Strategies + Synergies

RESILIENCE, PASSIVE DESIGN, & SMART GRID OPTIMIZATION

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critical facility
Provides **vital community function** despite unforeseen disruptions through resilient design enabling operational continuity.

Owner’s Goals

PROGRAMMATIC & FUNCTIONAL REQUIREMENTS

- Continuous operations
- Security
- Eliminate single points of failure

ORGANIZATIONAL & EMPLOYEE NEEDS

- Employee recruitment & retention
- Health & wellbeing
- Productivity

RESOURCE USE

- Minimize operational cost
- Reduce carbon footprint
- Accountability & value to stakeholders

Resilience

Diversity

Resourcefulness

Efficiency

Self-reliance

Redundancy

Resourcefulness

Connectivity

Equity

Stewardship

Simplicity

Restoration

resist external forces

durability

adapt to external forces

flexibility

change external forces

influence

Climate + Site Analysis

SITE SELECTION

OPPORTUNITIES

CHALLENGES

NORTHWEST CLIMATE

Modes of Operation

Resiliency design for daily and disruptive events

NORMAL

Operational Efficiency

Operations Budgets

Employee Comfort

TEMPORARY & LONG TERM OUTAGE

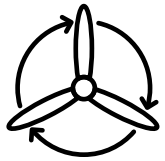
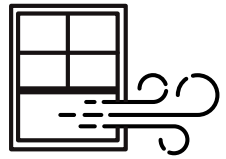
Security Breach

Power Supply Disruption

Earthquake

Modes of Operation

NORMAL vs POST DISASTER

	Normal Mode of Operation		**Post-Disaster** Mode of Operation
OCCUPANTS	Normal Business Hours **Fully Occupied**	After Business Hours **Critical Staff Only**	All Hours **Critical Staff Only**
THERMAL COMFORT	**68°F** to **75°F** 		**65°F** to **80°F** 
VENTILATION	**Automated** 		**Manually** Available 
LIGHTING	**Fully** Available 		**Reduced** Levels 
ELECTRICAL POWER	**Fully** Available 		**Reduced** Levels 

Load Reduction

HOW WE REDUCE LOADS

- Massing
- Orientation
- Daylighting
- Solar Control
- Thermal & Infiltration Performance
- Thermal Mass
- Operable Windows
- Natural Ventilation Shafts
- Heat Recovery
- Economizer
- Demand Control


Backup Power

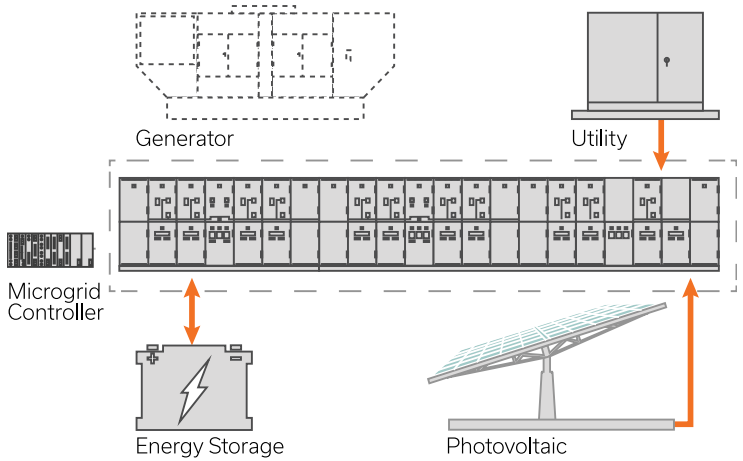
Generators
& Fuel Storage

PV &
Battery Storage

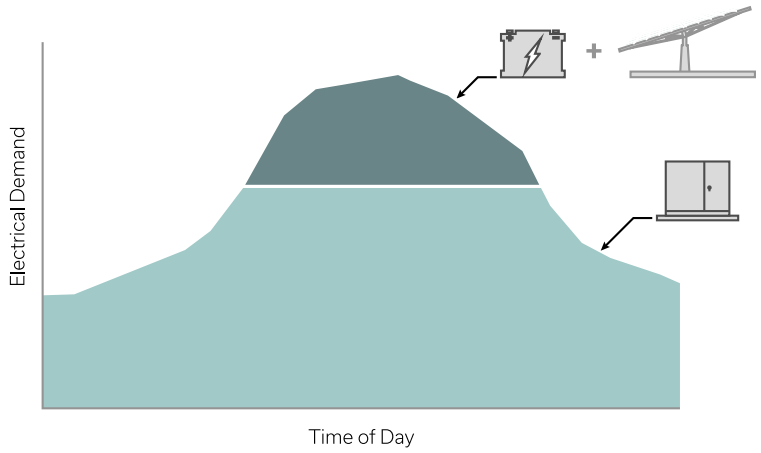
Microgrid

Microgrid + Energy Storage

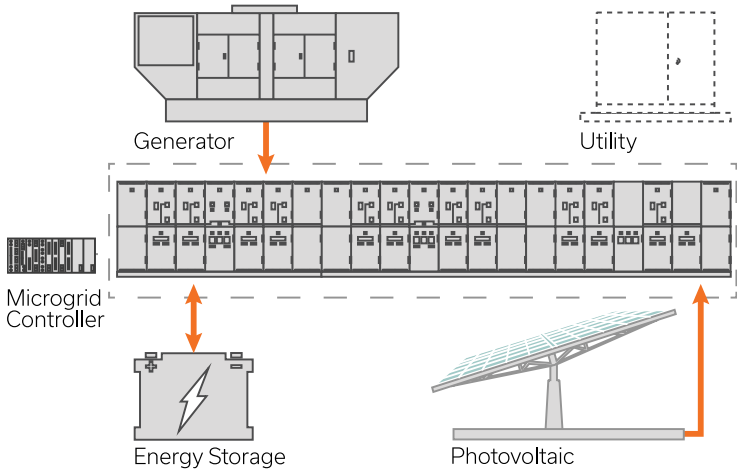
NORMAL



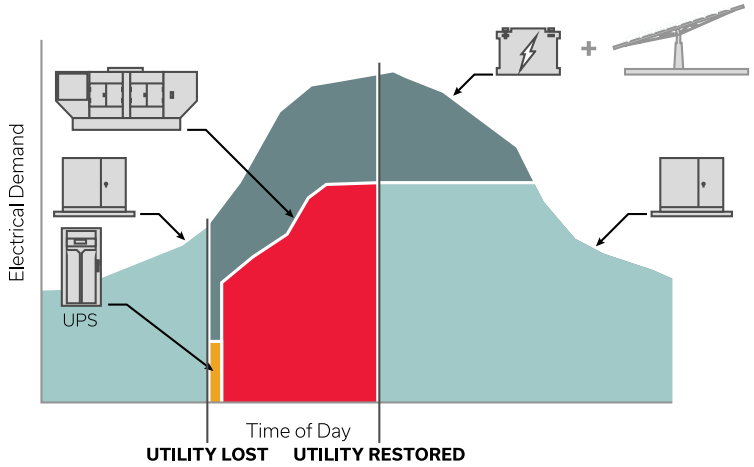
Peak Shaving



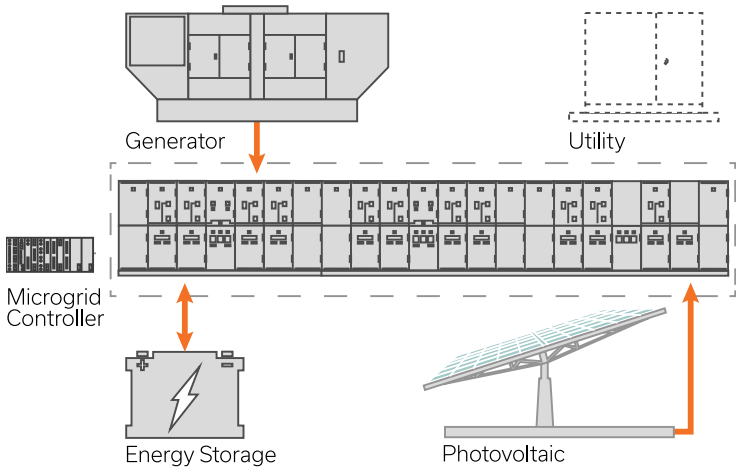
SHORT-TERM OUTAGE



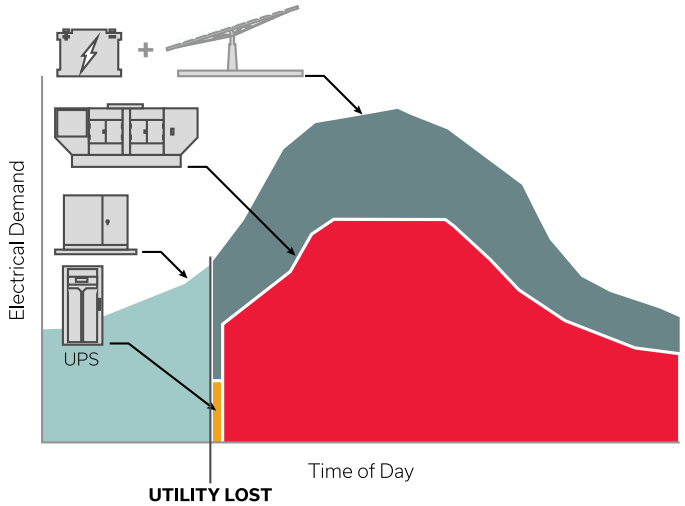
PV & Energy Storage Disabled **During** Outage



