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THERMAL STORAGE FOR ACTIVE DEMAND REDUCTION

May 27, 2020

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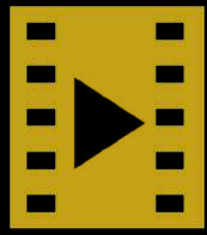

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Amanda Gassé

Zondits Content Manager

amanda@zondits.com

https://www.linkedin.com/in/amandagasse/

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VIJAY GOPALAKRISHNAN
SENIOR ENGINEER, ERS

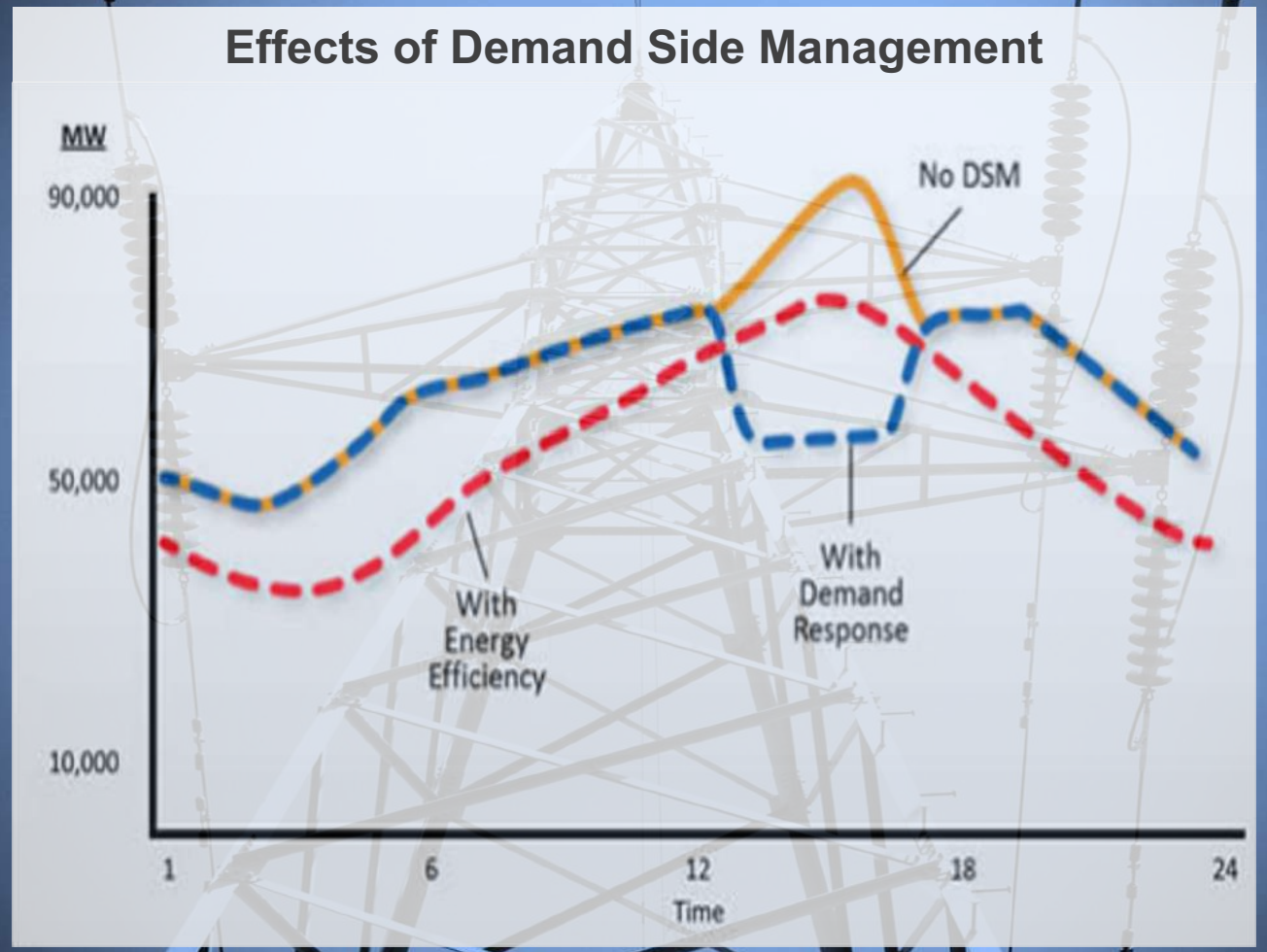
vijayg@ers-inc.com

https://www.linkedin.com/in/vijay-gopalakrishnan -177b0781/

www.ers-inc.com

Agenda

1. Introduction
2. HVAC thermal storage
