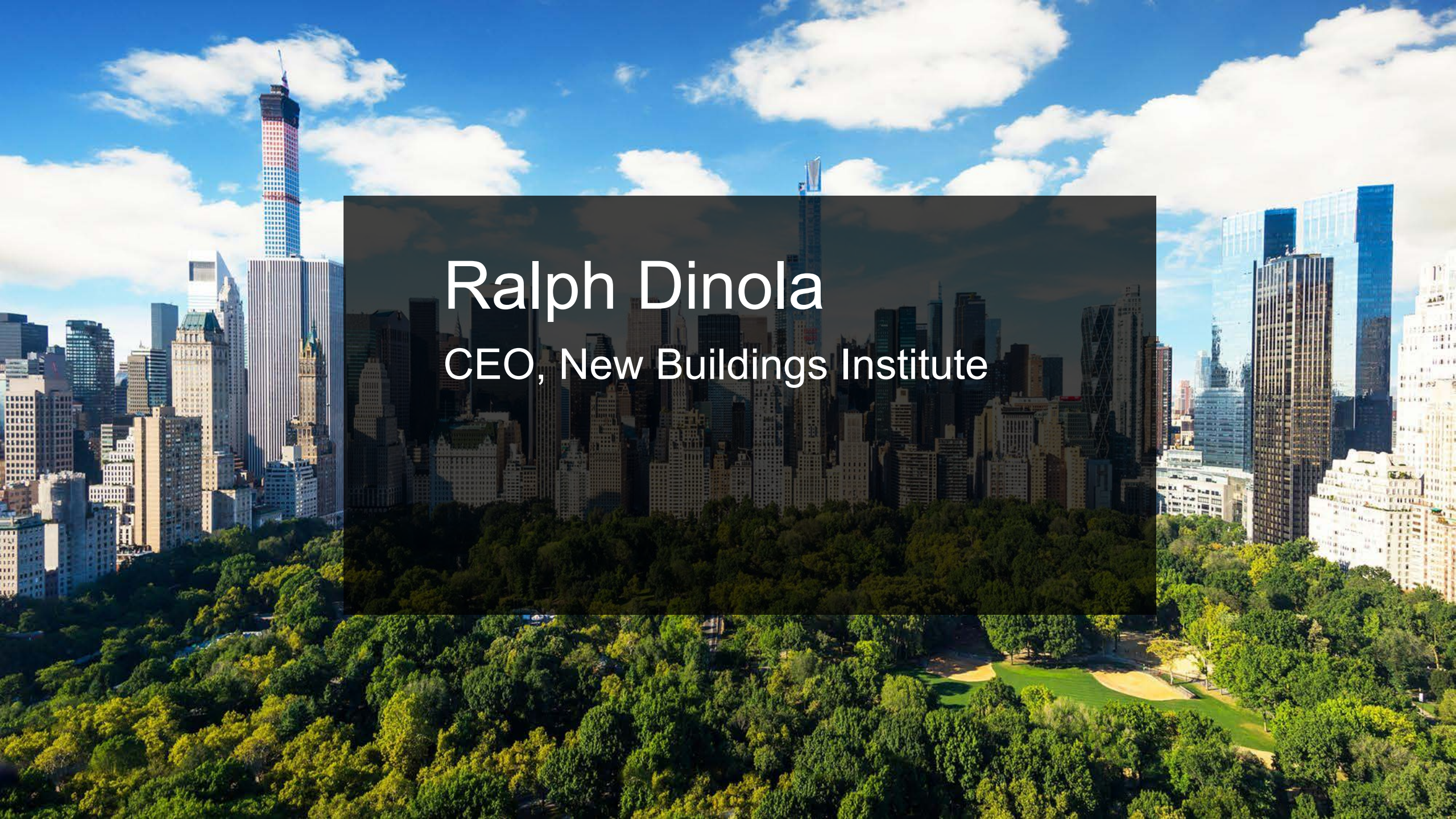
GREENING THE GRID: GRID FRIENDLY BUILDINGS

February 27th 2020 | 32BJ


Ralph Dinola
CEO, New Buildings Institute

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U.S. GREEN BUILDING COUNCIL USGBC

New Buildings Institute is:

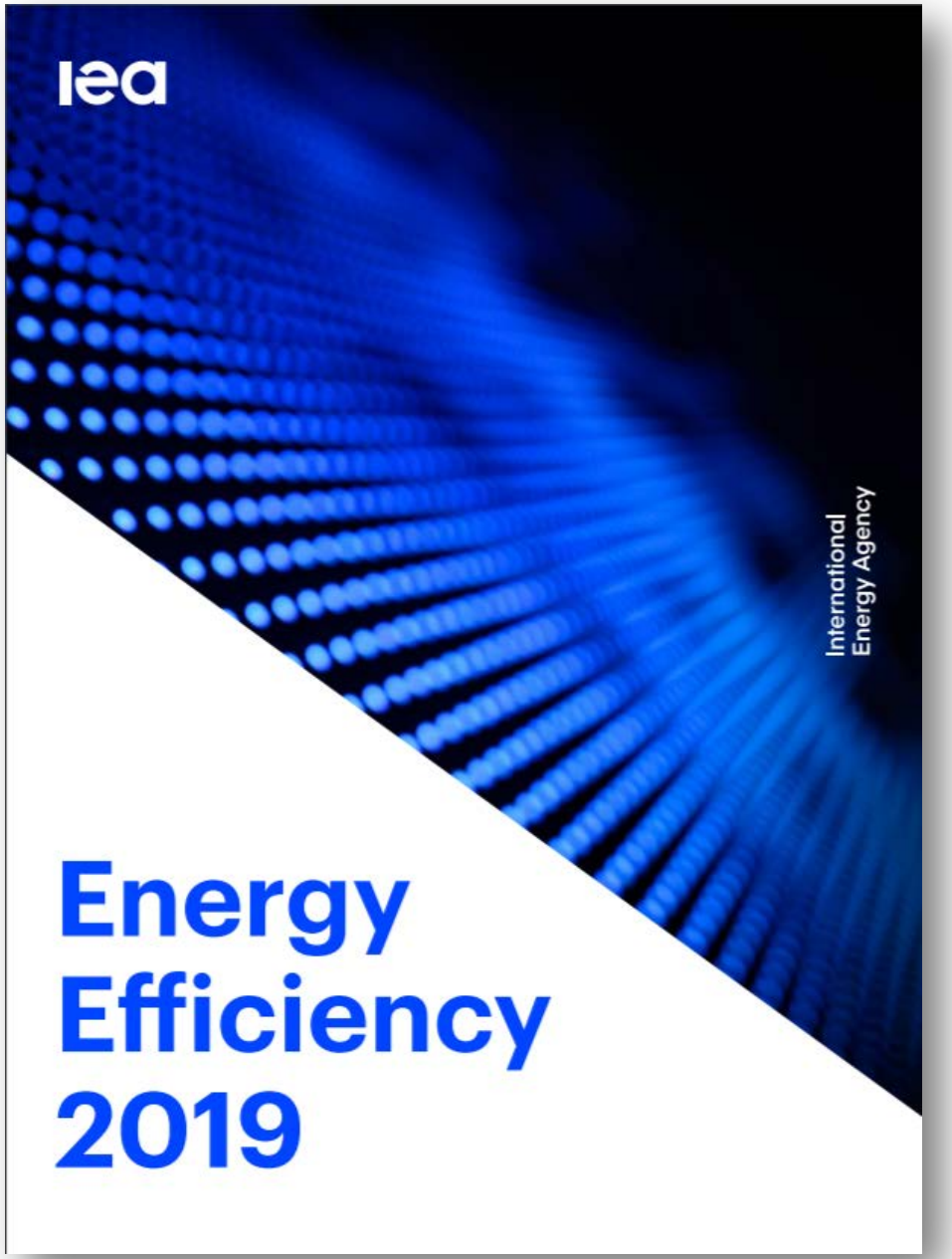
Vision: We envision a transformed built environment that is carbon-free, sustainable, and energy-efficient and supports thriving economies that benefit all people and the planet.

Mission: We push for better buildings that achieve zero energy, zero carbon, and beyond – through research, policy, guidance, and market transformation – to protect people and the planet.

Context

"The historic slowdown in energy efficiency in 2018 – the lowest rate of improvement since the start of the decade – calls for bold action by policy makers and investors."