LONG-TERM OUTAGE

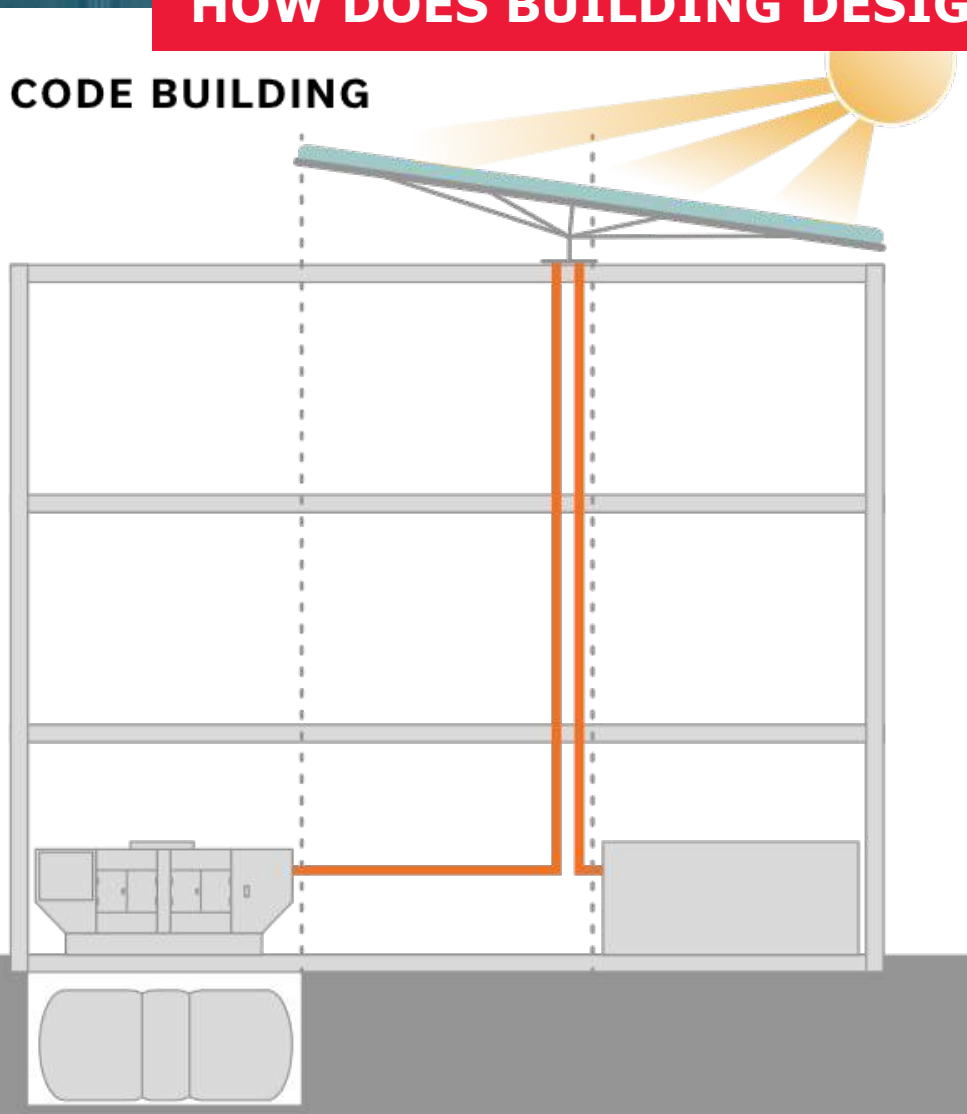


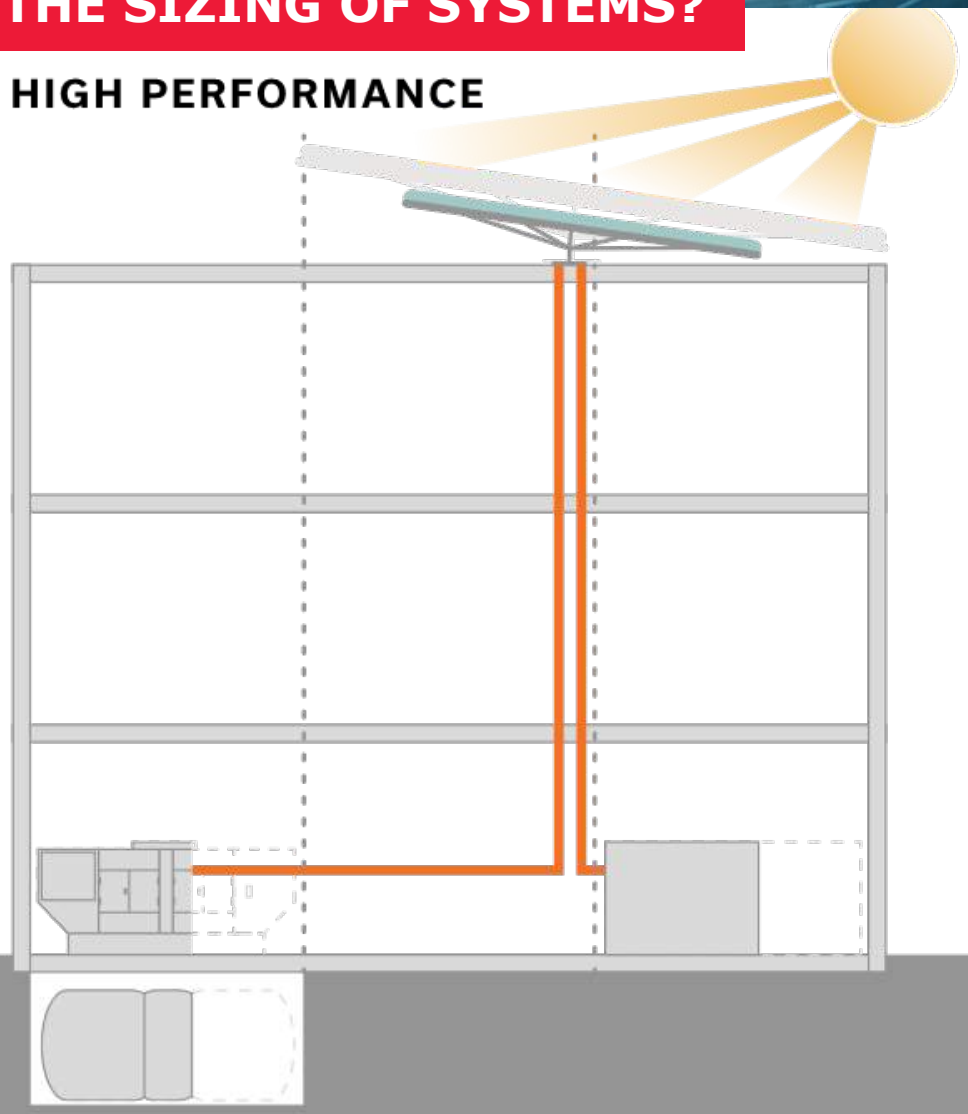
PV & Energy Storage Disabled **After** Outage

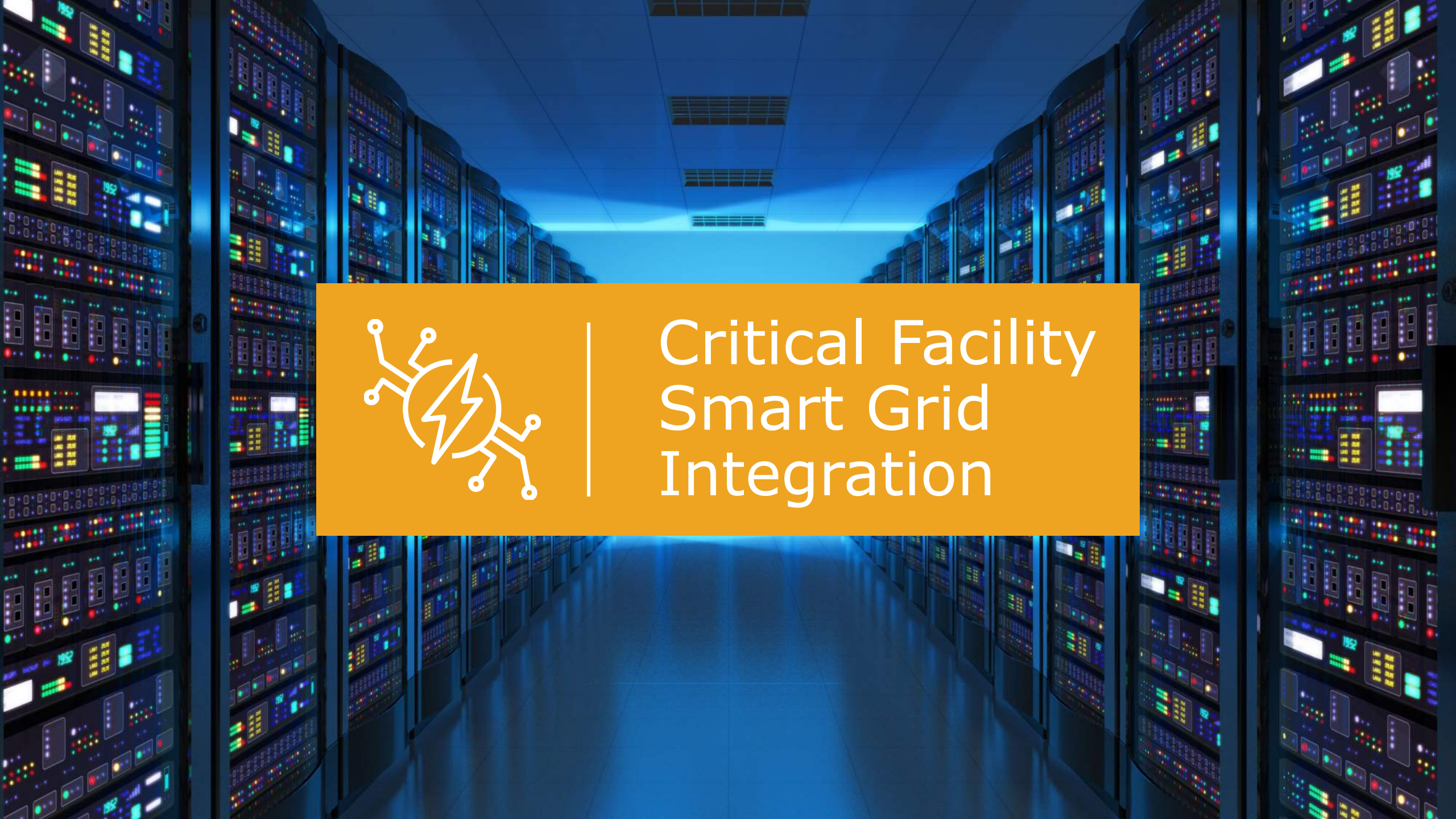


System Sizing

HOW DOES BUILDING DESIGN AFFECT THE SIZING OF SYSTEMS?