3. Refrigeration thermal storage
4. Key takeaways
5. Q&A



Why do we need active demand-side management?

- To mitigate demand during peak load conditions
- To avoid building additional peaking plants
- To maintain reliability of the grid (avoid blackouts)

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Thermal Storage Performance Metrics

	Daily Dispatch Reduction Average (kW)	ISO-NE ICAP Hour Reduction (kW)	Customer Monthly Peak Reduction Avg (kW)	Net Energy Impact (kWh)
Committed				
Reported				
M&V				

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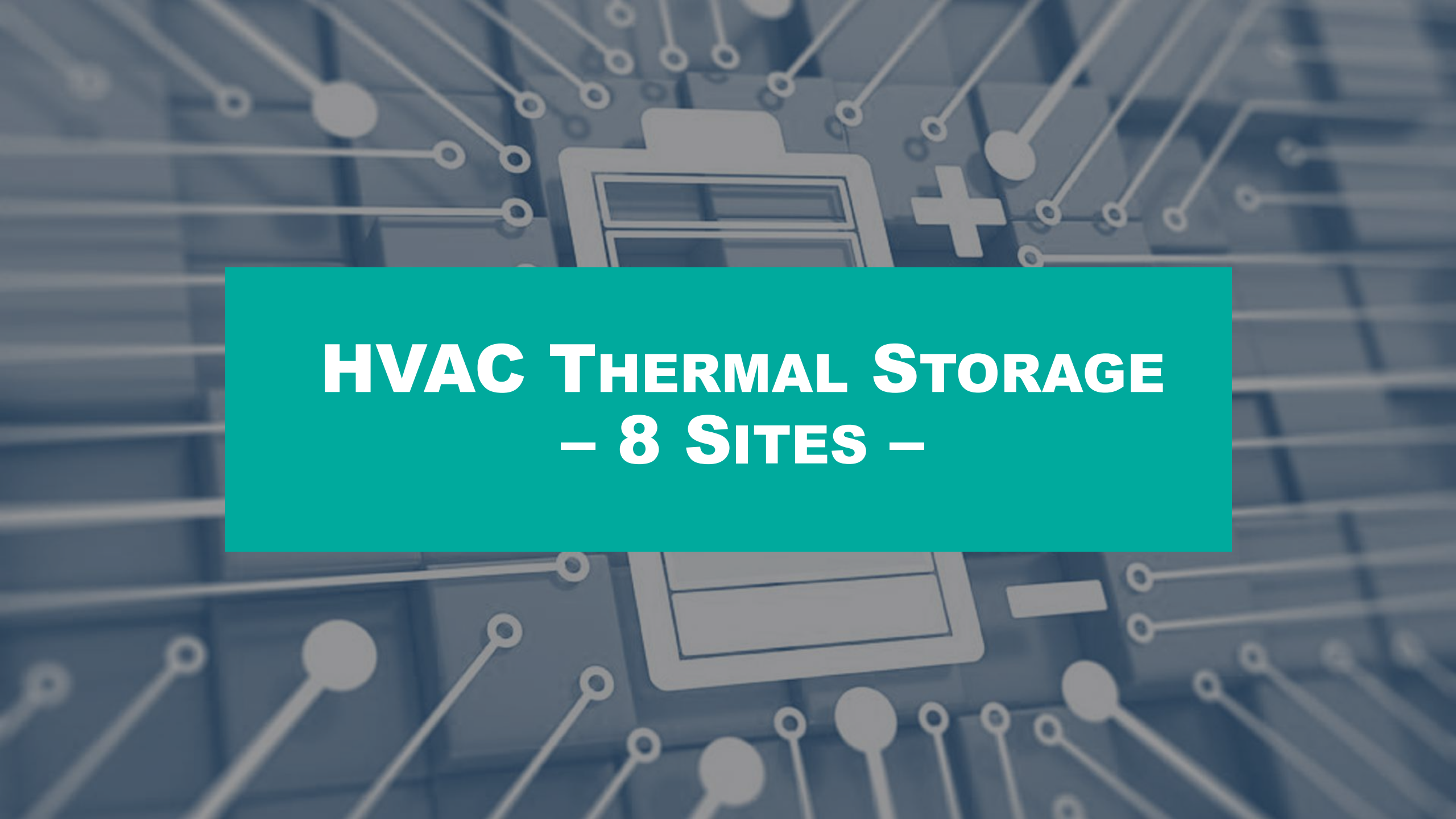
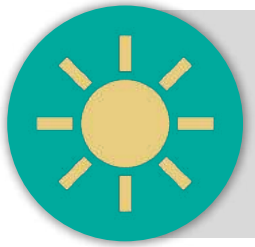