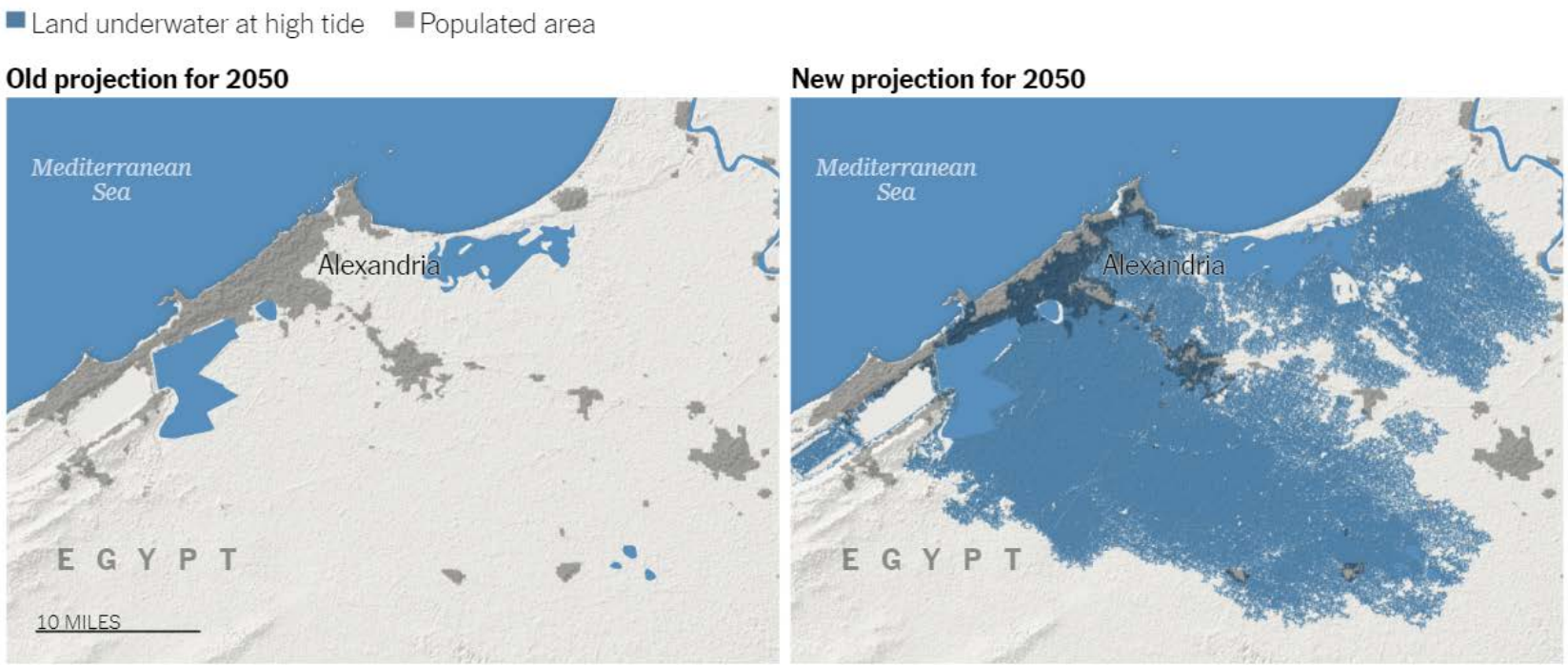
Fatih Birol, Executive Director, IEA



The New York Times

Rising Seas Will Erase More Cities by 2050, New Research Shows

By Denise Lu and Christopher Flavelle Oct. 29, 2019



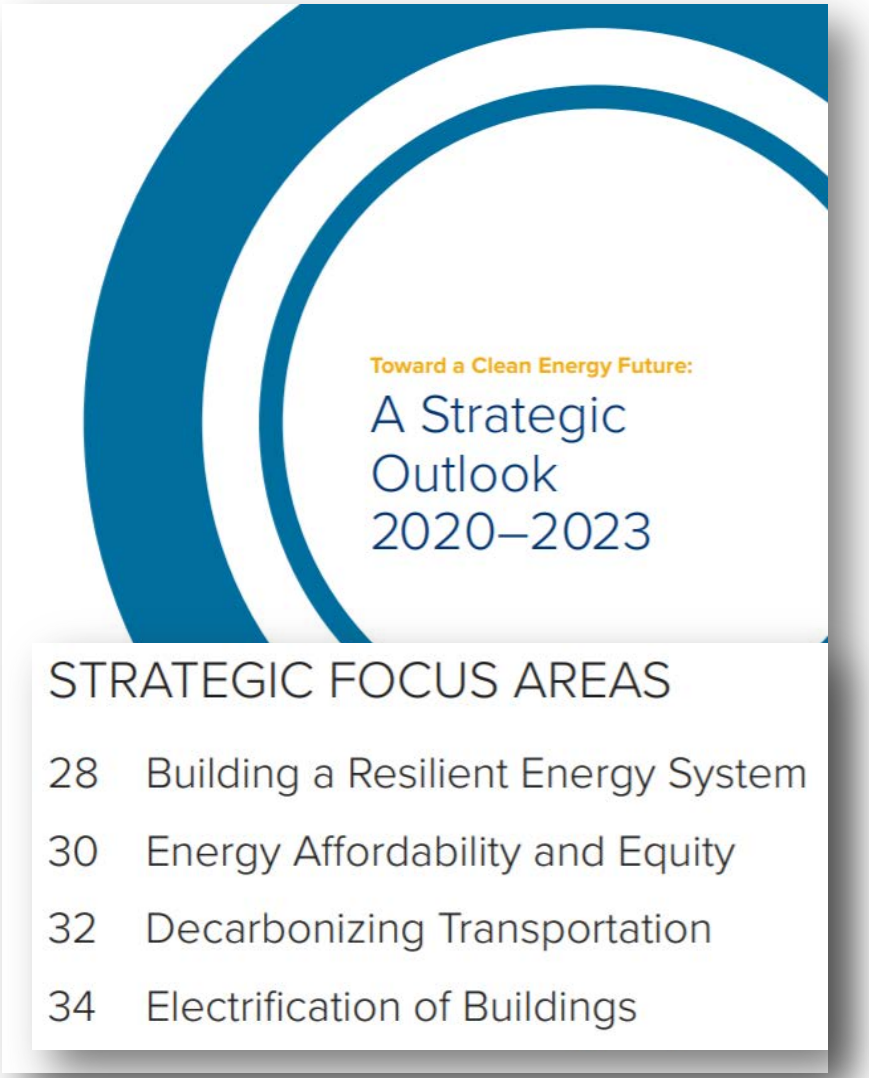
The disappearance of cultural heritage could bring its own kind of devastation. Alexandria, Egypt, founded by Alexander the Great around 330 B.C., could be lost to rising waters.

New York Context

Toward a Clean Energy Future: A Strategic Outlook 2020-2023

NYSERDA's 2020-2023 Strategic Outlook

- Greenhouse Gas Emissions Reduction
- Renewable Energy
- Energy Efficiency
- A Distributed and Resilient Energy System
- Building a Clean Energy Economy



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New York Context

"There is no historical precedent for the ambitious changes on the bulk power system envisioned by policymakers"

NYISO Power Trends Report 2019

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New York Context

- Real-time Energy Management (RTEM) is a pathway to Grid-Integrated Efficient Buildings (GEBs)
- Demand Response Programs
  - 4% of summer peak demand in 2018
- Local Law 97
  - GHG emissions limits at the building site
- Local Law 32
  - PREDICTED ENERGY USE TARGET. For each type of buildings, as such types correspond to the prototypes set forth in ASHRAE 90.1-2013, a maximum allowable predicted energy use of such buildings that are new buildings or existing buildings undergoing substantial reconstruction, as determined pursuant to this article

Climate Solutions?

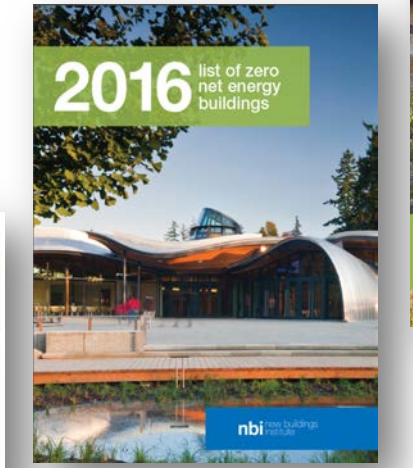
Zero Energy Building Counts

10x Growth since 2012

60 (2012)

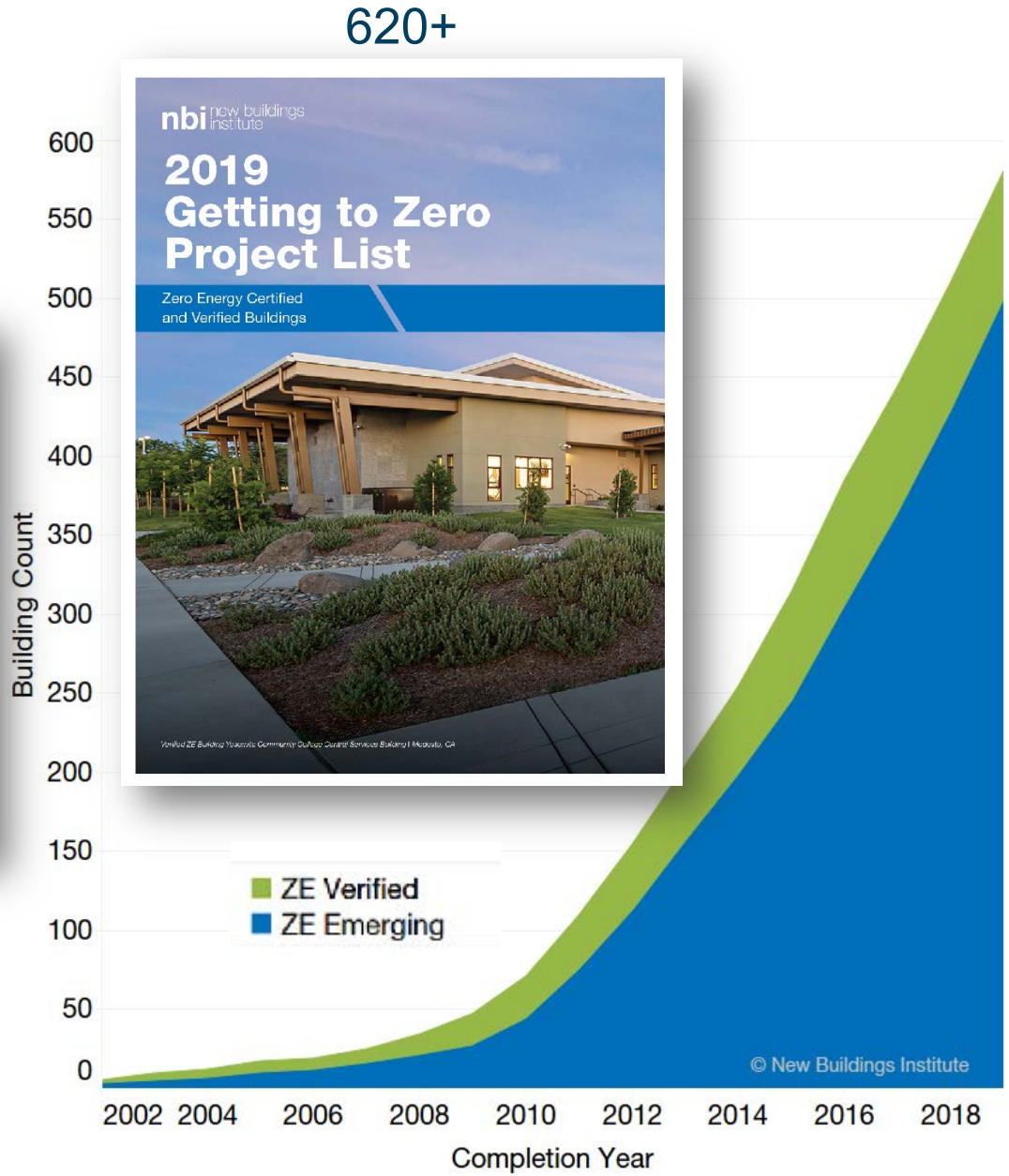
160

332



482

620+



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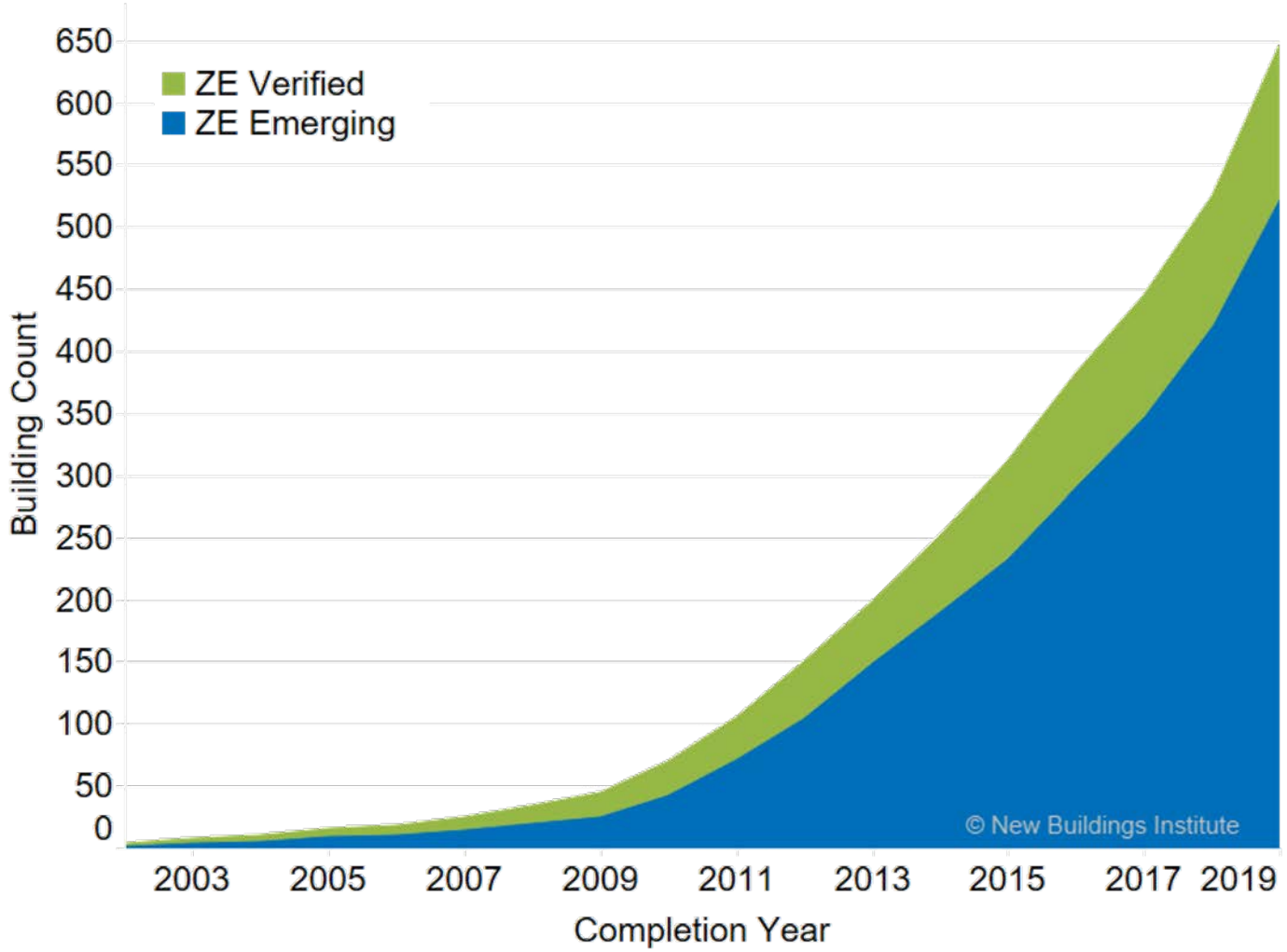
Zero Energy Buildings



