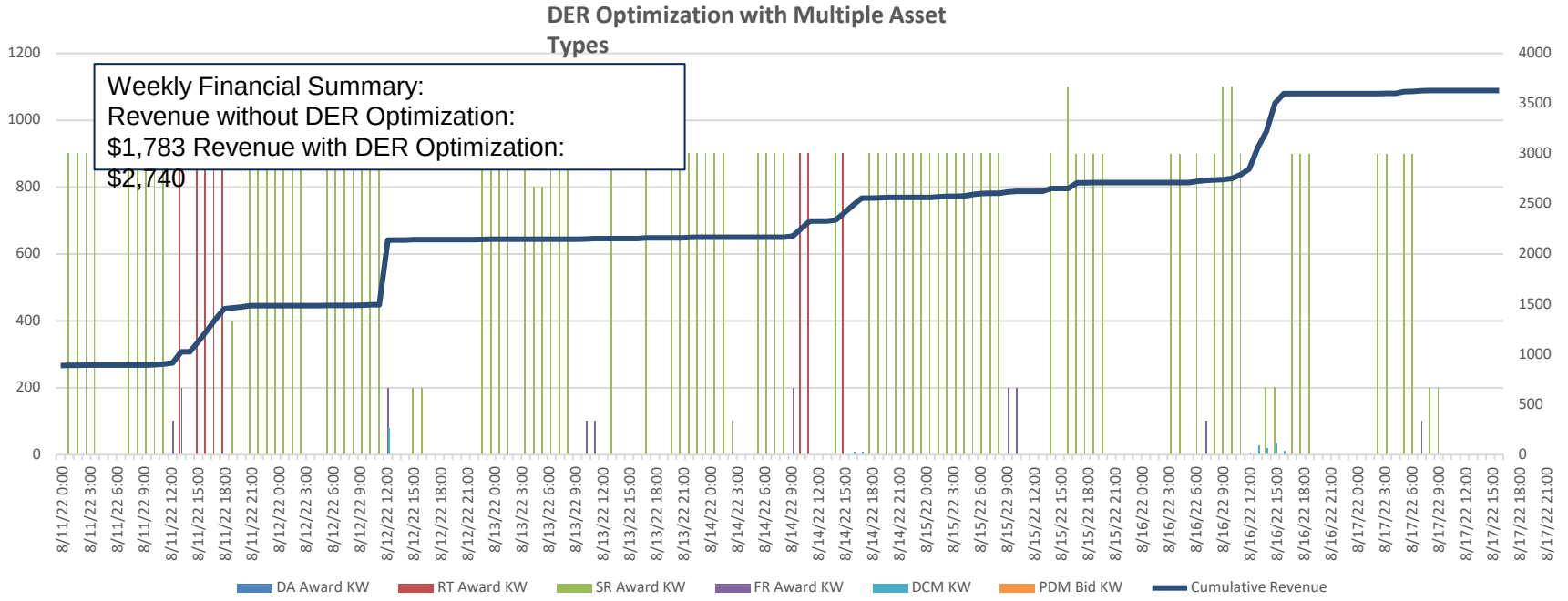
Vertical Farm

- Generator + Battery + Solar
- Programs: Capacity Performance, Frequency Regulation, Synchronized Reserve, RT and DA Economic, Coincident Peak Management (PLC)
- % Revenue Added by Optimization: 40%

Government (Dominion)

- Generator-only
- Programs: Capacity Performance, Synchronized Reserve, RT and DA Economic, Demand Charge Management
- % Revenue Added by Optimization: 68%