HVAC Thermal Storage
– 8 Sites –

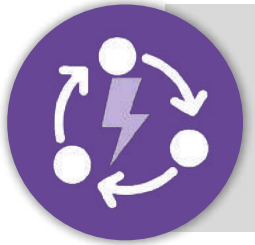
HVAC Thermal Storage Deployment



Dispatch strategy:
Daily during summer

Technology:
Ice storage units installed on RTUs allow for regularly scheduled daily shutdowns

Target facilities:
C&I with small- to medium-sized RTUs



Scale/magnitude:
Planned ~26 kW per site

HVAC Thermal Storage M&V Methodology

RTU kW (amps metered, voltage, PF spot measured) measured by M&V team

Ice-making equipment kW data provided by vendor

RTU kW data regressed with outdoor air temperature data for non-dispatch hours on non-holiday weekdays from June through September to determine baseline equation

Equation applied to dispatch window to calculate baseline kW

kW reduction = Baseline RTU kW – Installed RTU kW – Ice making component kW (pump and compressor)

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HVAC Thermal Storage Performance

	Daily Dispatch Reduction (kW)	ISO-NE ICAP Hour Reduction (kW)	Customer Monthly Peak Reduction (kW)
Committed	241.0	N.R.	N.R.
Reported	241.0	N.R.	N.R.
M&V	61.9	86.1	N/A

Green Stage 1

Pink Stage 2

HVAC Thermal Storage

Key Findings

- Solution was successful in offsetting the RTU cooling load during the dispatch window.
- RTUs selected for control were oversized and underutilized, resulting in low demand reduction.
- The daily dispatch schedule was successful in catching the Installed Capacity (ICAP) hour.
- No energy savings were expected or calculated for this solution.