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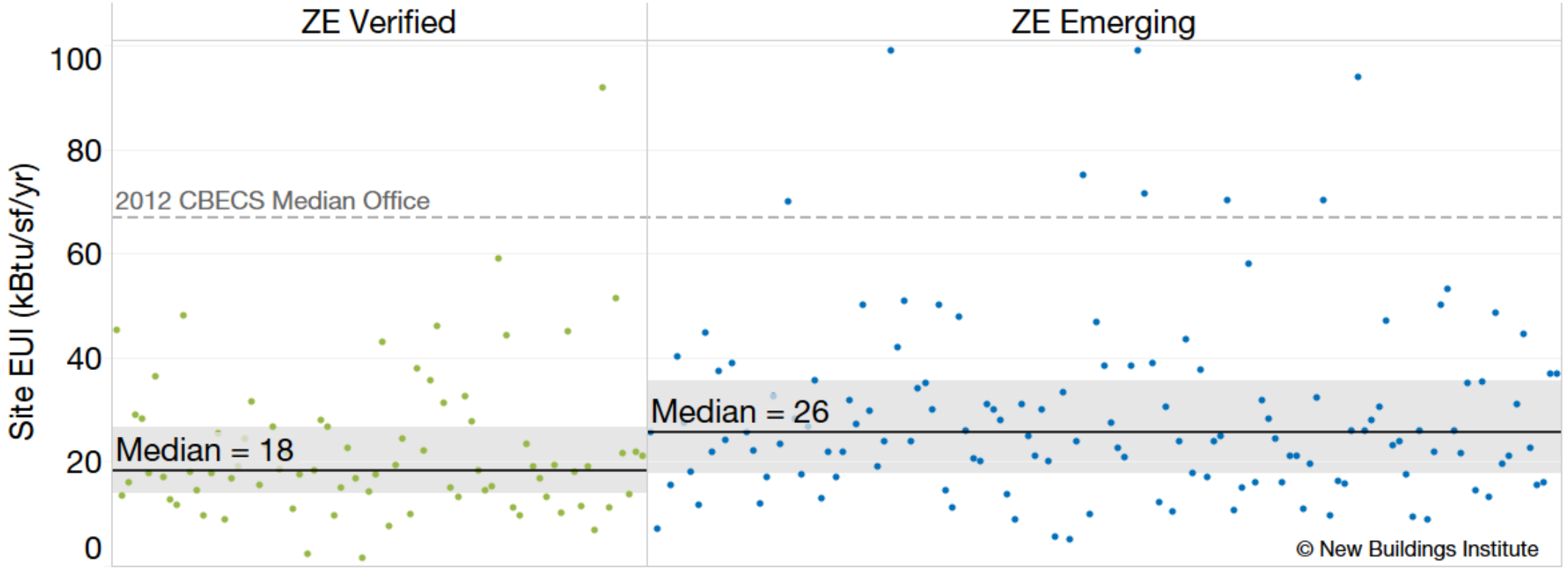
Zero Energy Building Performance



ZE Verified buildings on average use **60% less energy** than comparable existing U.S. commercial buildings and 46% less than new buildings under one of the most stringent U.S. base code (CA Title 24).

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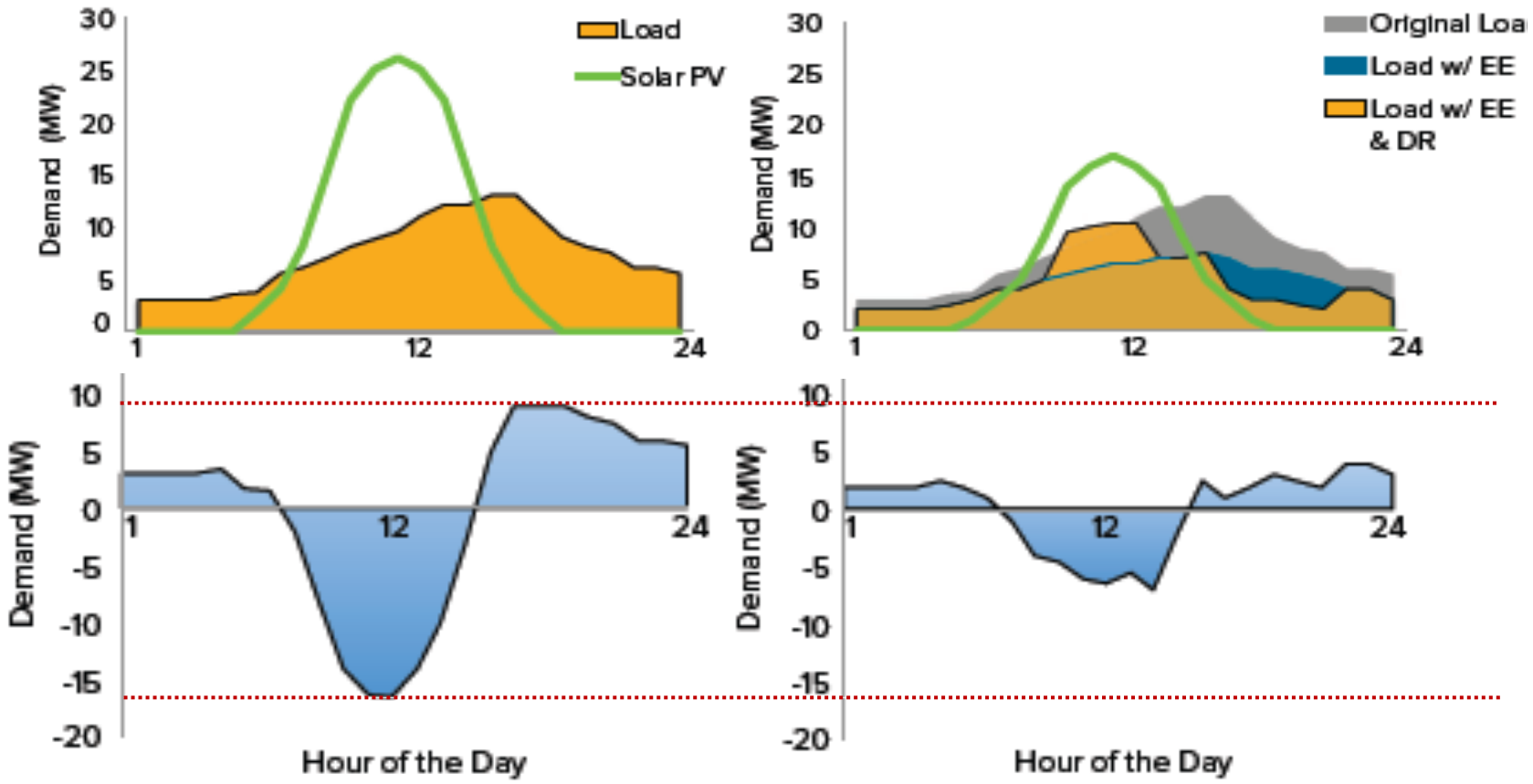
Zero Energy with and without Grid Integration

Solar PV only

Energy Efficiency, Demand Response + Solar PV

Load Shape

Grid Impact



Courtesy: NREL, RMI

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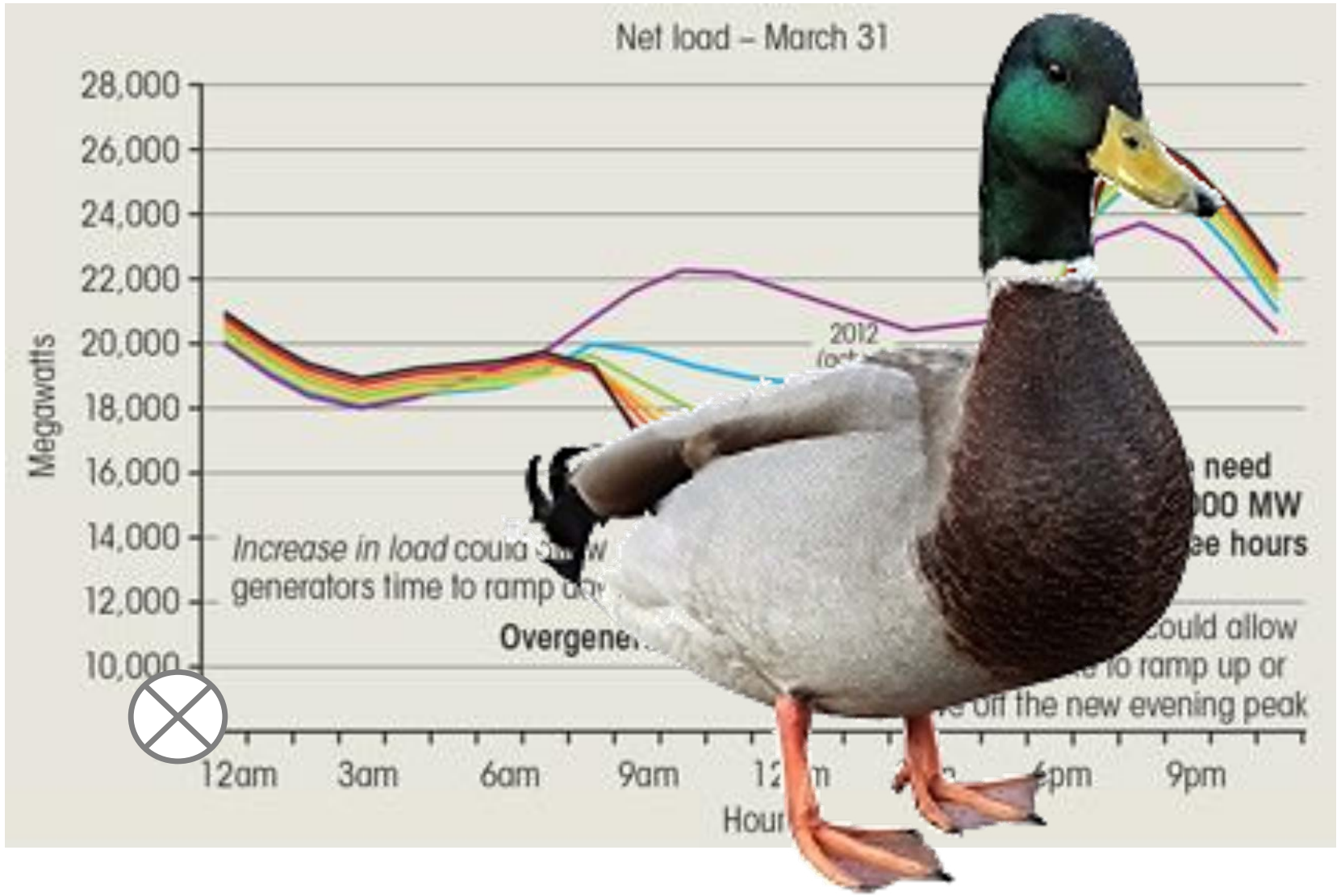
California: The Duck Curve