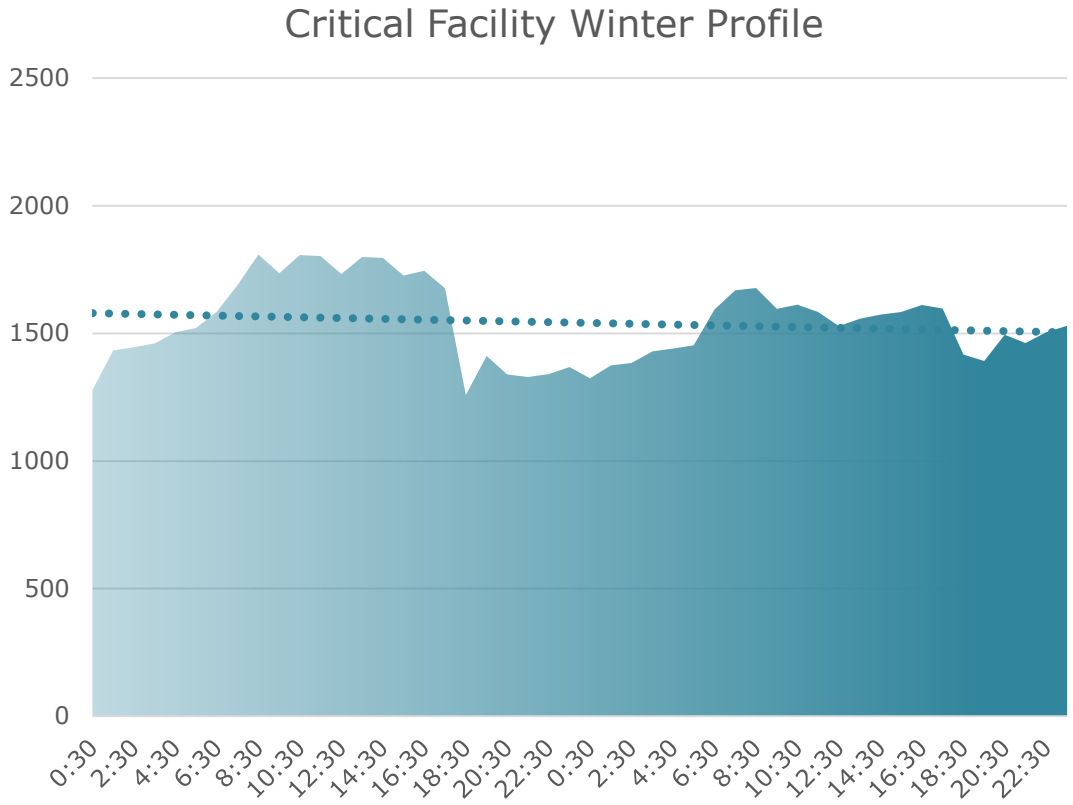


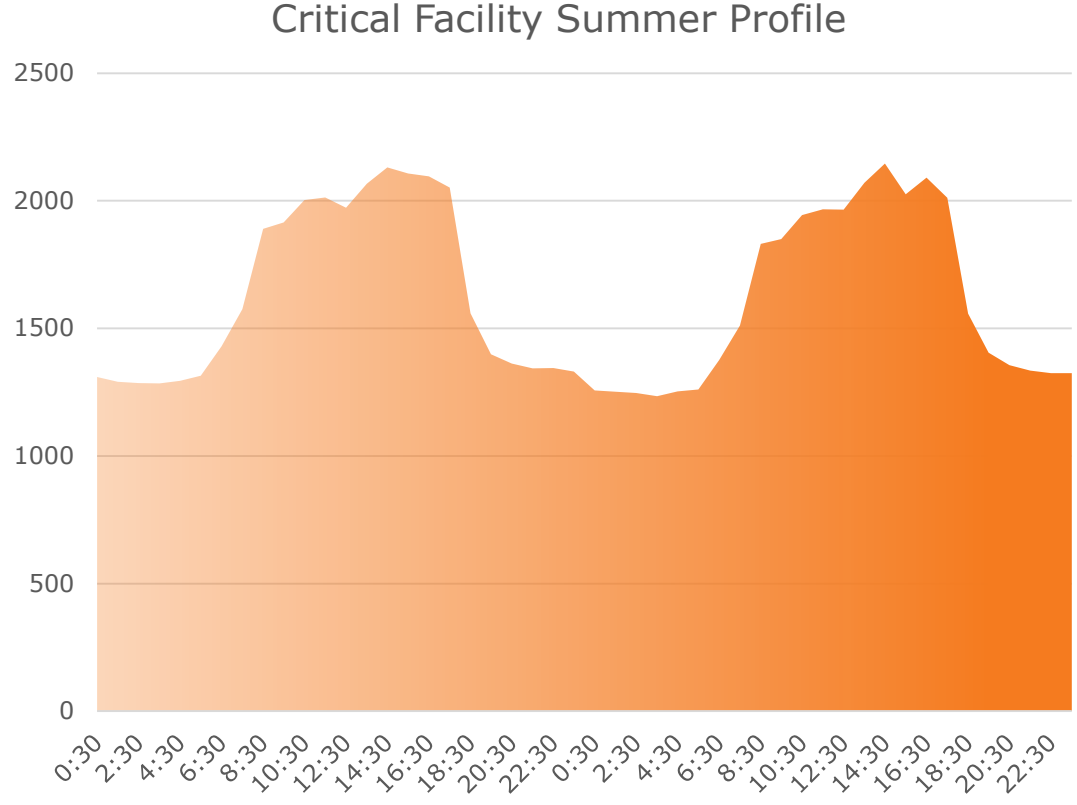


Critical Facility Smart Grid Integration

Critical Facility Profile

SEASONAL SCHEDULES





Critical Facility Energy Profile

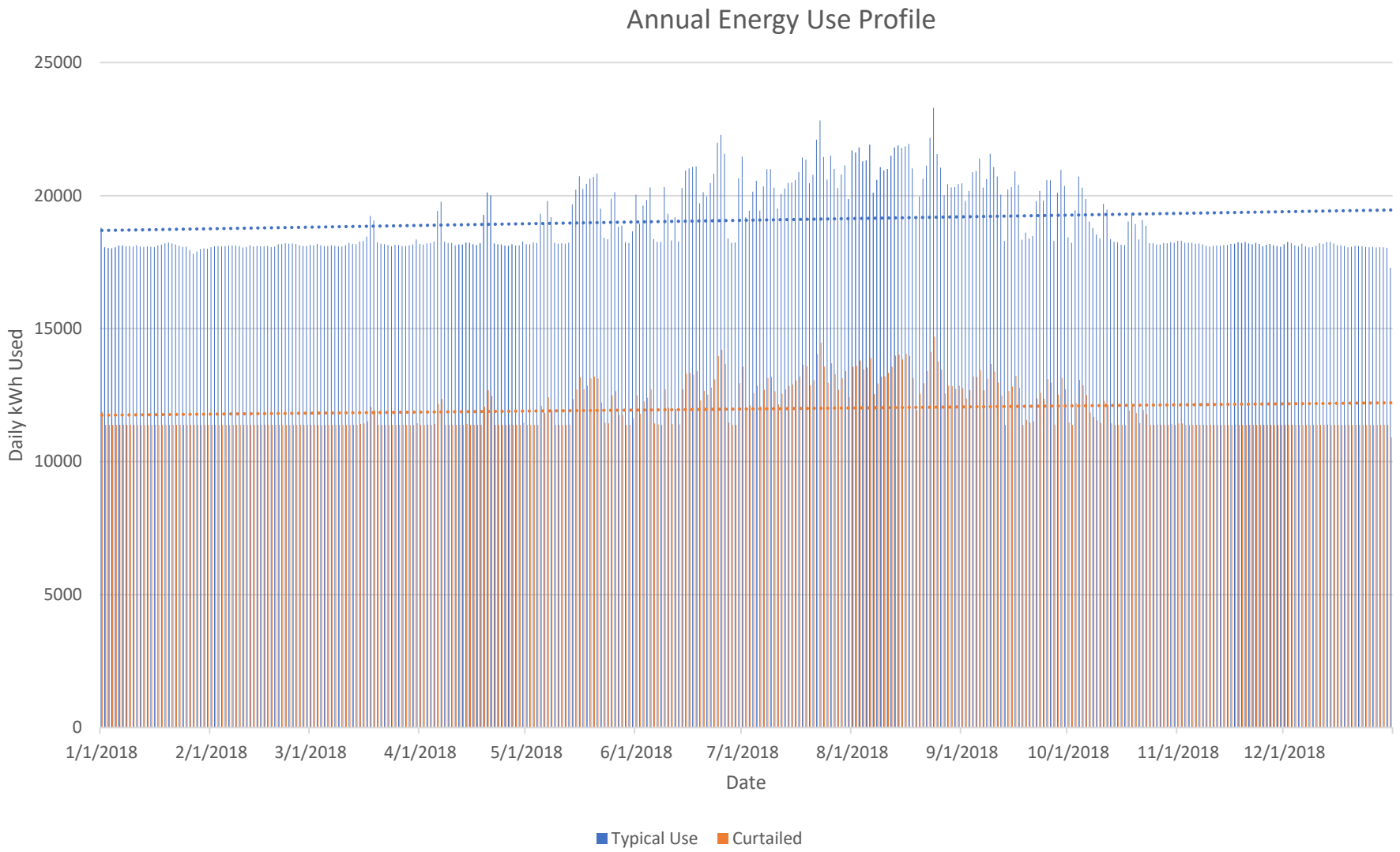
Curtailment Strategies:

IN NON-CRITICAL ZONE

- Lights off
- Temperature set back
- Ventilation off
- Plug loads reduced to laptops only