Incremental Revenue with DER Optimization



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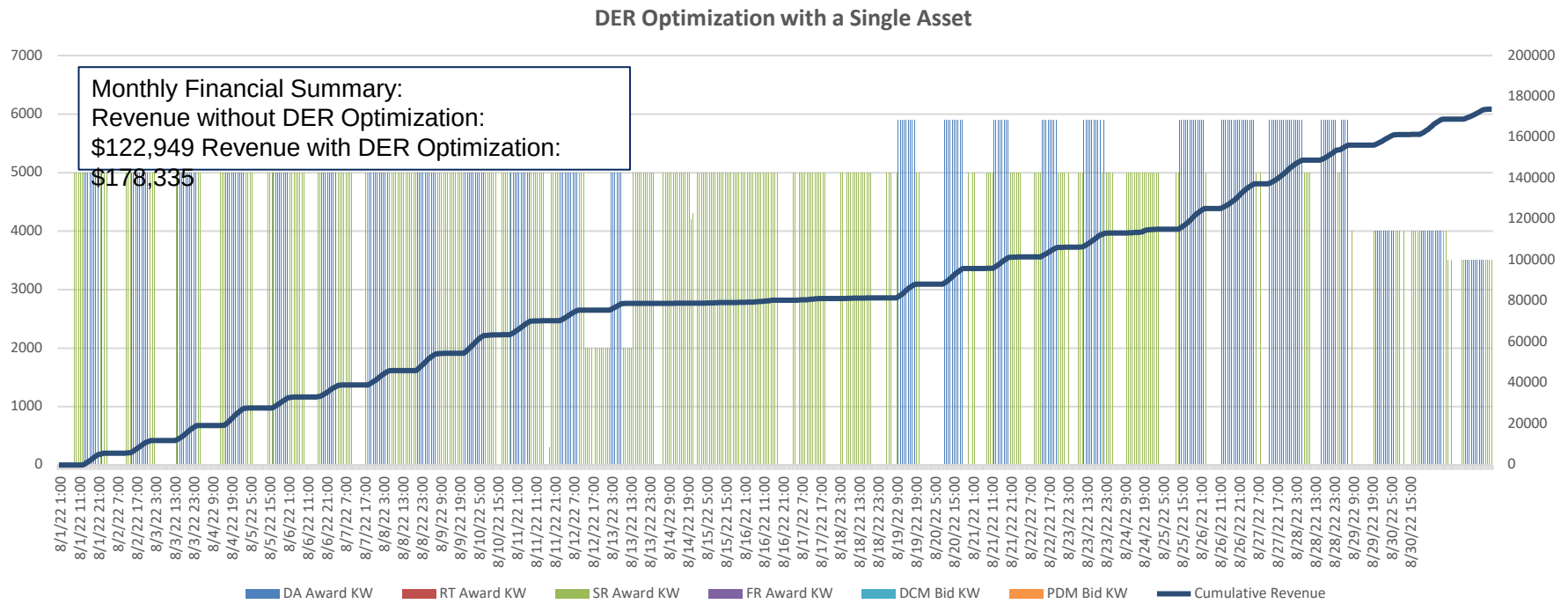
Incremental Revenue with DER Optimization



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Thank you!

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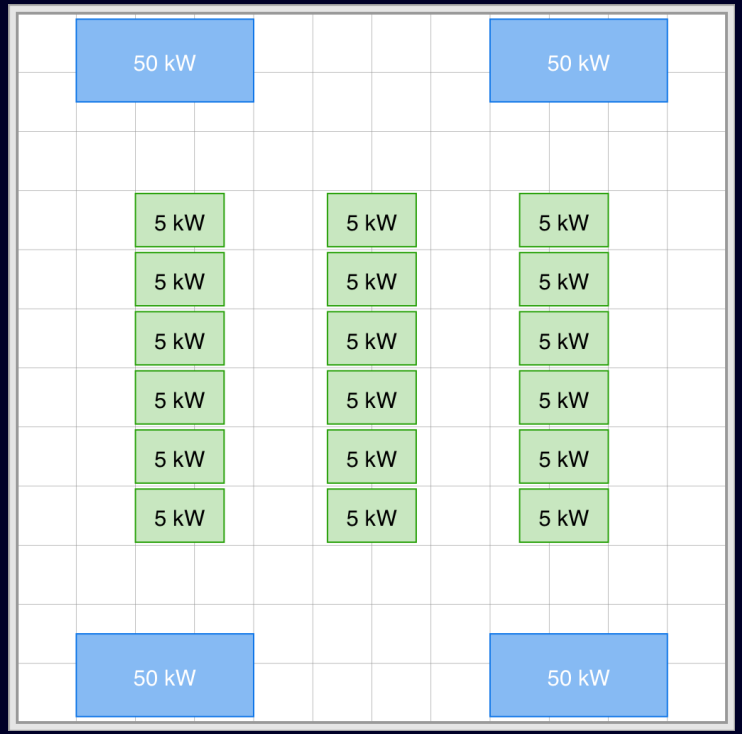
Data Center Cooling is Complex

Typical Facility

Design

- Uniform rack layout
- Uniform rack densities
- Airflow is zoned
- Every AHU operates the same