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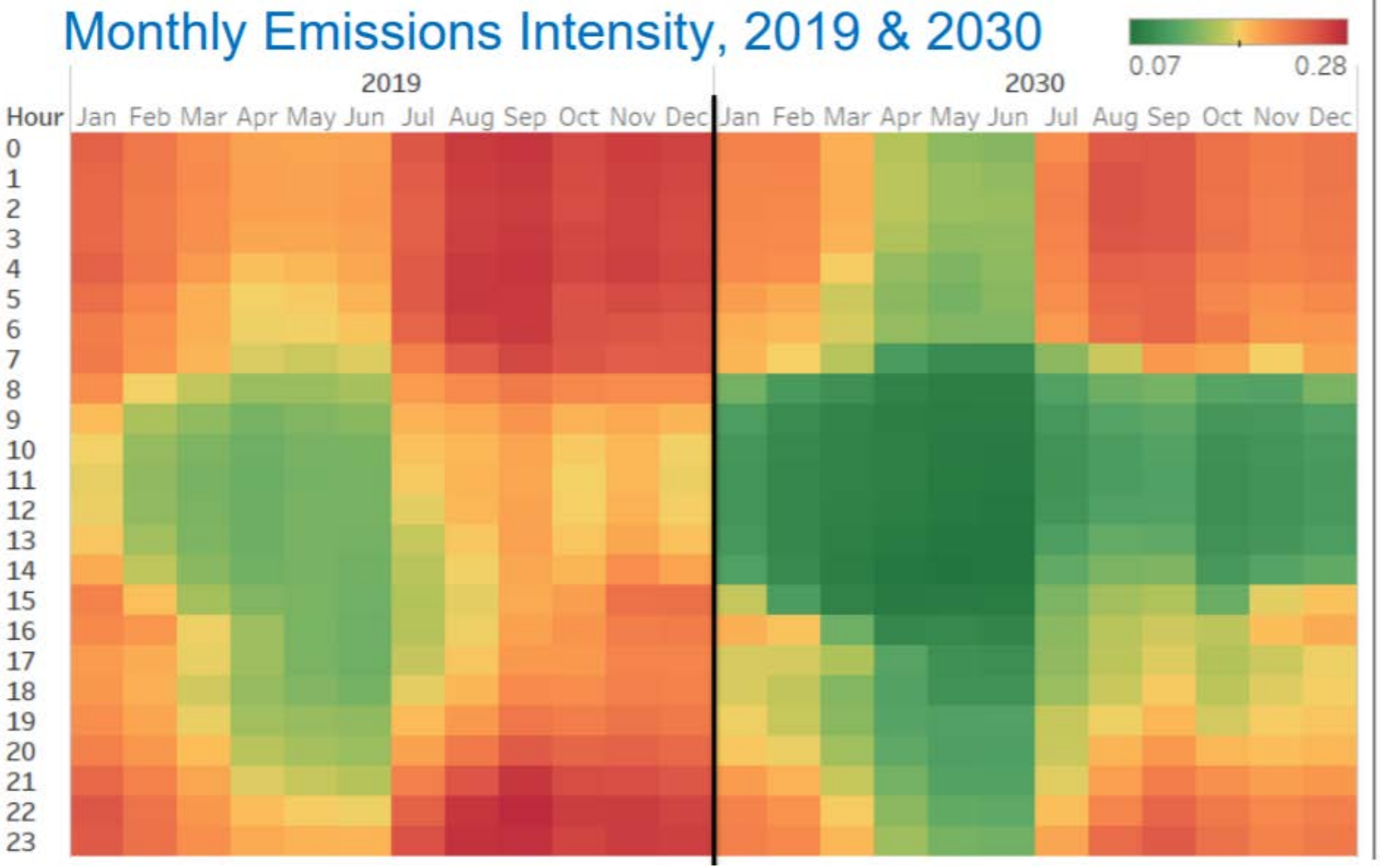
CALIFORNIA ENERGY COMMISSION

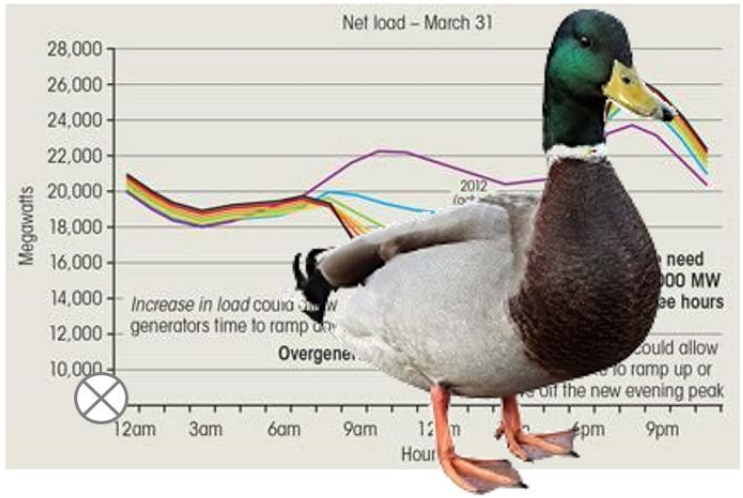
Electricity CO_2 Intensity



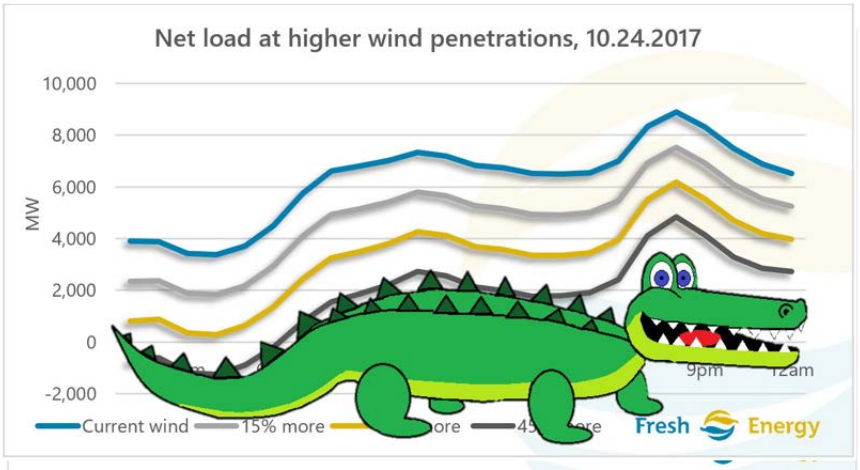
Brook, M. (2018). Building Decarbonization: 2018 Update Integrated Energy Policy Report. Presentation. Retrieved from https://efiling.energy.ca.gov/GetDocument.aspx?tn=223817&DocumentContentId=54026.

The Grid Menagerie

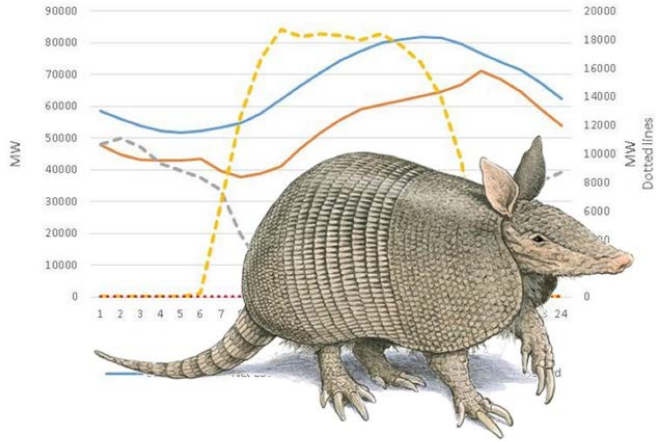
California: The Duck Curve



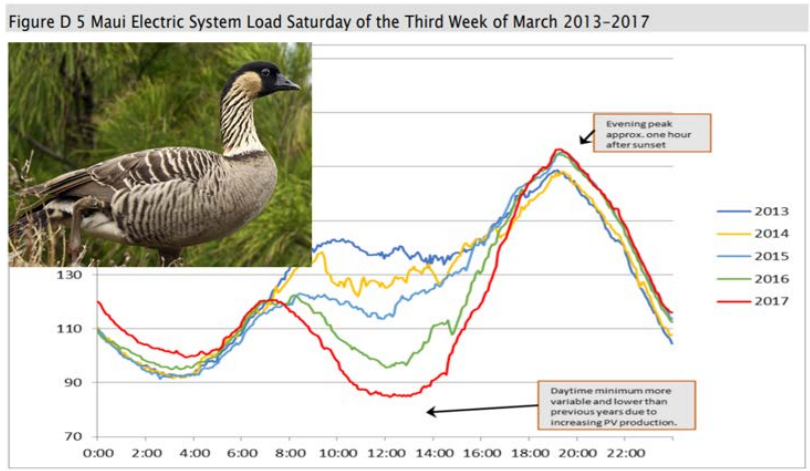
Midwest: The Gator Curve



Texas: The Armadillo Curve



Hawaii: The Nene Curve



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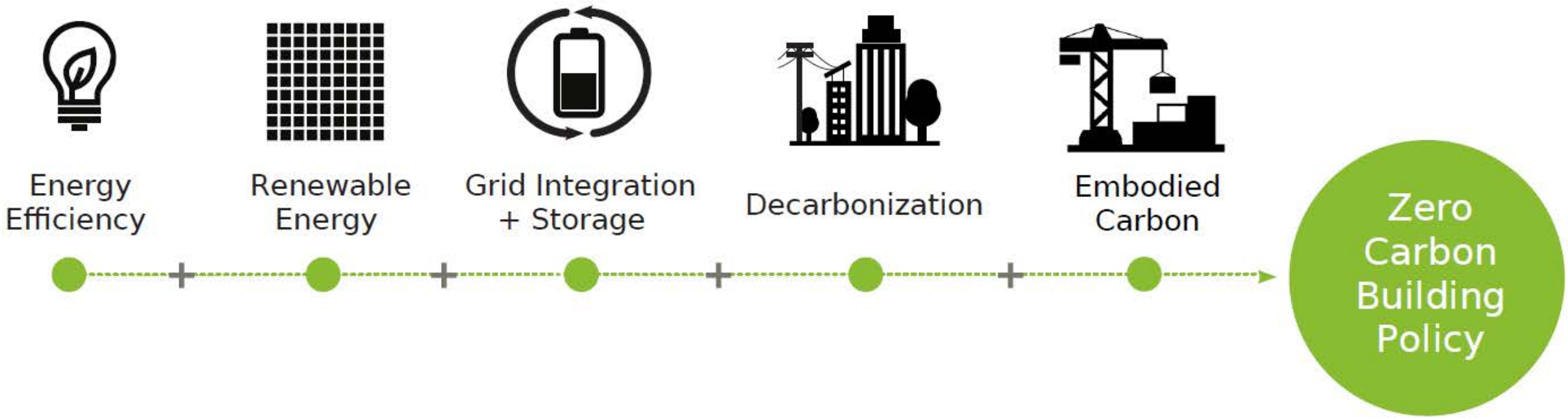
Macro Trends:

“a glimpse of the future”

- Zero Energy Proliferation
- Grid Decarbonization
- Building Decarbonization
- Vehicle Electrification
- Energy Resiliency
- Batteries

The Five Foundations of Zero Carbon Building Policies



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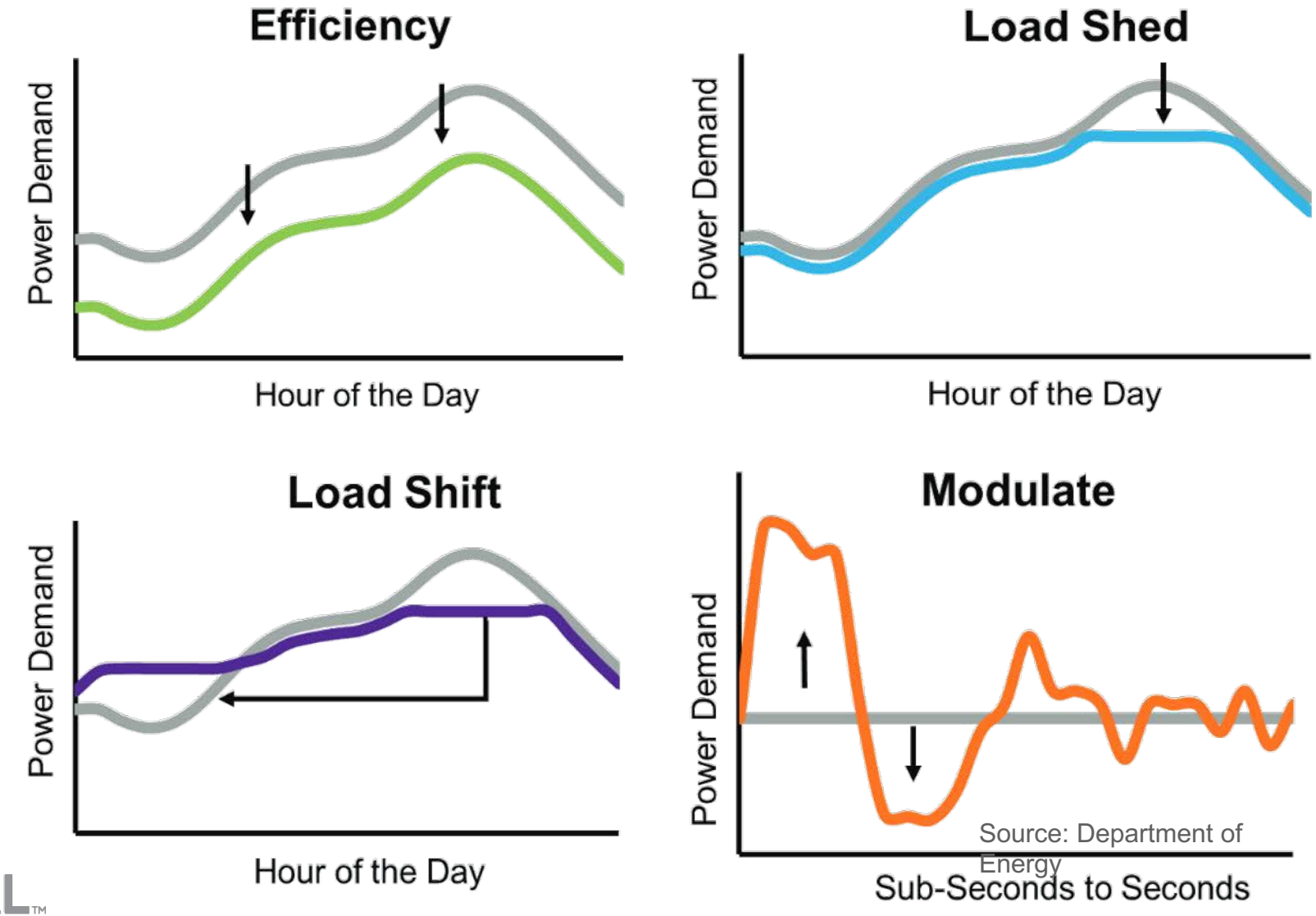
Building Modifications for Grid-Integration