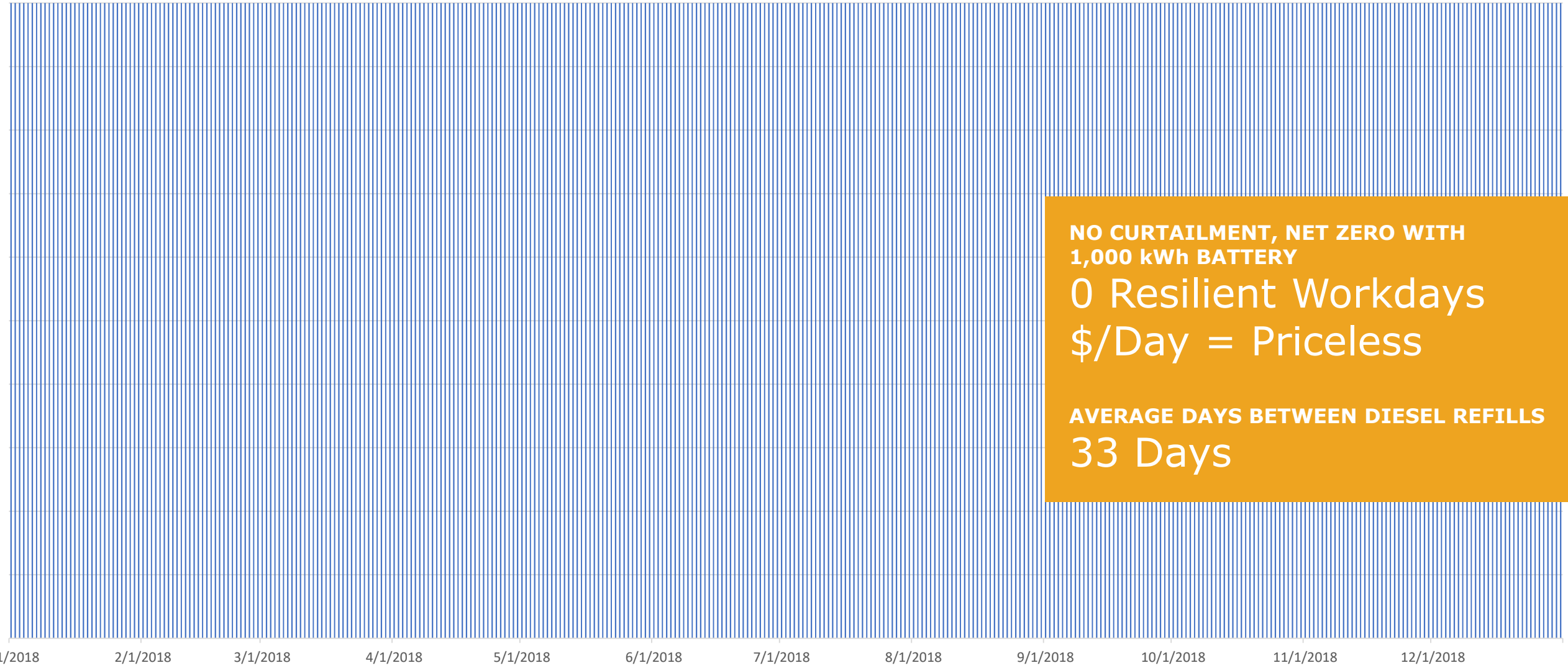
BOTH CRITICAL/NON-CRITICAL

- Elevator not used
- Only cold domestic water



Critical Facility Energy Profile

DAYS AT RISK OF AN EMPTY BATTERY WHEN ISLANDING



NO CURTAILMENT, NET ZERO WITH 1,000 kWh BATTERY

0 Resilient Workdays

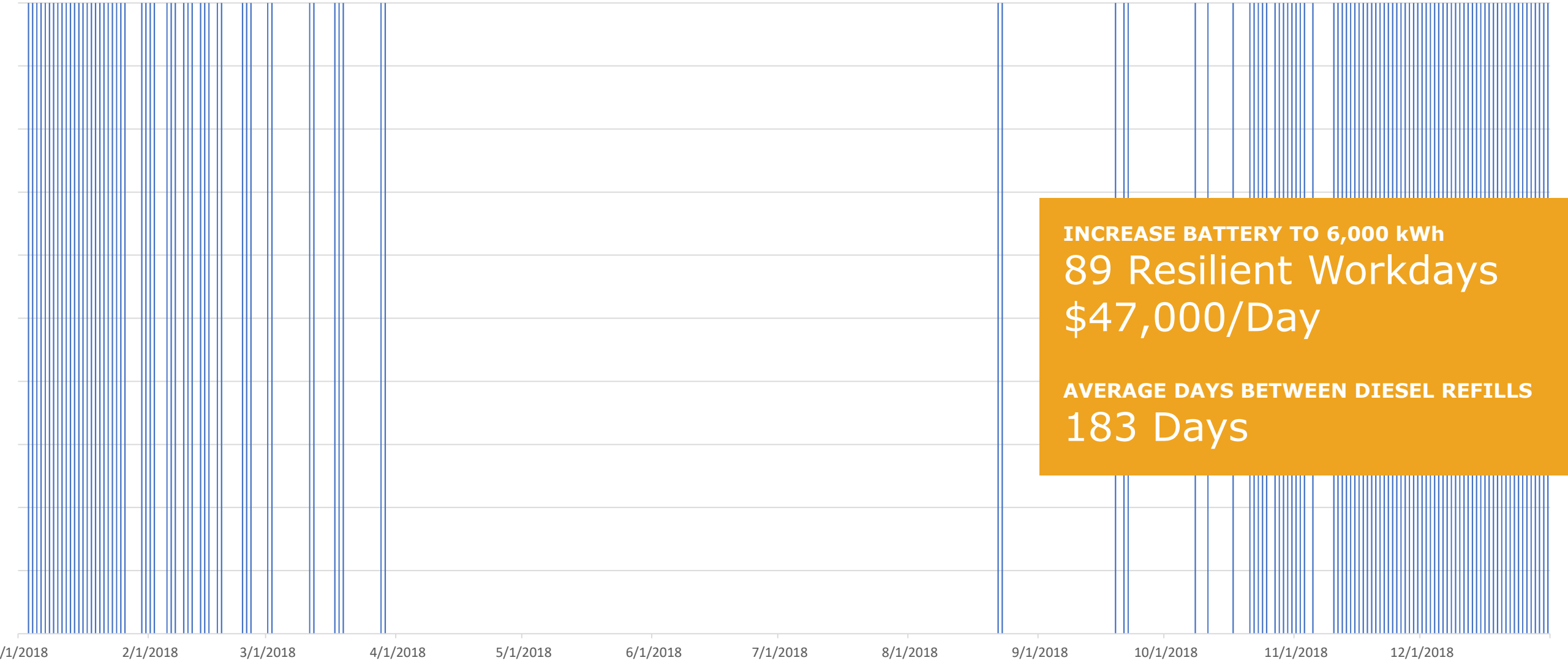
$/Day = Priceless

AVERAGE DAYS BETWEEN DIESEL REFILLS

33 Days

Critical Facility Energy Profile

DAYS AT RISK OF AN EMPTY BATTERY WHEN ISLANDING



INCREASE BATTERY TO 6,000 kWh

89 Resilient Workdays

$47,000/Day

AVERAGE DAYS BETWEEN DIESEL REFILLS

183 Days

Critical Facility Energy Profile

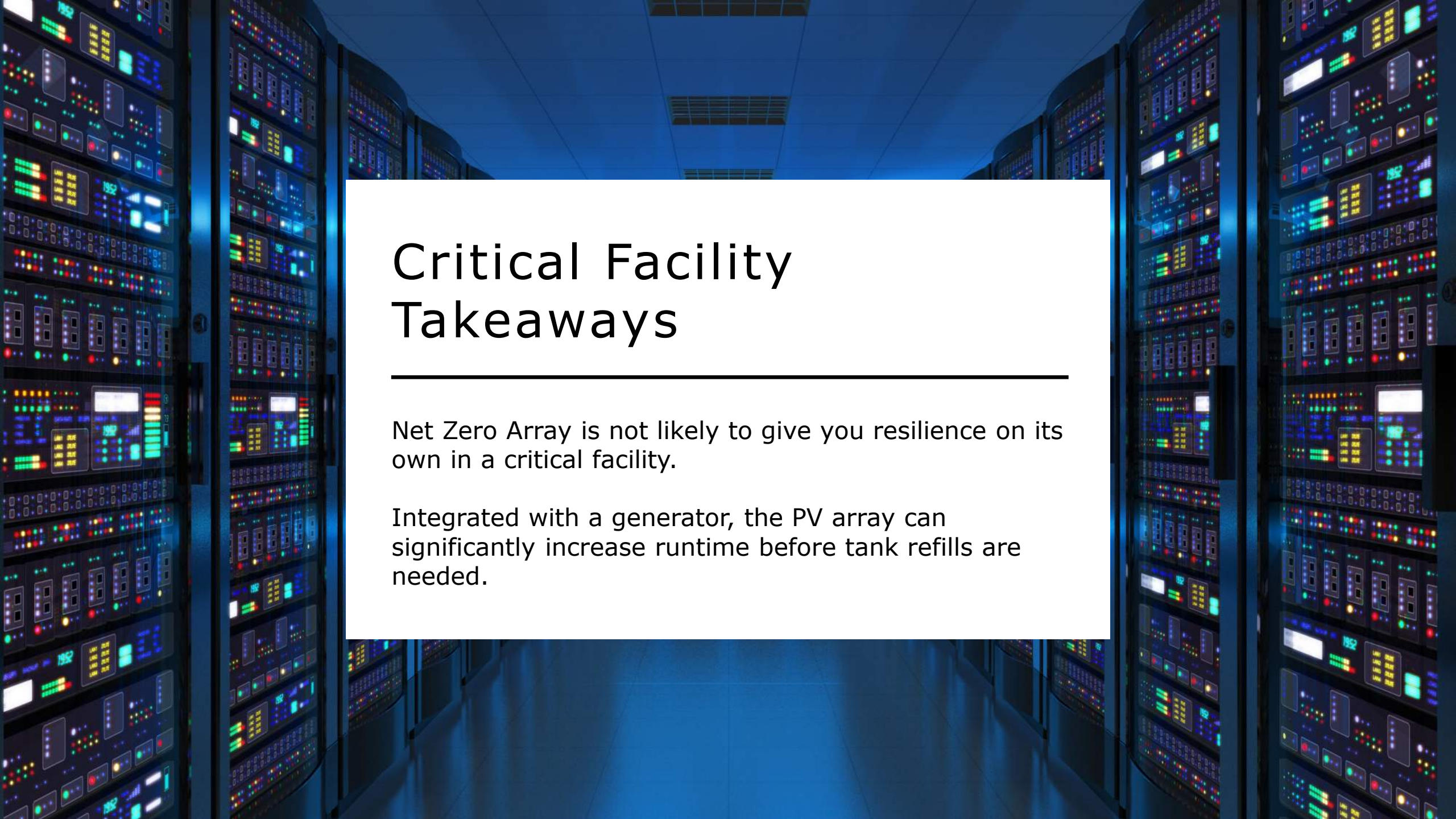
DAYS AT RISK OF AN EMPTY BATTERY WHEN ISLANDING

INCREASE BATTERY TO ONE FULL DAY:
20,000 kWh

365 Resilient Workdays
$73,000/Day

AVERAGE DAYS BETWEEN DIESEL REFILLS

365 Days



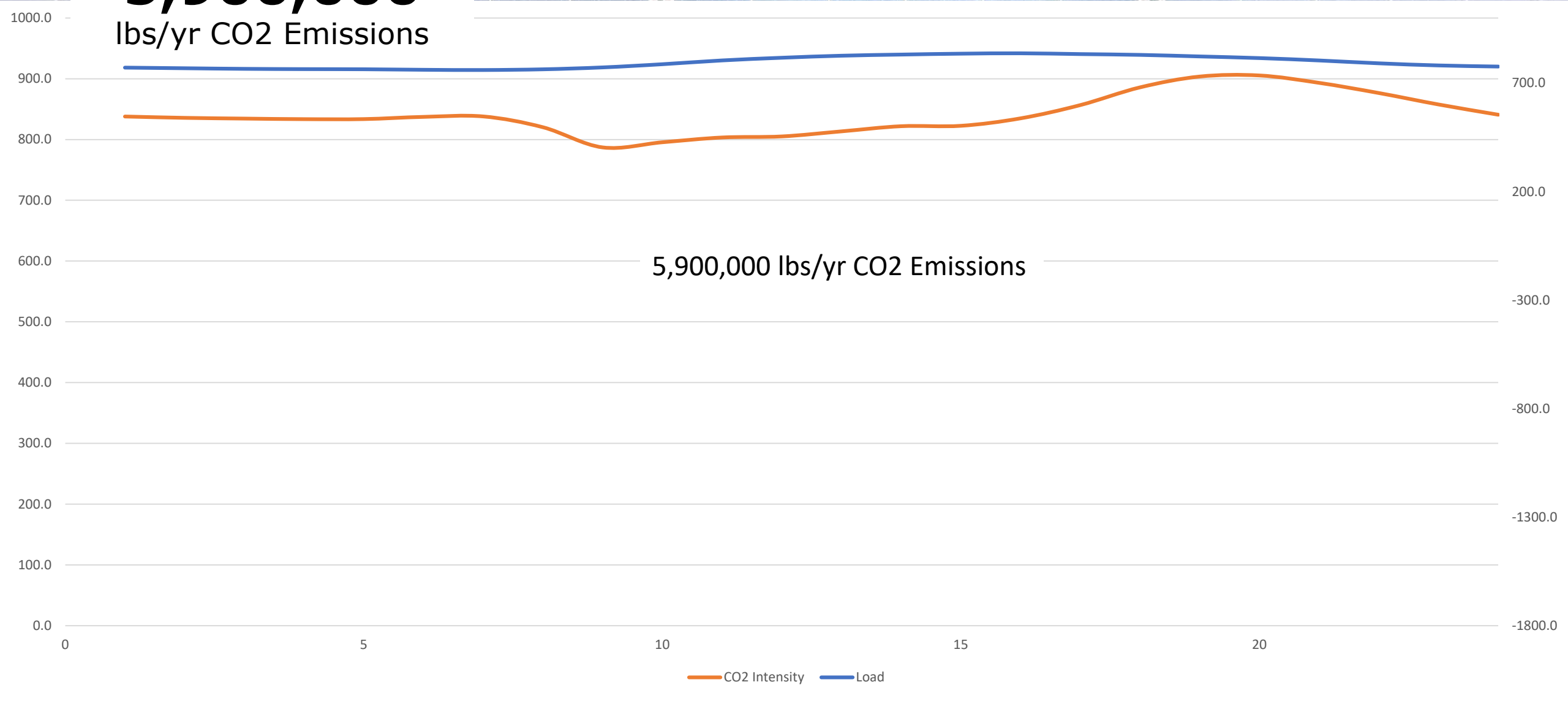
Critical Facility Takeaways

Net Zero Array is not likely to give you resilience on its own in a critical facility.