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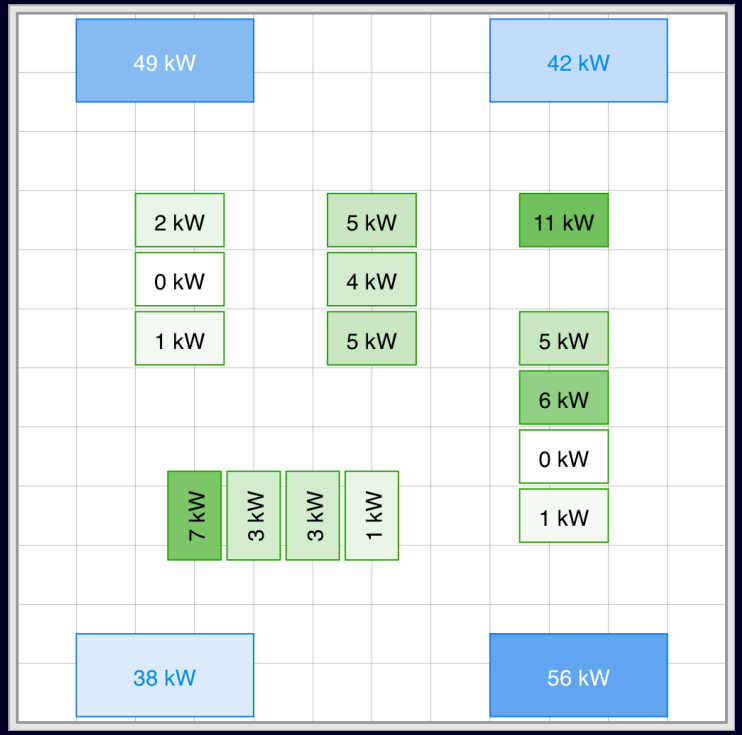
Typical Facility

~~Design~~ **Reality**

- ~~Uniform~~ Varied rack layout
- ~~Uniform~~ Diverse rack densities
- Airflow is ~~zoned~~ complex & dynamic
- Every AHU operates ~~the same~~ differently



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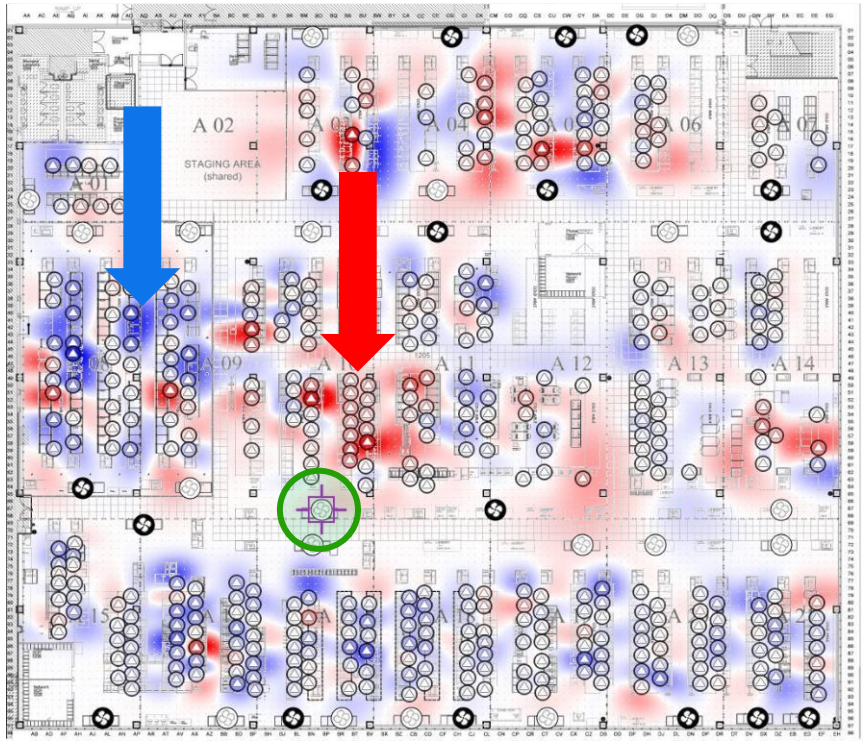
How AI can be used to Optimize