Source: Department of Energy

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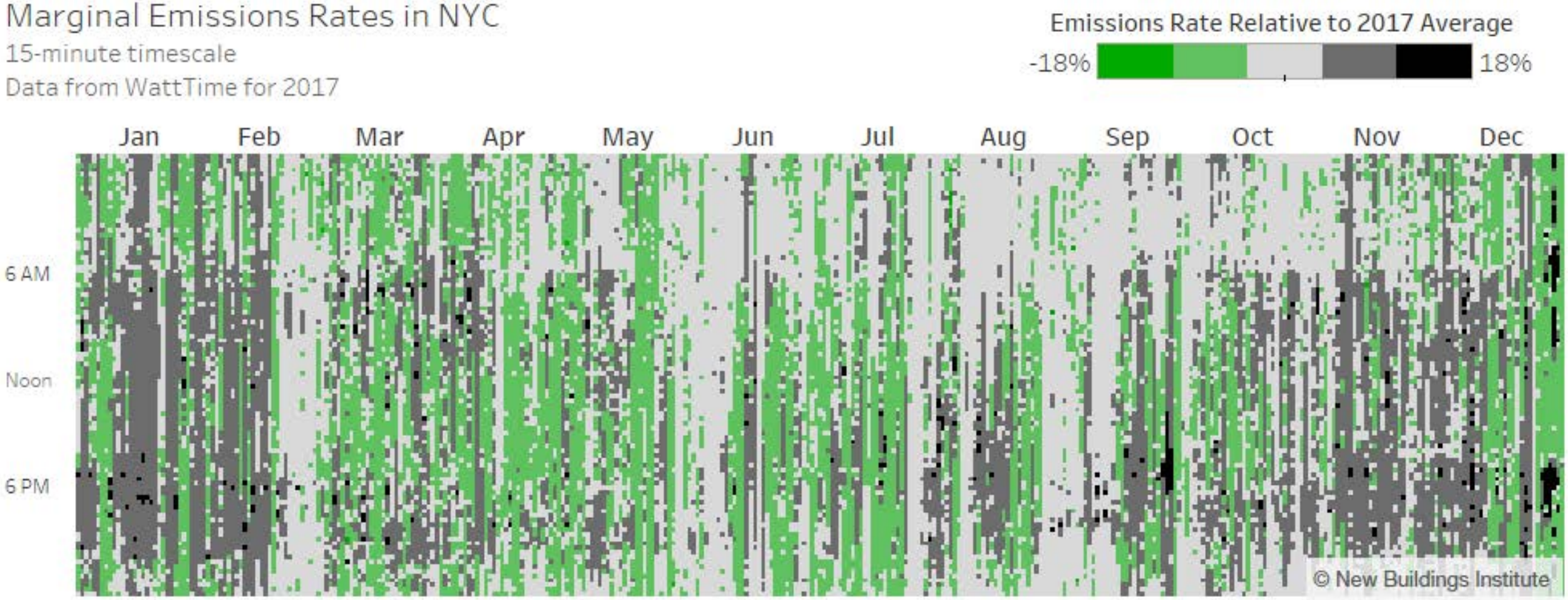
Marginal Emissions Rates in NYC

15-minute timescale

Data from WattTime for 2017



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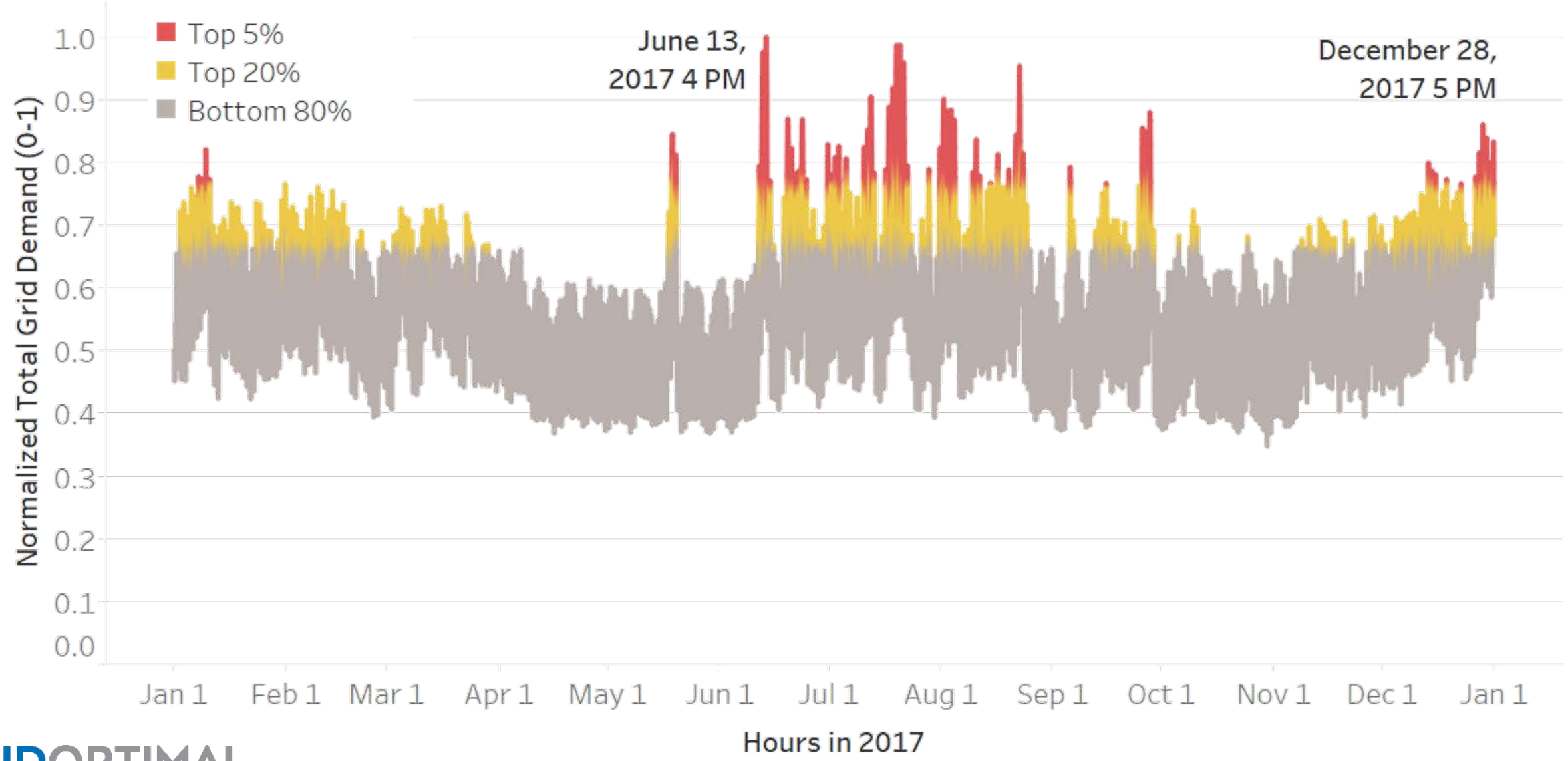
ISO-NE Grid Demand in 2017



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The GridOptimal Buildings Initiative

New Metrics for Building-Grid Integration

GridOptimal Buildings Initiative Supporting Members

NBI and USGBC recognize these leading organizations for their generous support for and participation in the GridOptimal Buildings Initiative.