Integrated with a generator, the PV array can significantly increase runtime before tank refills are needed.

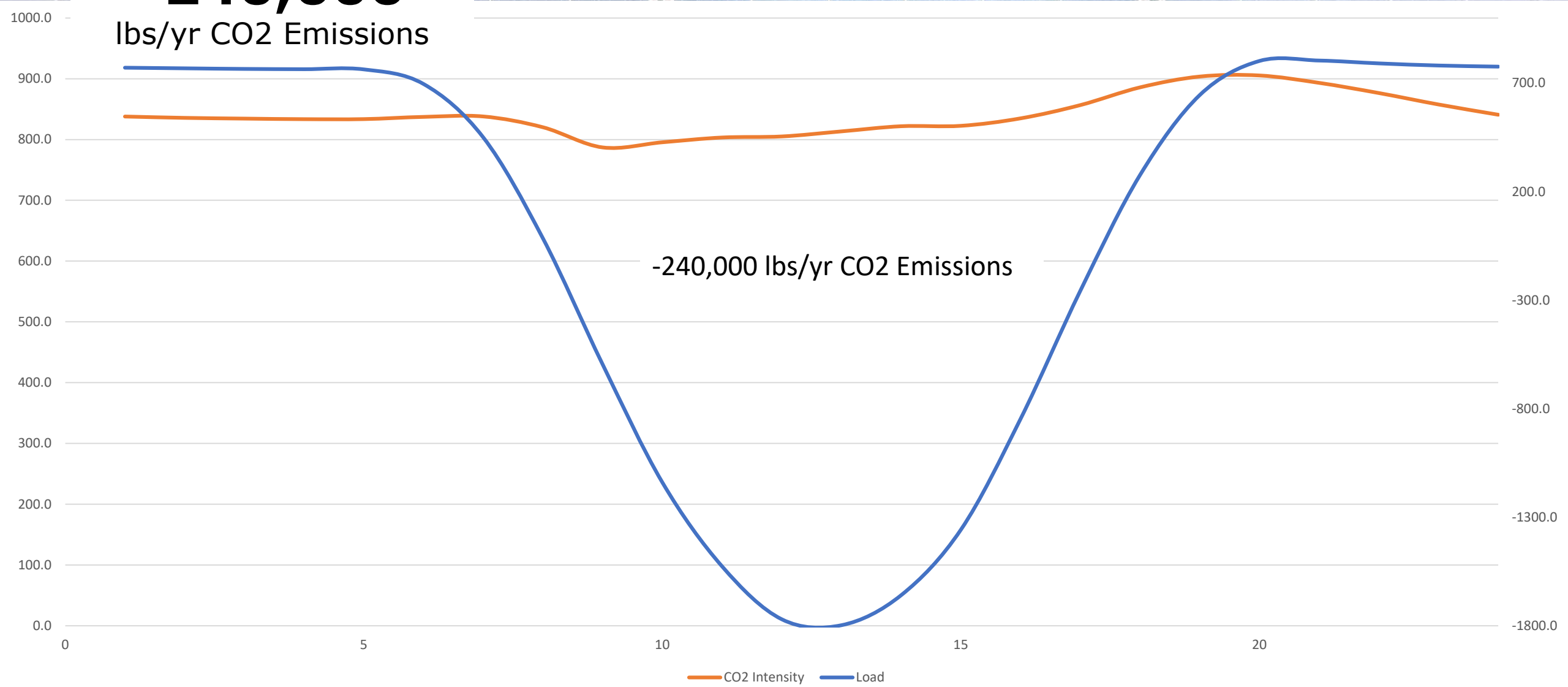
CO2 Impact

5,900,000
lbs/yr CO2 Emissions



CO2 Impact

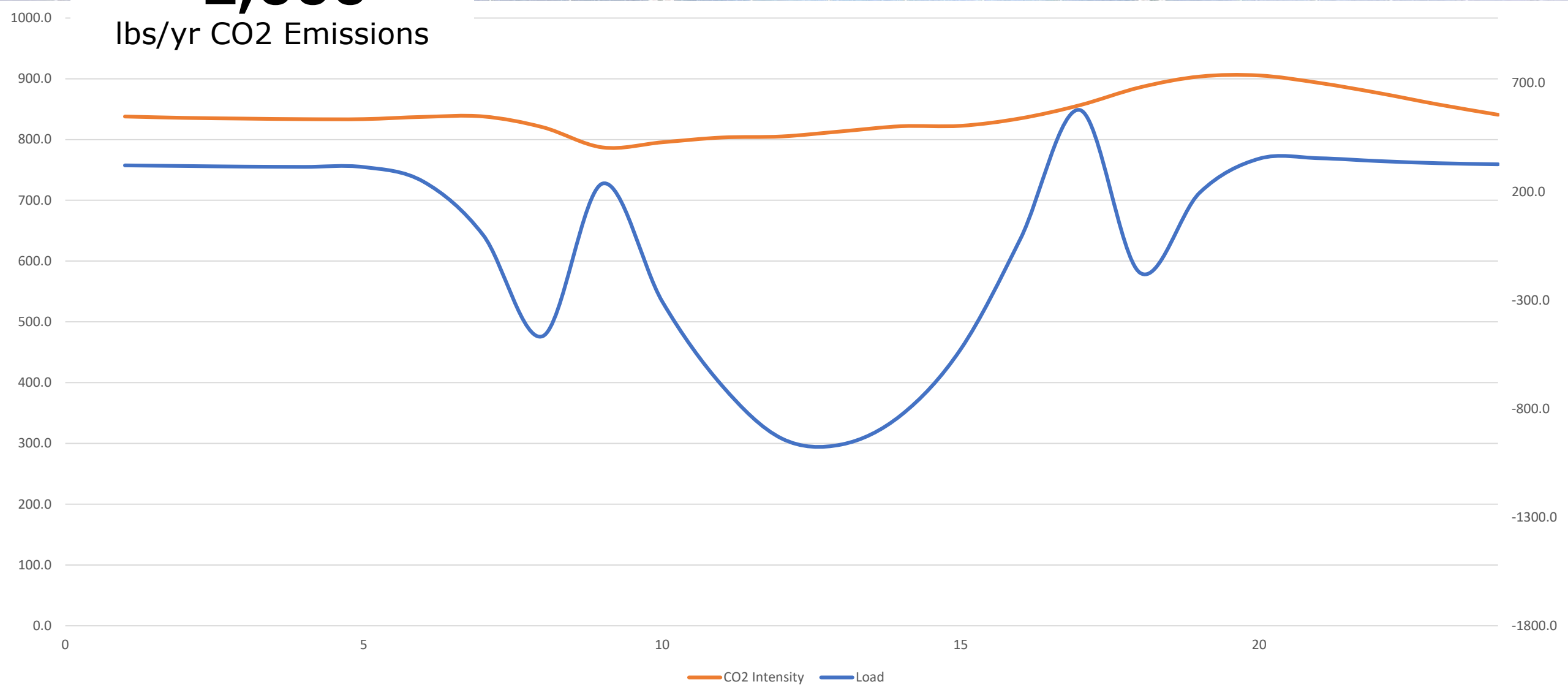
-240,000
lbs/yr CO2 Emissions

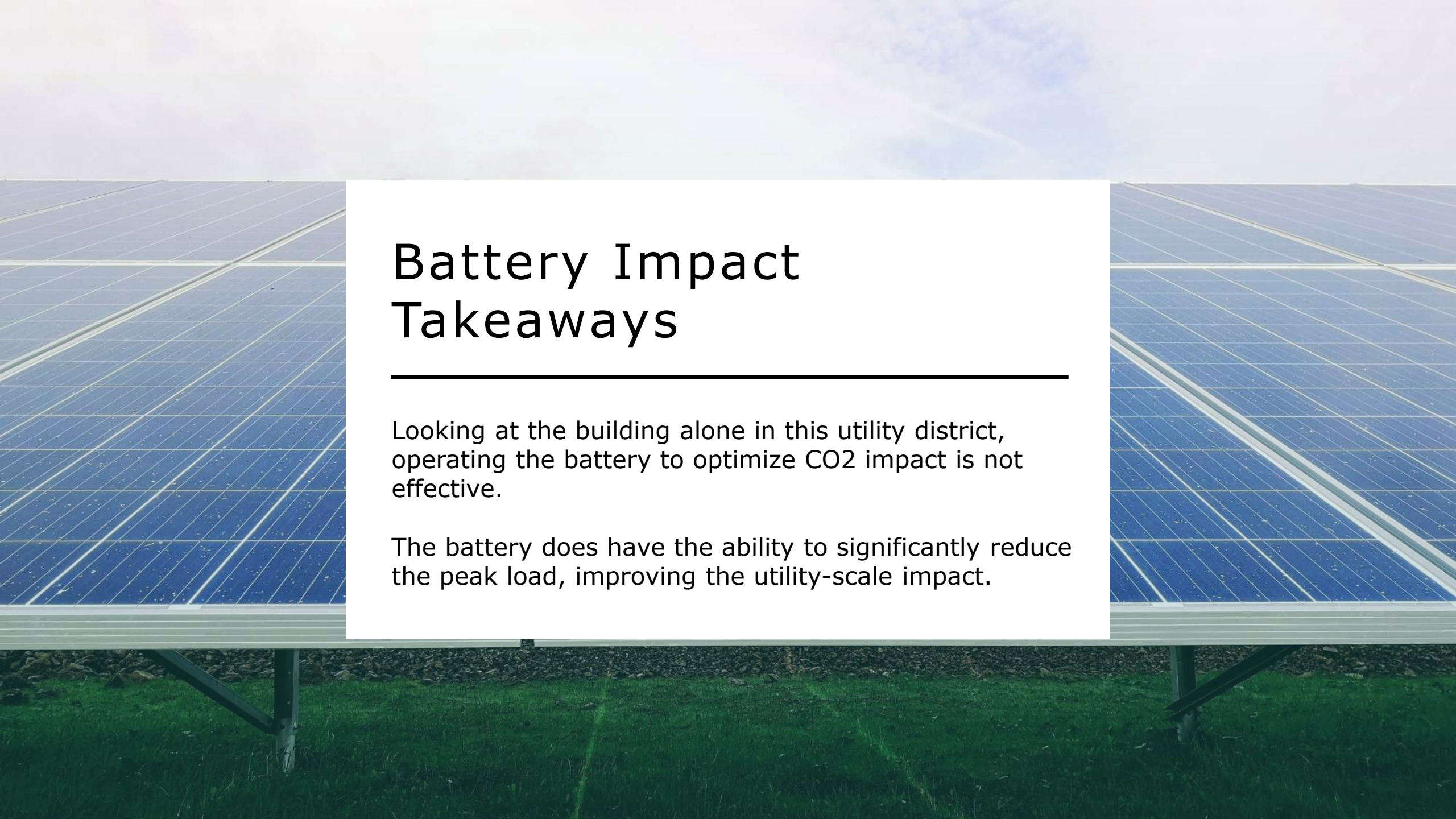


CO2 Impact

-2,000

lbs/yr CO2 Emissions

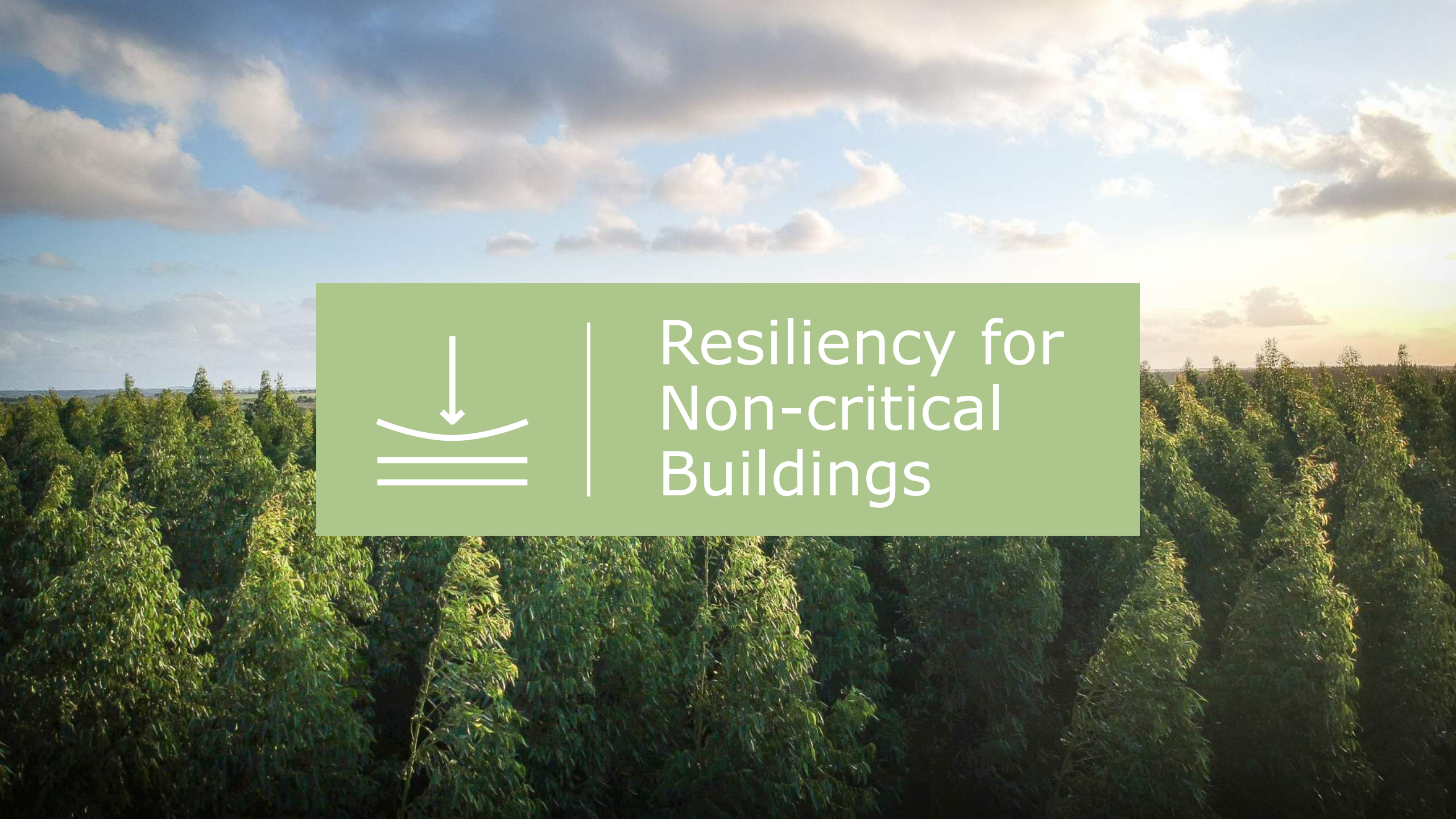




Battery Impact Takeaways

Looking at the building alone in this utility district, operating the battery to optimize CO2 impact is not effective.

The battery does have the ability to significantly reduce the peak load, improving the utility-scale impact.