Unveil the Complexity and Address the Issue



Standard 100-kW CRAHs on a raised floor

Has a cooling influence in some areas only in some areas

Has no influence on spaces / entire room

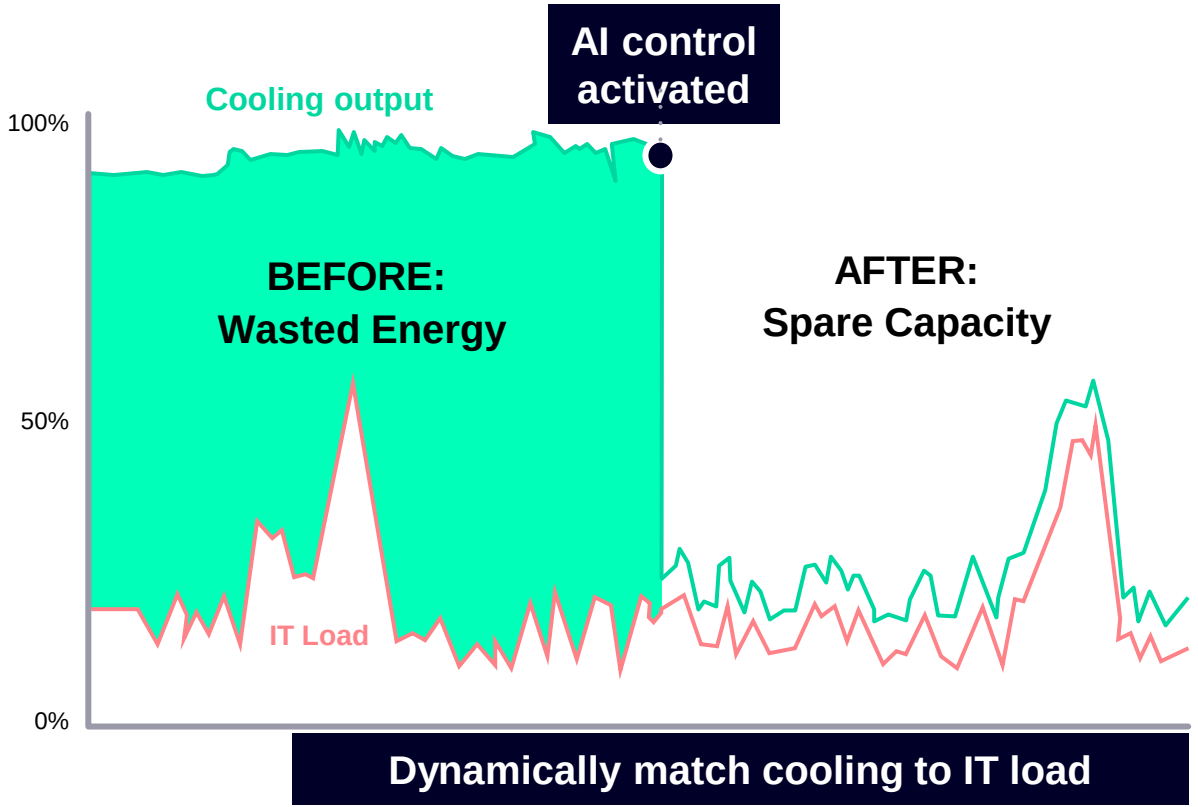
And a heating influence on other areas

Siemens AI Optimization of Data Center Cooling

Design standards provide **more cooling than needed**

Airflow complexity and IT variability make it **impossible to optimize manually or with simple cooling unit controls**

The result is **wasted energy, lost capacity and hidden thermal risk by hot spots**