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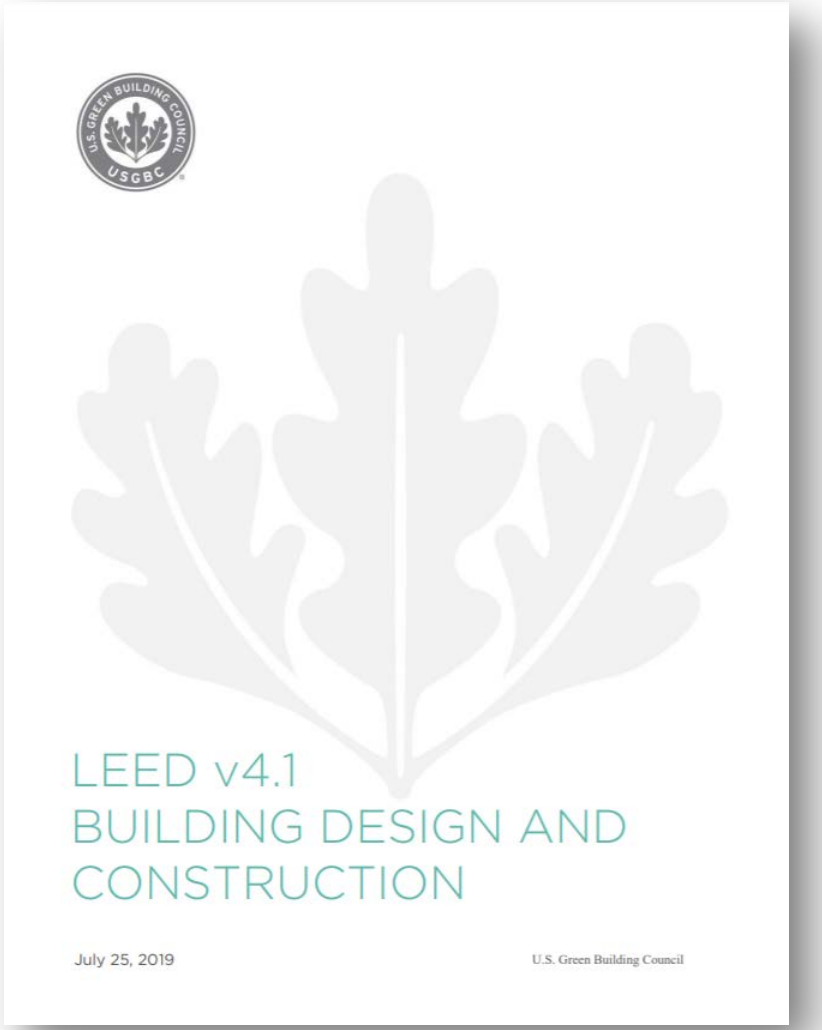
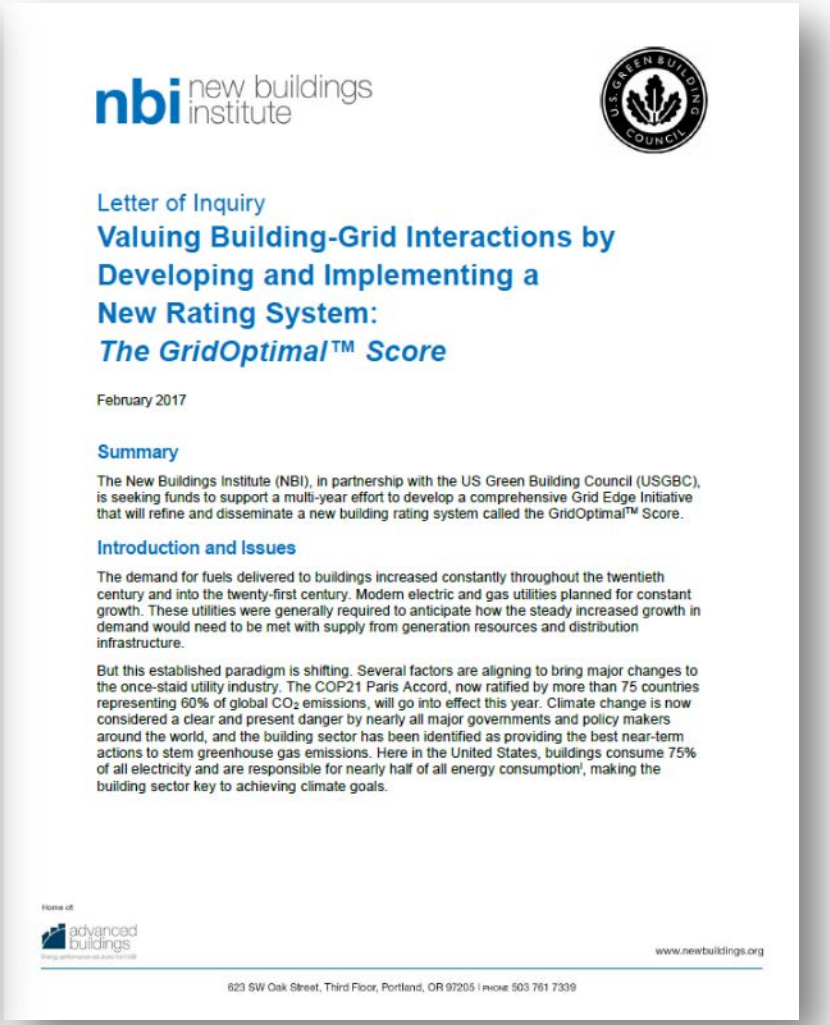
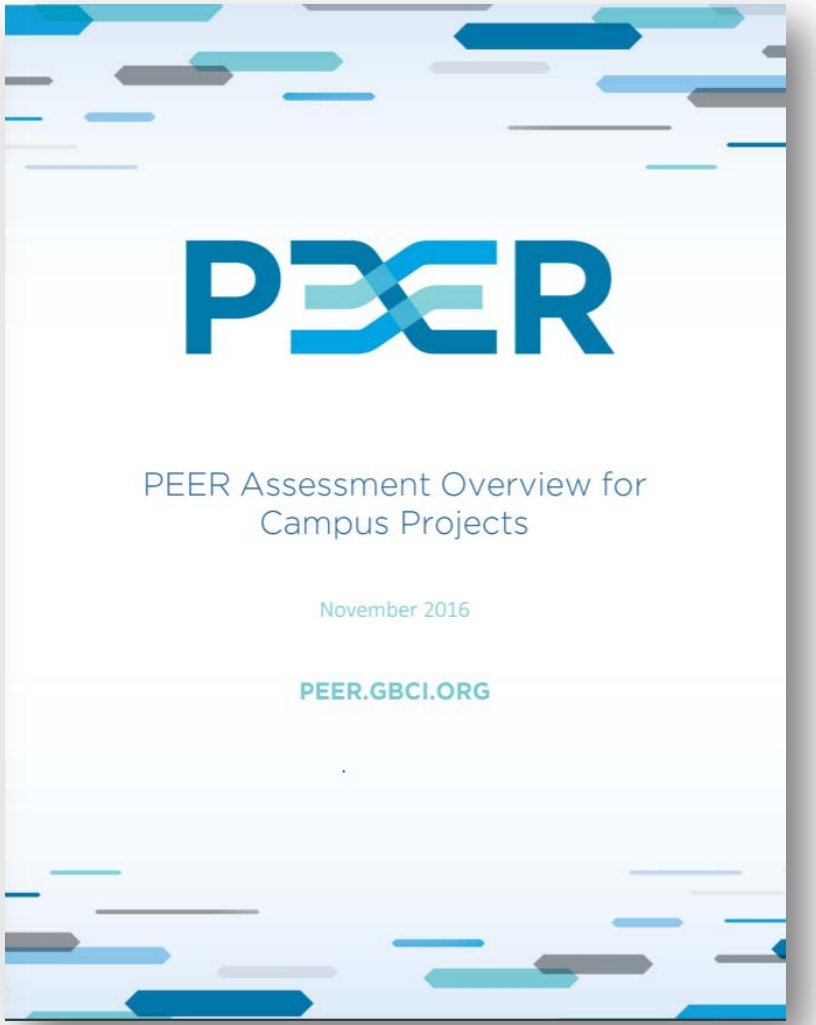
Critical Bridge Between Buildings and the Grid







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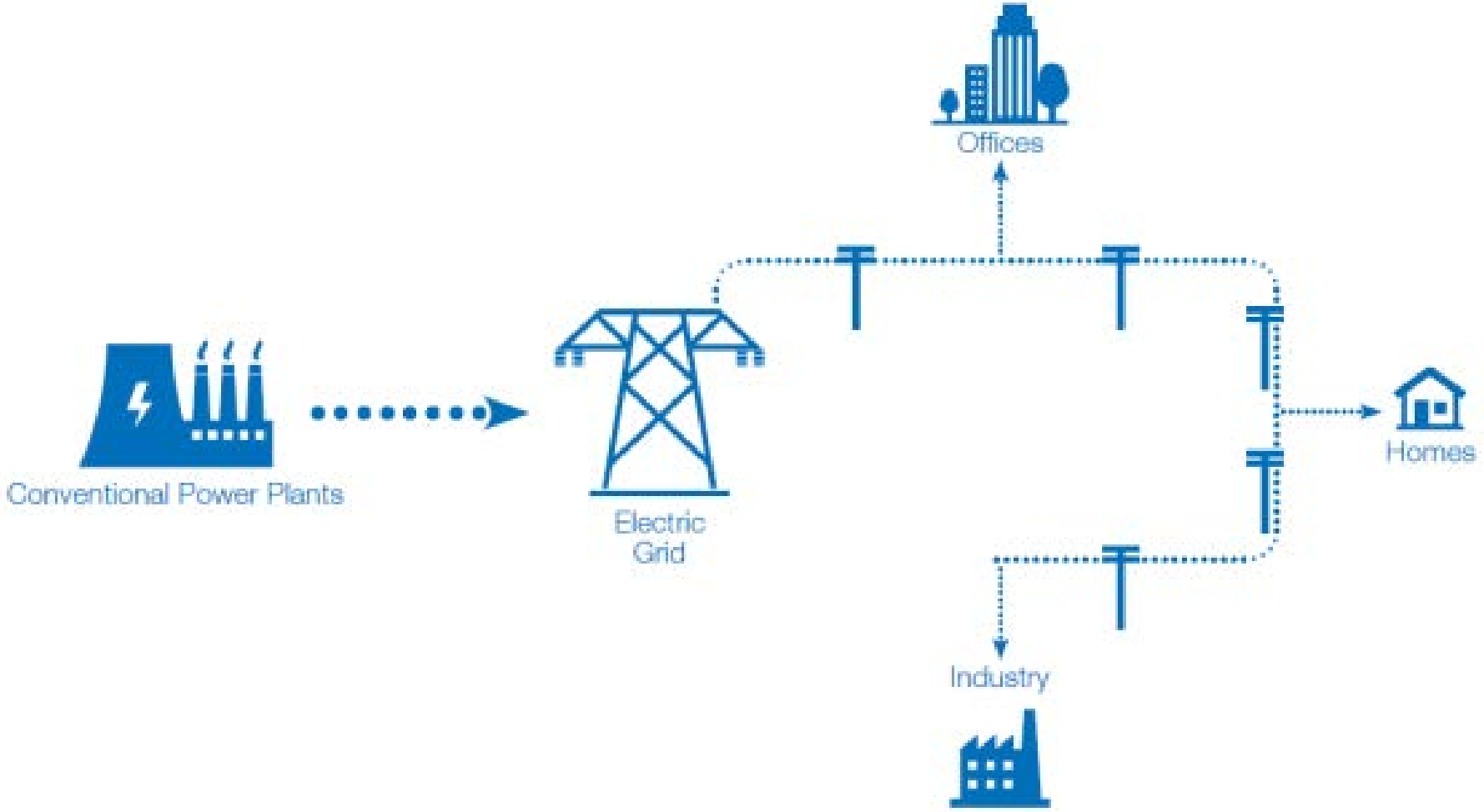
The GridOptimal Buildings Initiative - Key Themes

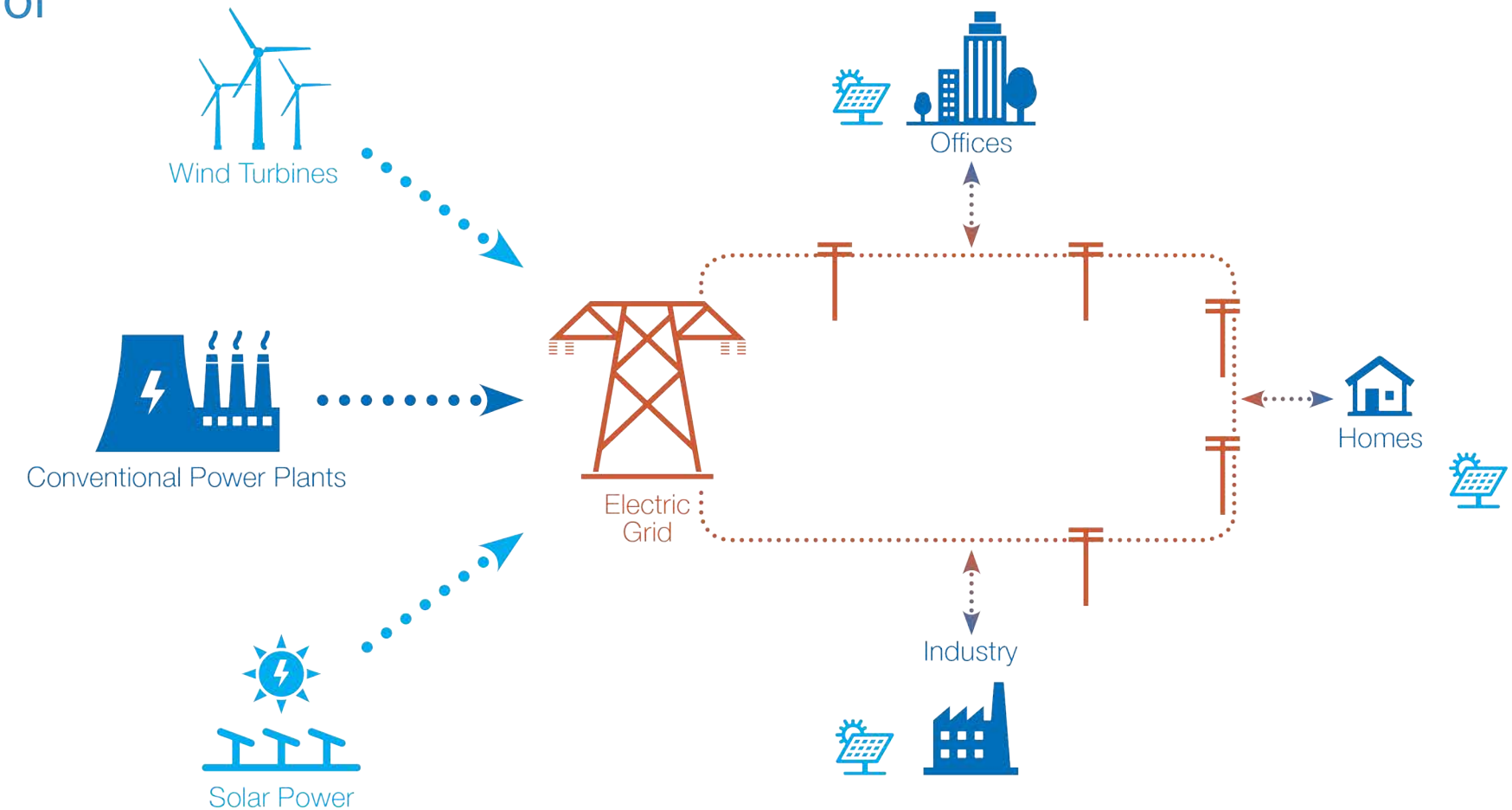
- The way **buildings interact with the electric grid** is evolving rapidly.
- Buildings will face increasing **regulatory and economic pressure** to be able to respond to **changing utility rate and delivery structures**.
- Designers will need to **understand and incorporate strategies** that allow buildings to directly interact with the utility grid.
- Adapting to the ***interactive grid*** will be critical to maintaining **building services and comfort** and to **grid dependability**.
- Efforts to **decarbonize the electrical grid** will require **better integration** of distributed energy resources.