Resiliency for Non-critical Buildings

Business Continuity

Internal Benefits

MAINTAIN STAFF PRODUCTIVITY

MAINTAIN BUSINESS OUTPUT

SUPPORT STAFF
Sanctuary in an event

SUPPORT BRAND
Perception as Community Support

Critical Facility or Mode

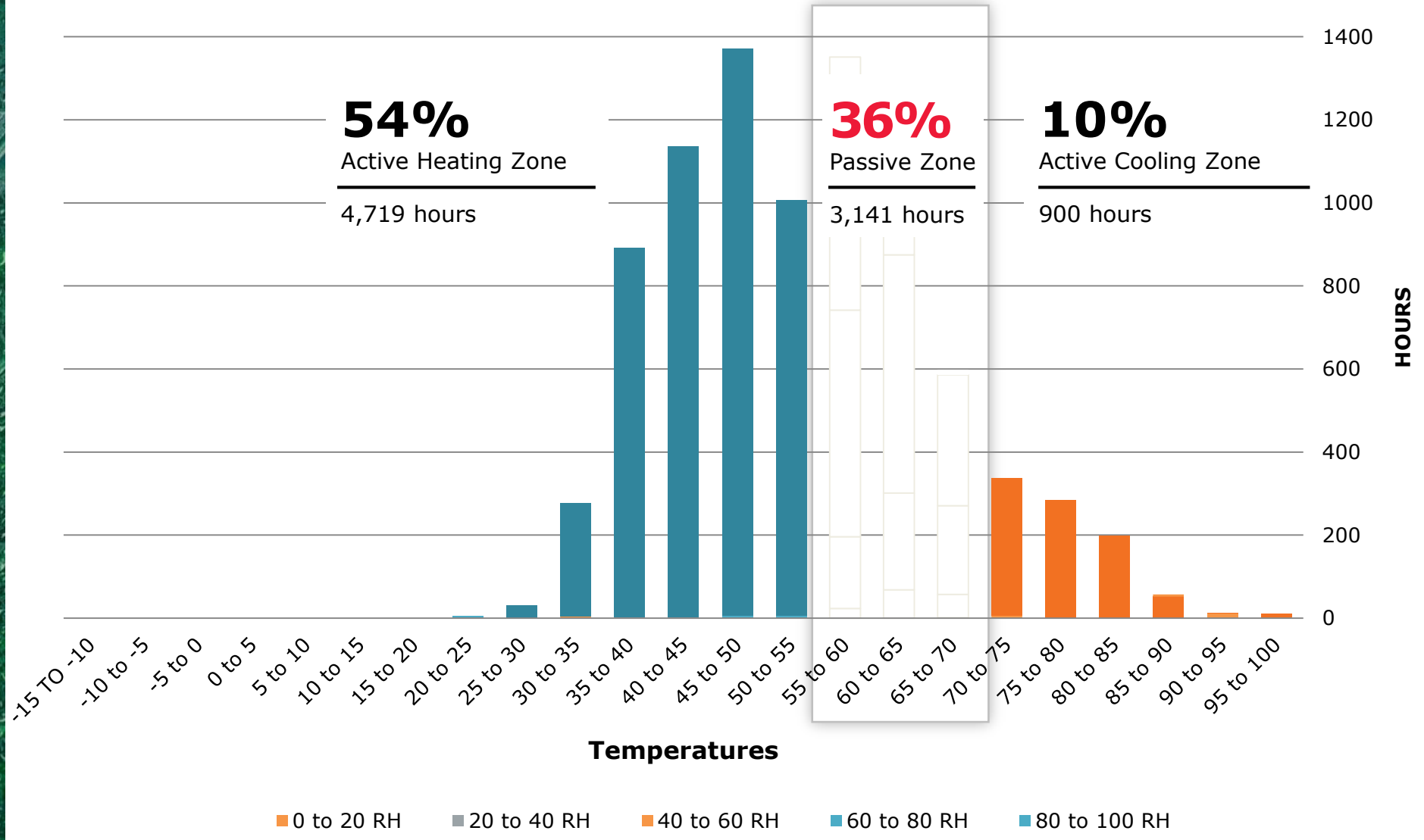
Cultural Systems & Community Benefits

BUILDING THAT IS OPTIMIZED TO BE A PIECE OF A SMART GRID

OPTIMIZED BUILDING EFFICIENCY FOR NET ZERO GOALS

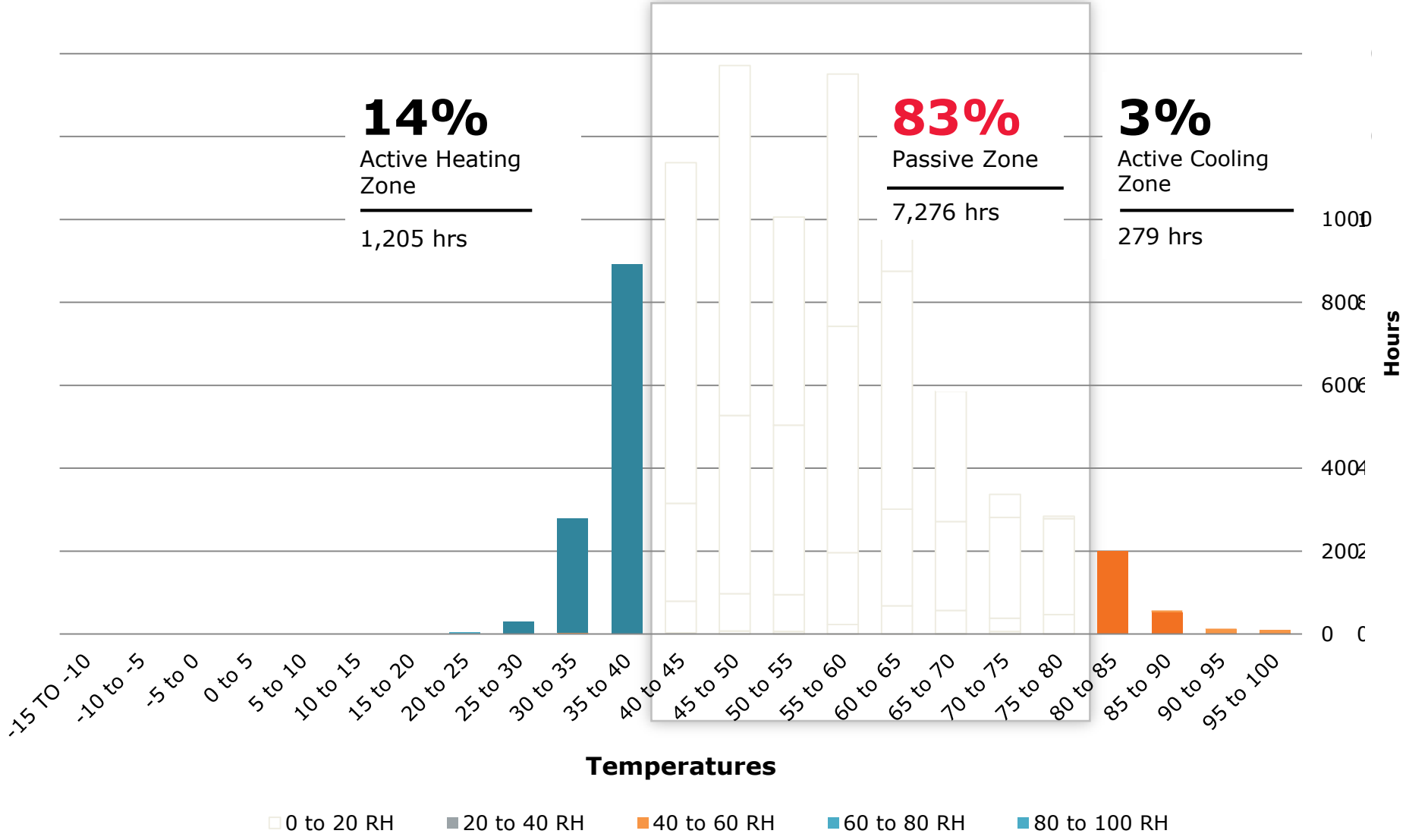
Passive Opportunities

Climate Analysis | Temperature Bins Portland

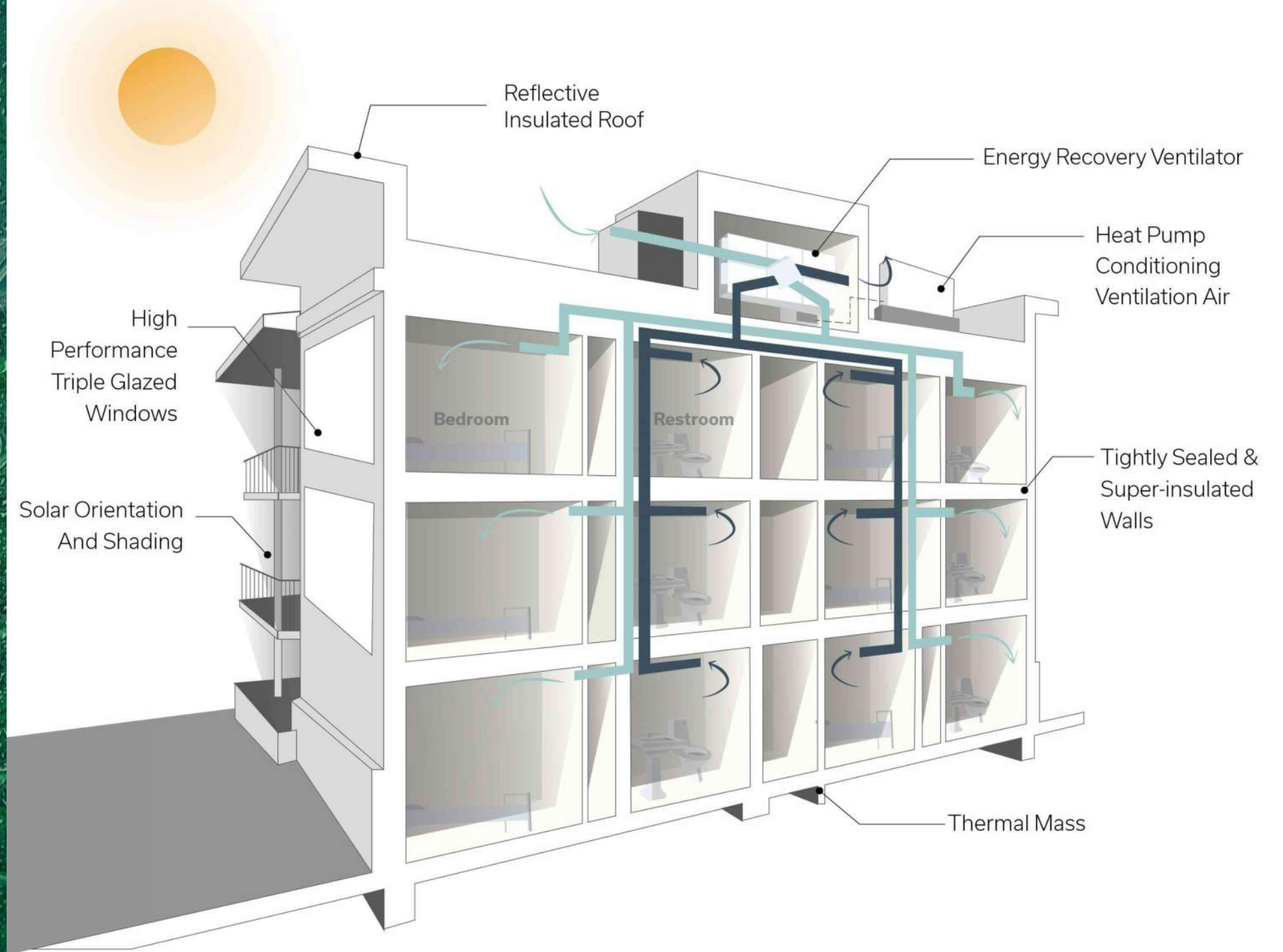


Passive Opportunities