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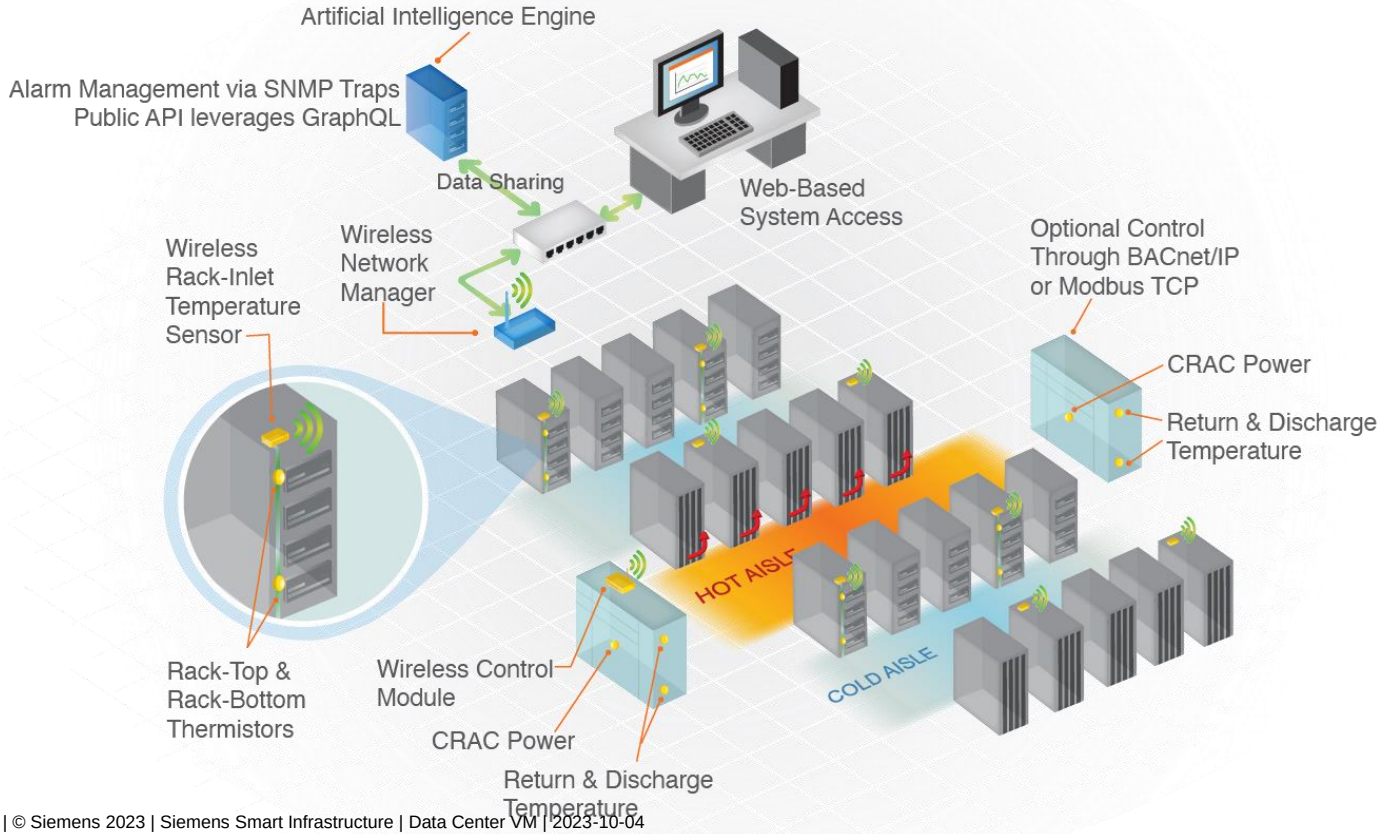
Flexible Network Architecture

Wireless or Wired, Analog or Digital & Predictive Control Algorithm



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Siemens AI-powered cooling allows to address multiple core KPIs of data center operators

Resilience, efficiency and capacity impacted by cooling management

- **Hotspots in white space** create the risk of overheating and server rack downtime

- **Unnecessary high cooling efforts**, while cooling is the largest lever to optimize OPEX. 40% of OPEX are cooling related.

- Rack capacity is often limited by **cooling capacity**.

AI-engine continuously optimizing white space cooling

- Heat maps, influence maps, AI-based individual and dynamic adjustments of air handling units

- Demand driven cooling, individual and dynamic adjustments of air handling units

- Demand based cooling management frees up cooling capacity to allow higher power density in server racks

Cooling optimization to improve major KPIs of the data center

- **Improve Data Center resilience** against overheating of server racks

- 97% hot spots

- **Adjust cooling efforts dynamically** to demand to reduce OPEX significantly.

Up to 45 % less energy cost, Ø 15 %

- Driving **data center profitability**:
- Adjust cooling effort to the true demand to extend the data center capacity