GRIDOPTIMAL™ BUILDINGS INITIATIVE

One-Way Grid



The proliferation of distributed generation creates a need for more active grid management



GridOptimal Technologies and Strategies:

renewable energy

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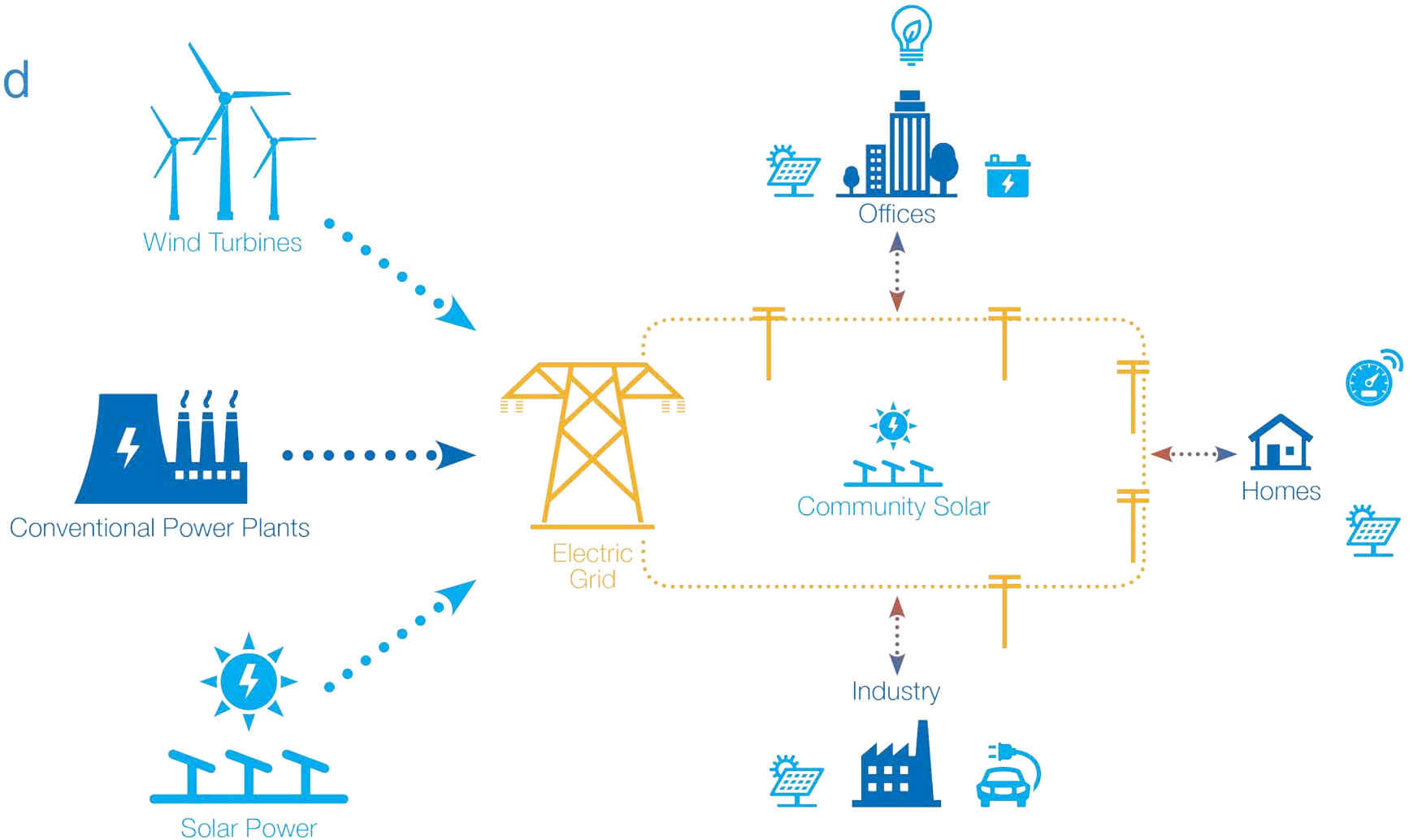
Storage and smart devices can help support clean grid operations



GridOptimal Technologies and Strategies:

- renewable energy
- energy efficiency
- electric vehicle
- energy storage
- smart connected controls

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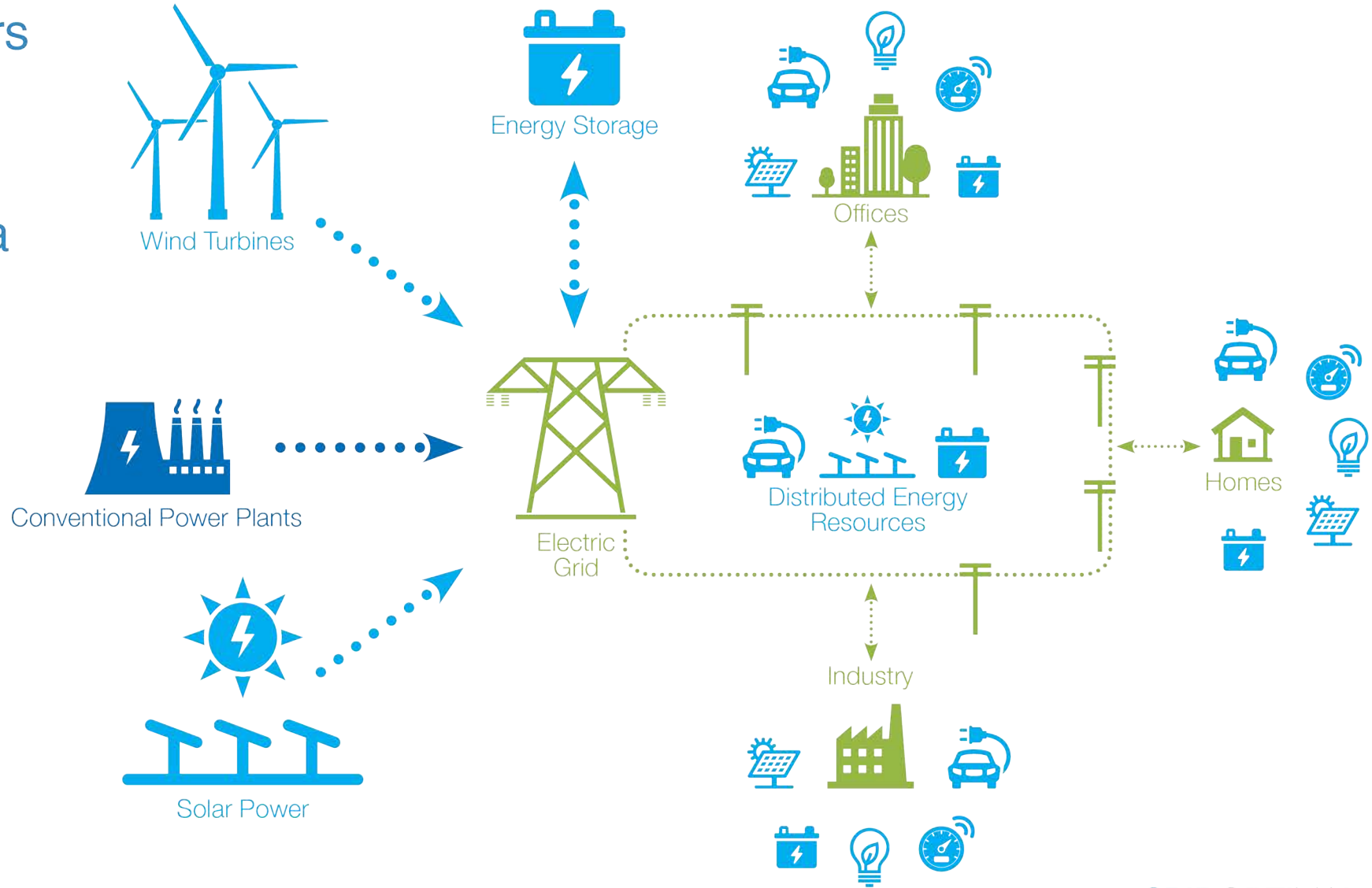
GridOptimal empowers players on both sides of the meter to actively support the transition to a carbon free grid



GridOptimal Technologies and Strategies:

- renewable energy
- energy efficiency
- electric vehicle
- energy storage
- smart connected controls

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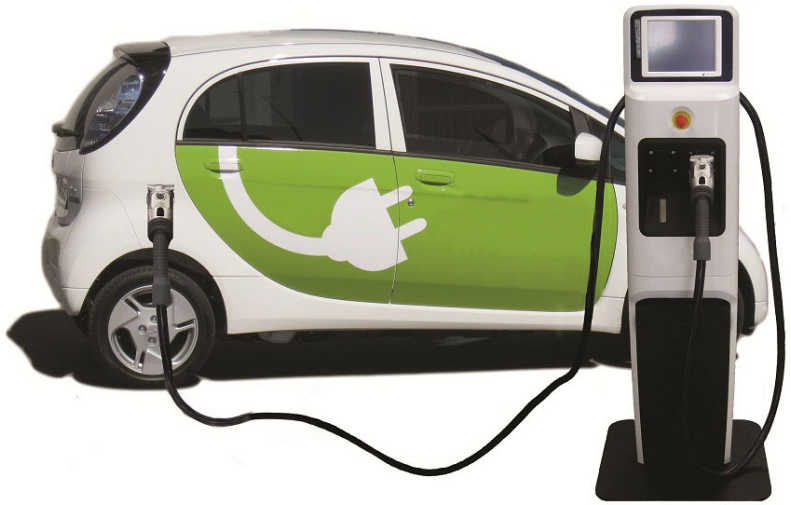
Opportunities for Building Integration with Grid

- **Permanent Efficiency**
  - Reduce building energy loads…
- **Peak Shifting**
  - Design to modify time of peak building energy use to adapt to grid…
- **Dynamic Response**
  - Actively reduce building energy use in response to short-term grid constraints…
- **Dispatchable Energy Storage**
  - Actively manage energy use patterns based on grid signals…



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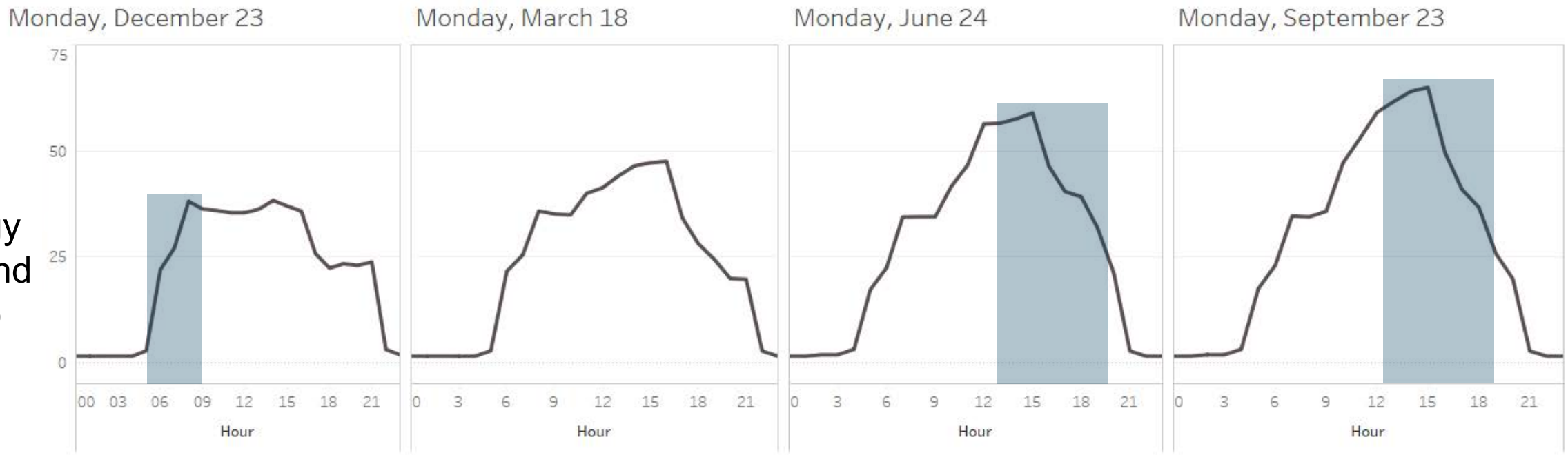
Building Energy Load Shape