Climate Analysis | Temperature Bins Portland



Passive Design

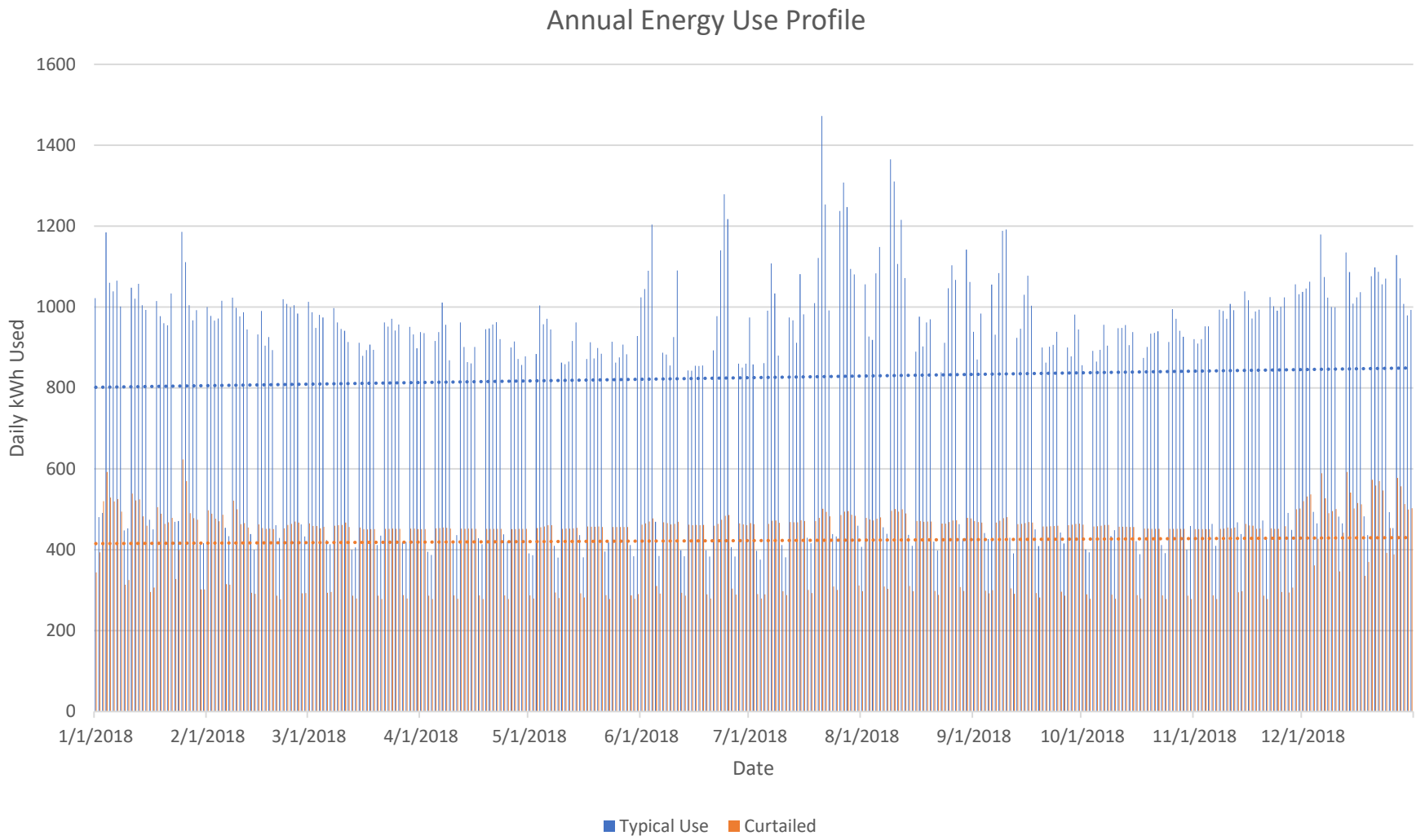


Business Continuity

OFFICE BUILDING EXAMPLE

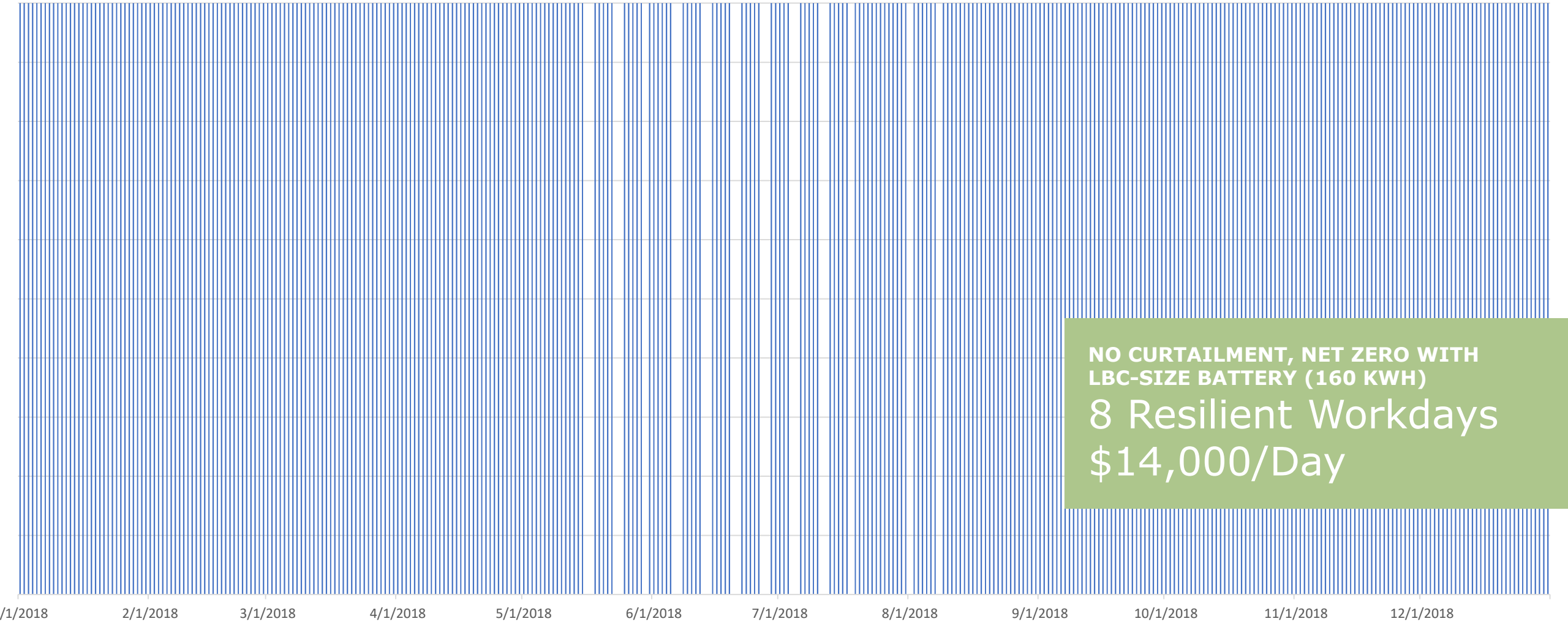
Curtailment Strategies:

- Lights off
- Temperature set back
- Ventilation off
- Plug loads reduced to laptops only
- Elevator not used
- Only cold domestic water



Business Continuity

DAYS AT RISK OF AN EMPTY BATTERY WHEN ISLANDING



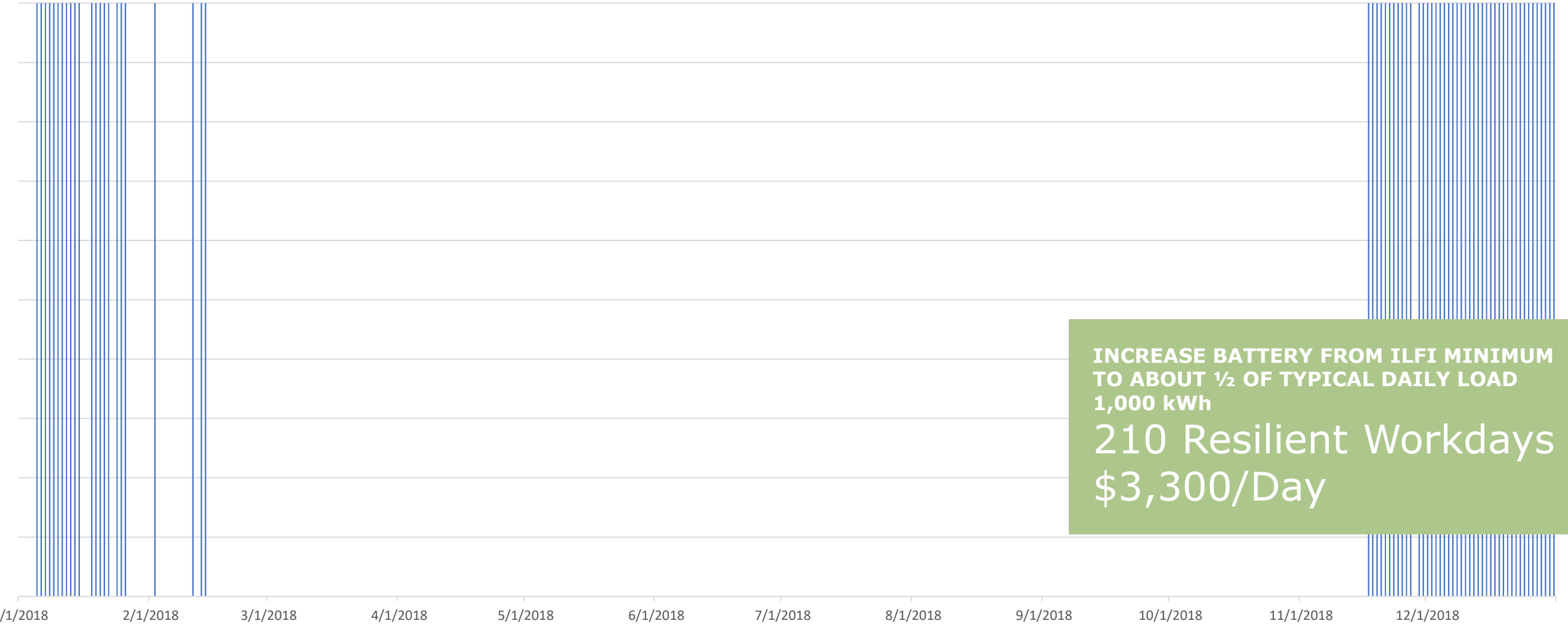
NO CURTAILMENT, NET ZERO WITH LBC-SIZE BATTERY (160 KWH)

8 Resilient Workdays

$14,000/Day

Business Continuity