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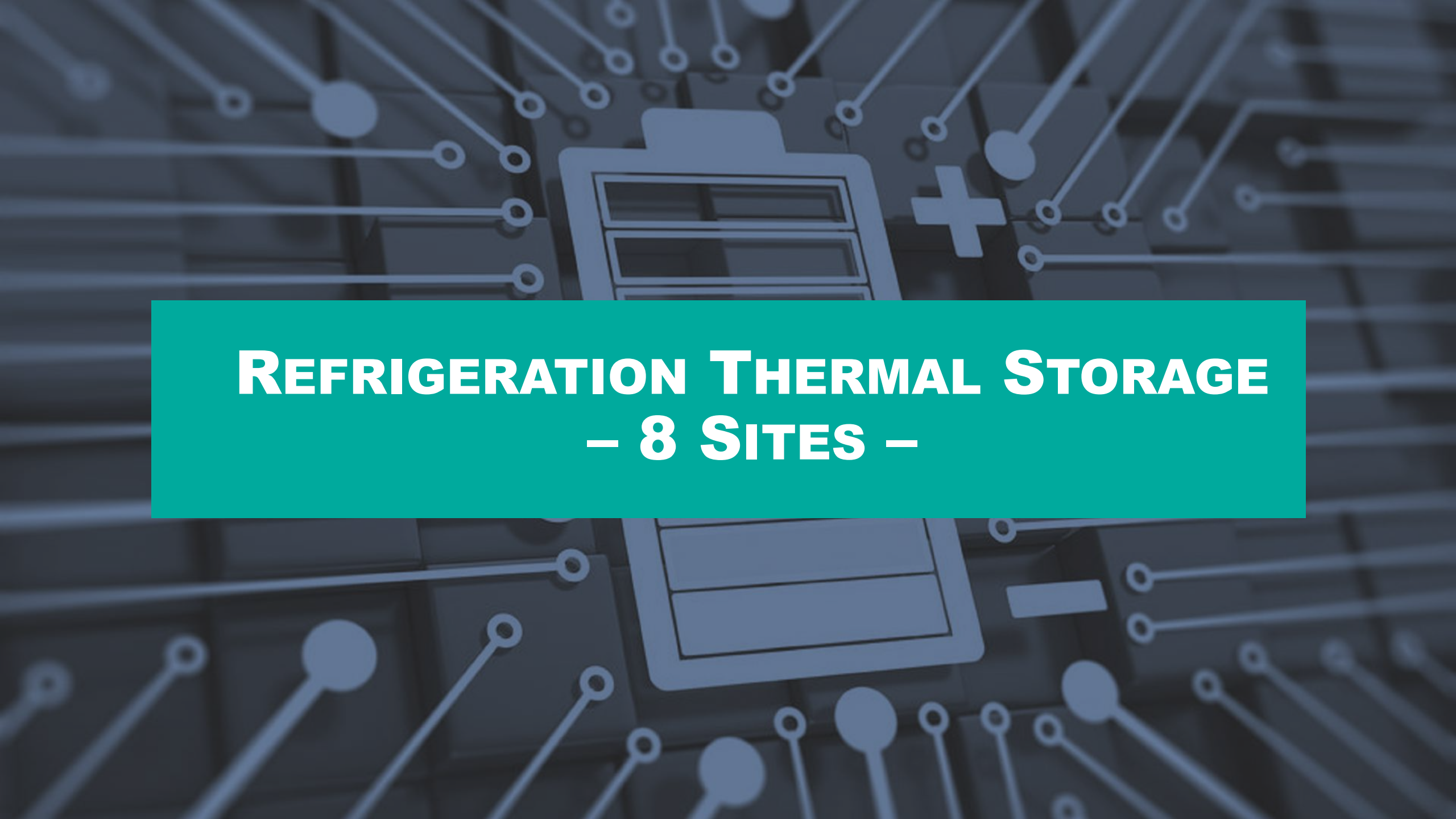
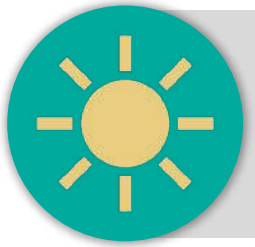


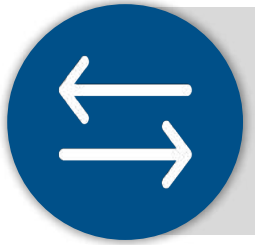
Refrigeration Thermal Storage
– 8 Sites –

Refrigeration Thermal Storage Deployment



Dispatch strategy:

Daily during summer



Technology:

Phase change materials (PCM) allow refrigeration equipment to be turned off during dispatch window

PCMs ensure temps in affected spaces are maintained within permissible limits during window

Target facilities:

Cold storage facilities

Scale/magnitude:

Planned ~140 kW per site

Refrigeration Thermal Storage
M&V Methodology

Refrigeration system component (compressors, evaporator fans, condenser fans) kW data

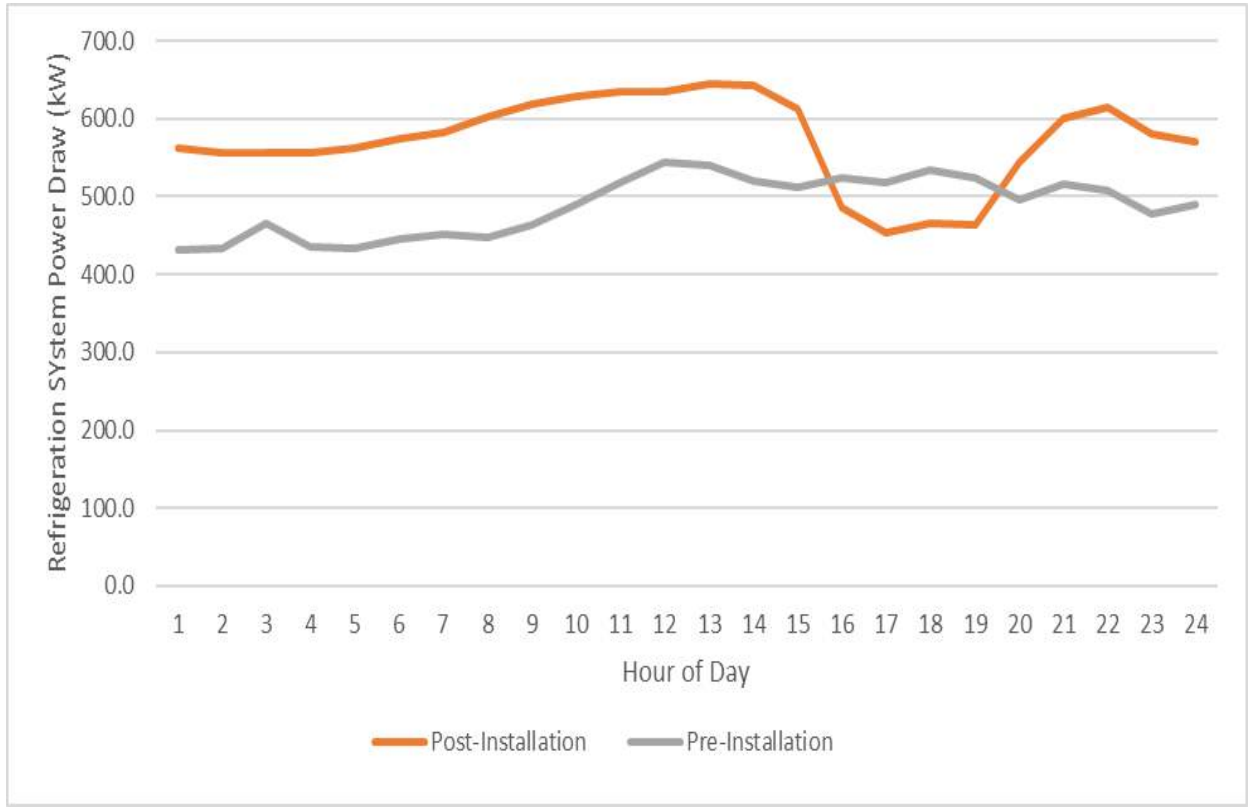
Baseline period defined as non-dispatch hours on non-holiday weekdays from June 2019 through September 2019