10 – 25 % more server capacity possible

WSCO: White Space Cooling Optimization

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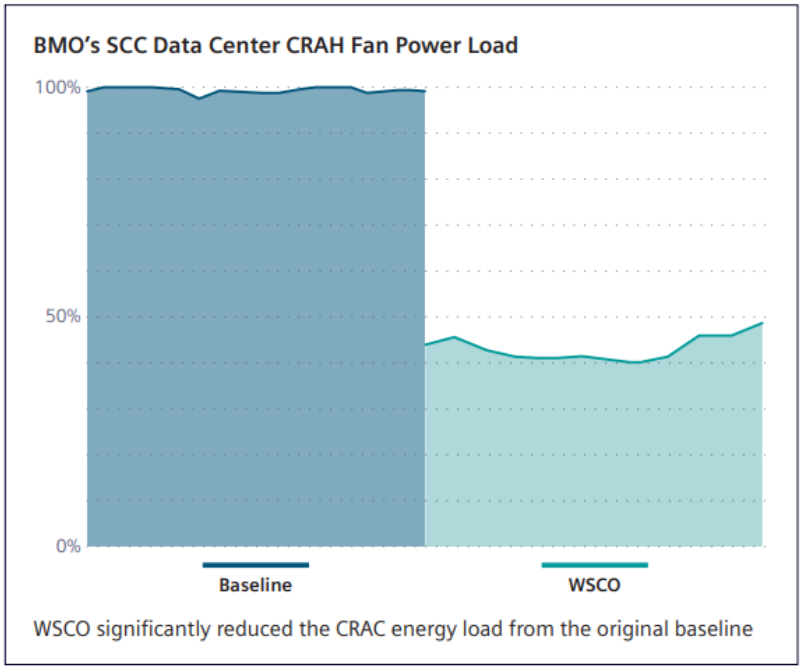
Enhance transparency with persona-based Dashboards
Visualize Influenced Maps for CRAC/H Units
Visualize WSCO Thermal Map

Case Study: Real World Impact

Siemens Artificial Intelligence for BMO Financial Group



- Artificial Intelligence was deployed in two data rooms at the SCC Data Center
- Reduced the number of operating units by 64% for constant speed fans and lowered the speed of variable speed units, delivering a total reduction in CRAC fan energy use.
- In addition to these savings, the system was able to improve thermal control within the space. Siemens helped BMO's Critical Environments Group secure utility rebates, resulting in a payback time of less than two years.

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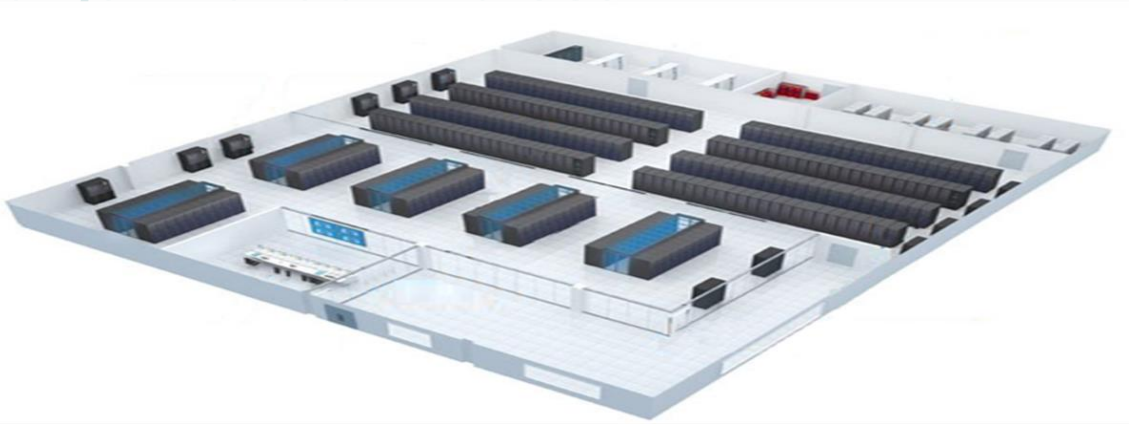
Proven Results with Siemens Artificial Intelligence Optimization Large Financial End User



Challenges: **Inefficient cooling control** in white space areas; **a lack of adequate sensing capability** required overcooling of the data halls. **Running all 72 CRAC units to accommodate the cooling load causing them to lose their Tier rating.**

Solutions: **Demand Flow** was implemented to the cooling plant. Supply water temp was increased to 50 deg F which allowed them to utilize the existing plate and frame heat exchanger longer. The branch provided **WSCO** leveraging wireless technologies to monitor rack inlet temps, coupled with the Artificial Intelligence Engine's "Area of Influence" algorithms, **enabled an increase to the ASHRAE-recommended inlet temp** of 80.6F resulting in over 50% of the CRAH's shutting down completely and increased CHW return temperature to the central plant. **Now they are only running 35 CRAC units which restored their Tier level back to Tier III.**

Central Plant – Demand Flow

- **37% Reduction in Annual Energy Usage**
- **Utility Rebate $200K**
- **$206,169 Annual Savings ($0.11/kWh)**
- **2.75-year Payback**

Server Rooms – WSCO

- **72 CRAH units**
- **71% kWh Savings**
- **$241,817 Annual Savings**
- **Utility Rebate $150K**
- **<2-year Payback**

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Thank you

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Technology: What's New & What's Next?

Audience Q&A

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