DAYS AT RISK OF AN EMPTY BATTERY WHEN ISLANDING



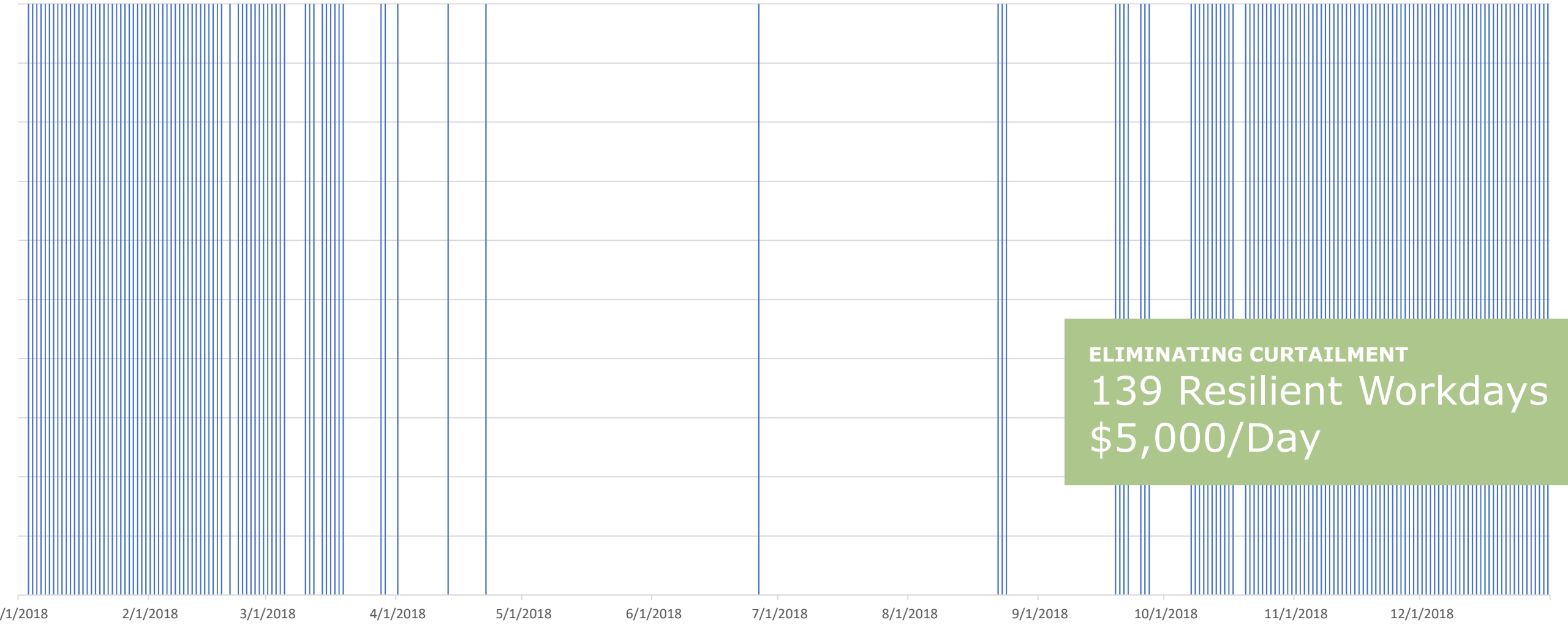
INCREASE BATTERY FROM ILFI MINIMUM TO ABOUT ½ OF TYPICAL DAILY LOAD
1,000 kWh

210 Resilient Workdays

$3,300/Day

Business Continuity

DAYS AT RISK OF AN EMPTY BATTERY WHEN ISLANDING



ELIMINATING CURTAILMENT

139 Resilient Workdays

$5,000/Day

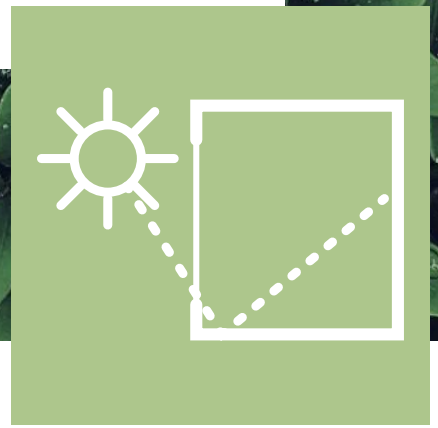
Business Continuity Takeaways

Curtailment is a critical element to broad resiliency. The most impactful curtailment measures are Passive Design features.

NATURAL VENTILATION

LOW LOADS

Acceptable comfort without conditioning



DAYLIGHTING


Questions?