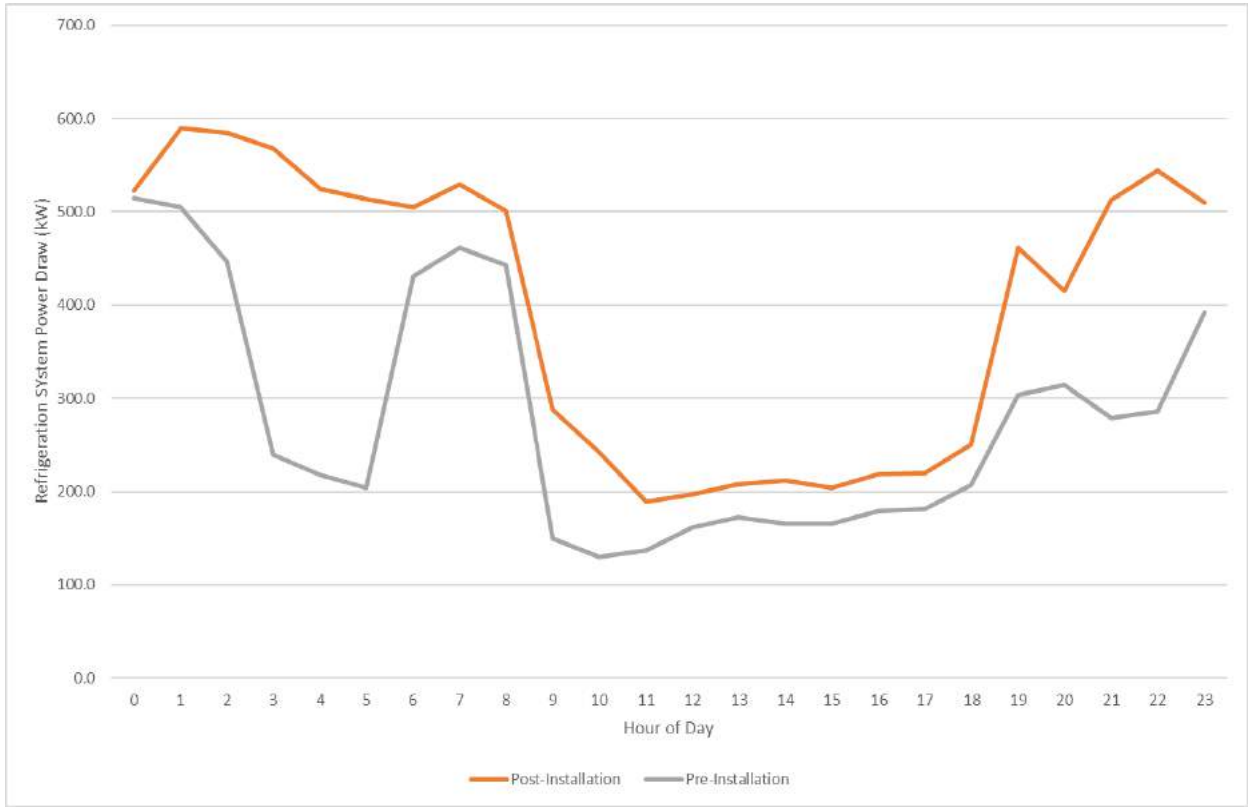
Average load during baseline period was used to calculate baseline kW since no meaningful OAT relationship was found

kW reduction = Baseline refrigeration system kW – Installed refrigeration system kW

Refrigeration Thermal Storage Performance

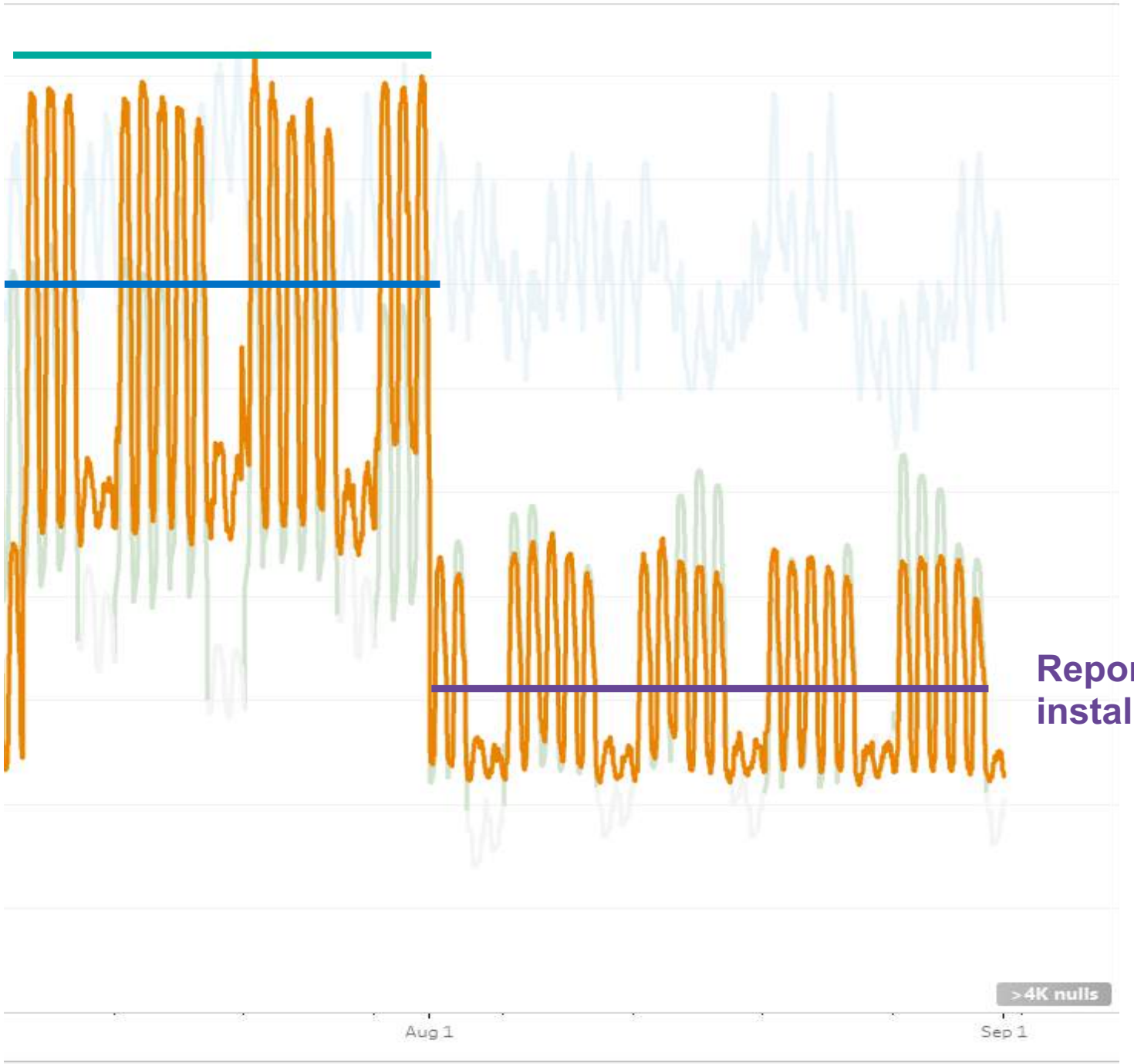
	Daily Dispatch Reduction (kW)	ISO-NE ICAP Hour Reduction (kW)	Customer Monthly Peak Reduction (kW)	Net Energy Impact (kWh)
Committed	1,270.0	N.R.	N.R.	N.R.
Reported (peak during baseline period)	1,110.0	N.R.	N.R.	138,148
M&V (average during baseline period)	515.6	576.8	252.6	126,420





Reported baseline

M&V baseline



Reported and M&V post-installation period

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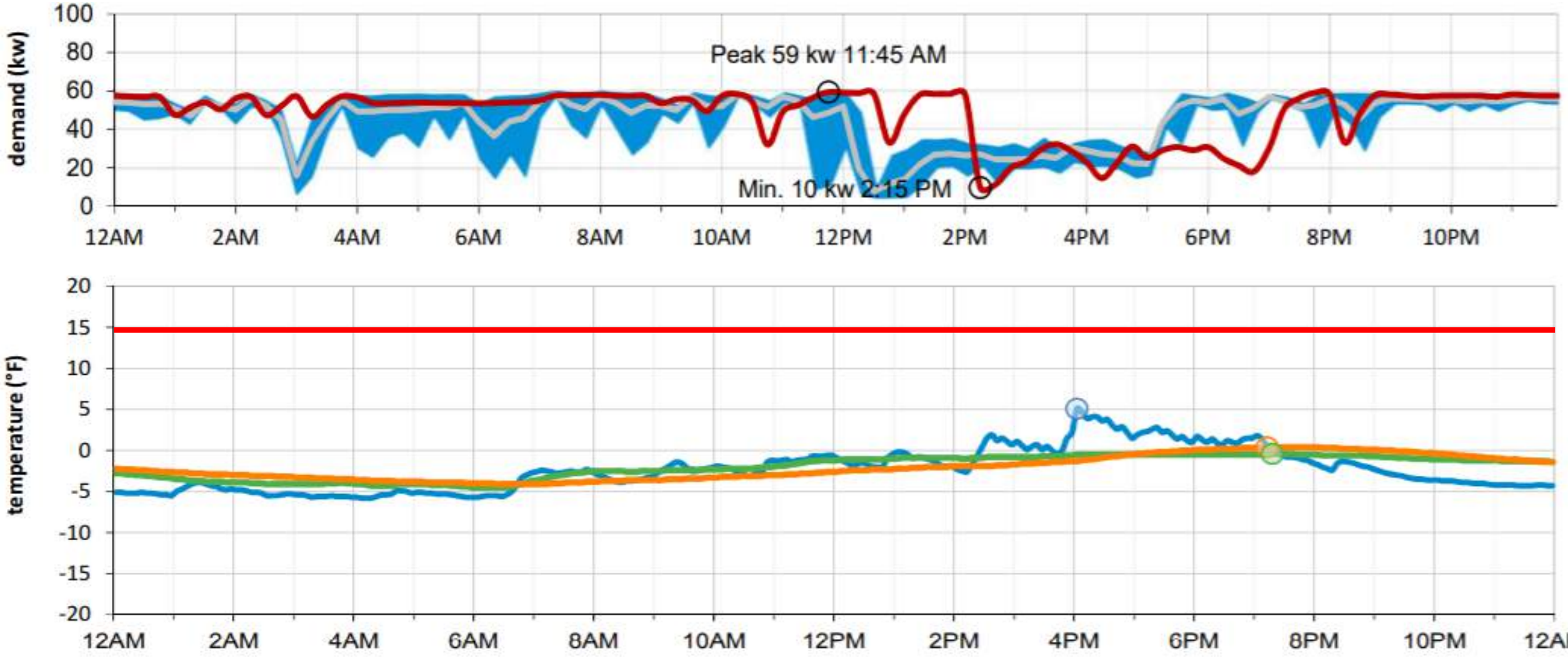
Refrigeration Thermal Storage – Space Temperature



The impacted freezer space temperature did not exceed 7°F during the demand reduction windows, thus satisfying the site's requirements!

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Refrigeration Thermal Storage

Key Findings

- This solution was reliable and successful in shedding load during the dispatch window.
- The lower-than-reported demand reductions are entirely due to differences between the reported and M&V calculation methodologies.
- The daily dispatch schedule was successful in catching the Installed Capacity (ICAP) hour.
- This solution resulted in savings of 126,420 kWh during the 2019 summer season.

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Key Takeaways

Equipment-level metering is most appropriate for thermal storage solutions.

Both solutions were effective in shedding load during dispatch

It's essential to examine feasibility of solutions early in the sales and scoping process

Pre-metering of affected equipment load would provide more insight into achievable demand reductions

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Contact Us

Vijay Gopalakrishnan

vijayg@ers-inc.com

(978) 521-2550 x 219

www.ers-inc.com

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