Reduce energy use in the

Winter mornings and **Summer evenings**

Looking at *when* energy is saved is key

GridOptimal Metrics

West Berkeley Public Library, Berkeley, CA

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Select Pilot Projects

- Sonoma Clean Power HQ
- School in Vermont

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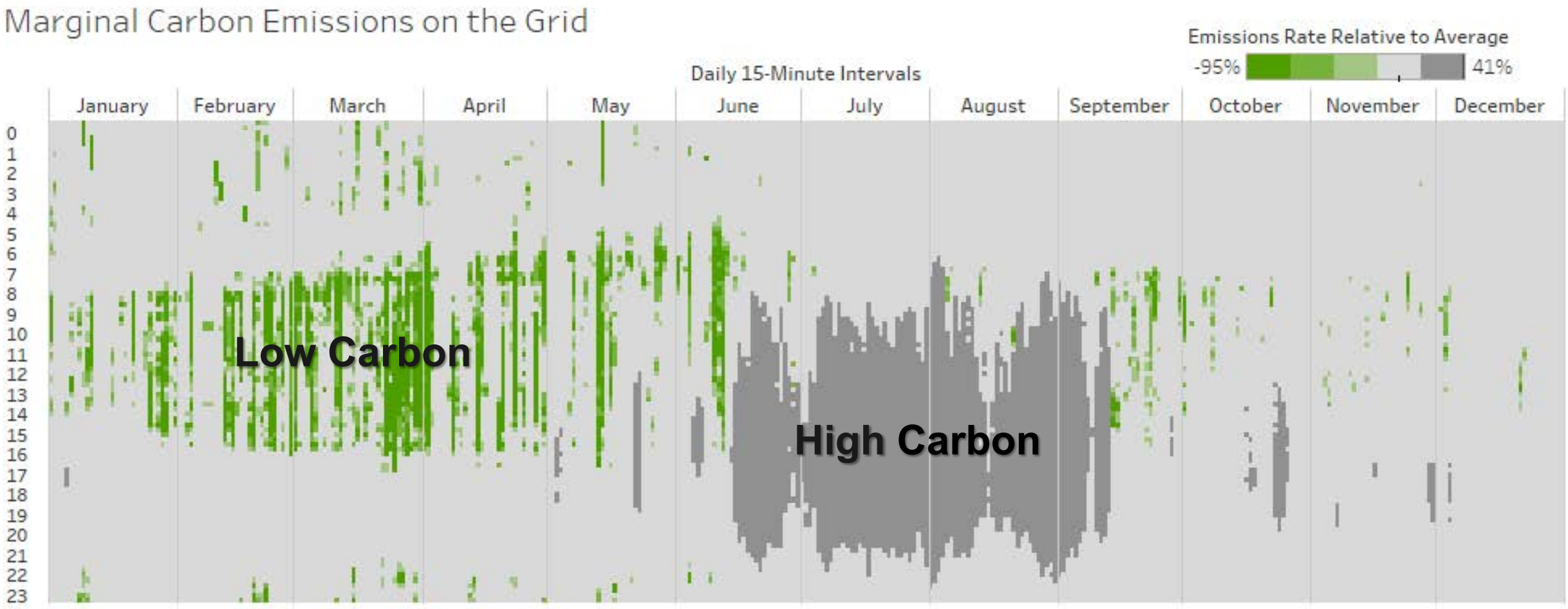
Grid Optimal Pilot – Case Study

Sonoma Clean Power Headquarters

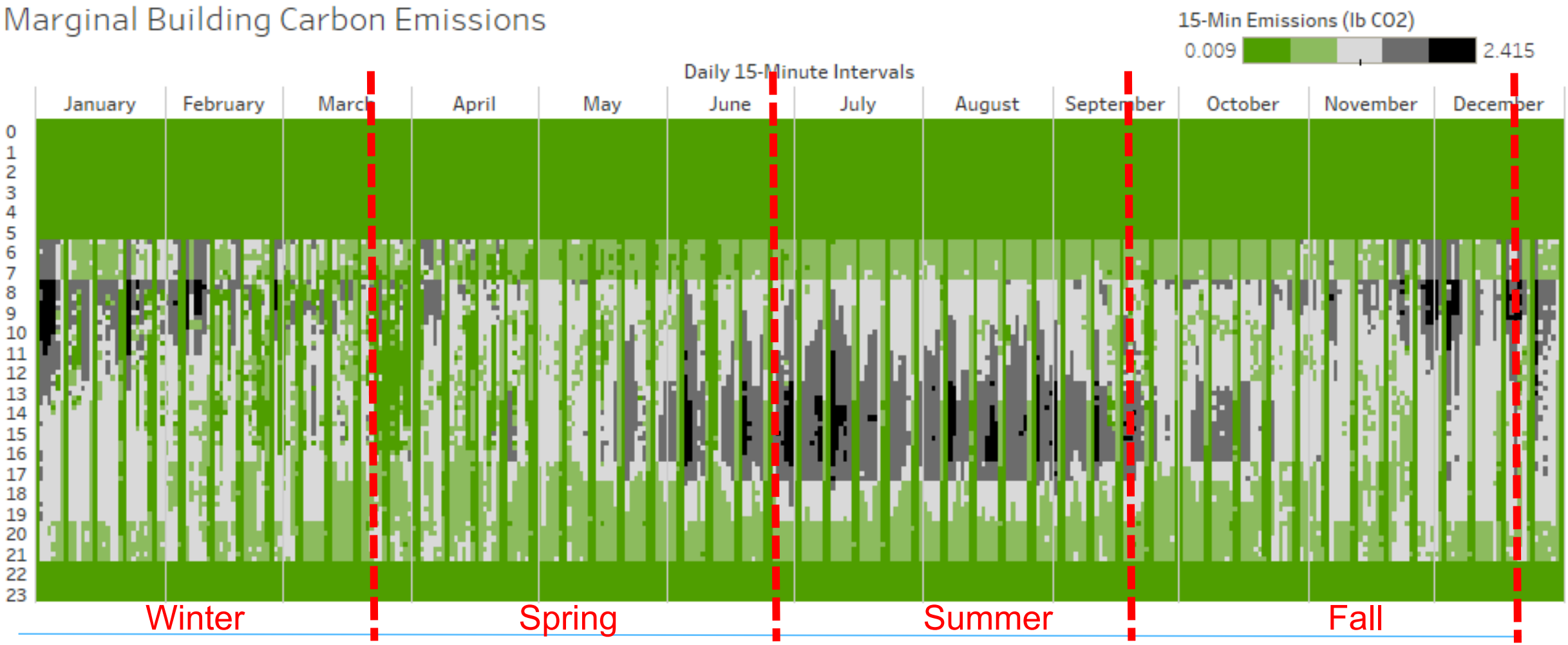
Guttmann & Blaevoet CONSULTING ENGINEERS

ehdd

Carbon Intensity of the Grid Varies Over Time



Building Emissions Based on Time of Use



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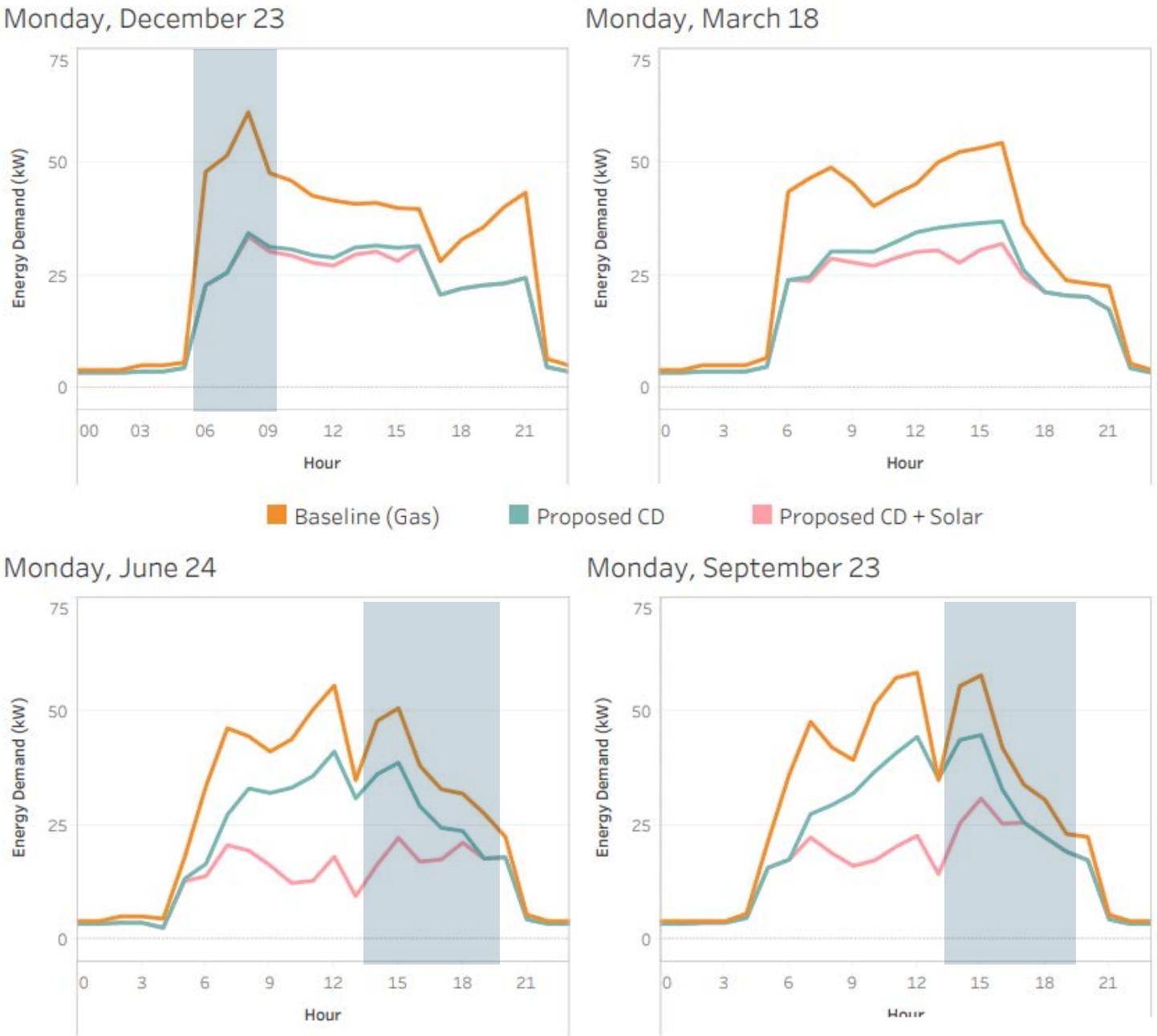
Sonoma Clean Power HQ

45% Annual carbon reduction from baseline (mixed-fuel) building



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Energy Efficiency Measures

Design Features

- Upgraded envelope
- Exceptional daylighting
- All electric heating, hot water
- Induction cooking
- Building dashboard
- Grid-connected appliances
- 41 kW Photovoltaic Array
- 150 kW battery
- Car charging

Time dependent measures modeled

- Summer Temp Setback
- Afternoon Lighting Setback
- Interoperable Thermofusers
- Early Morning Warm-Up
- **Daily battery deployment**
- Grid connected appliances
- Grid-managed vehicle charging

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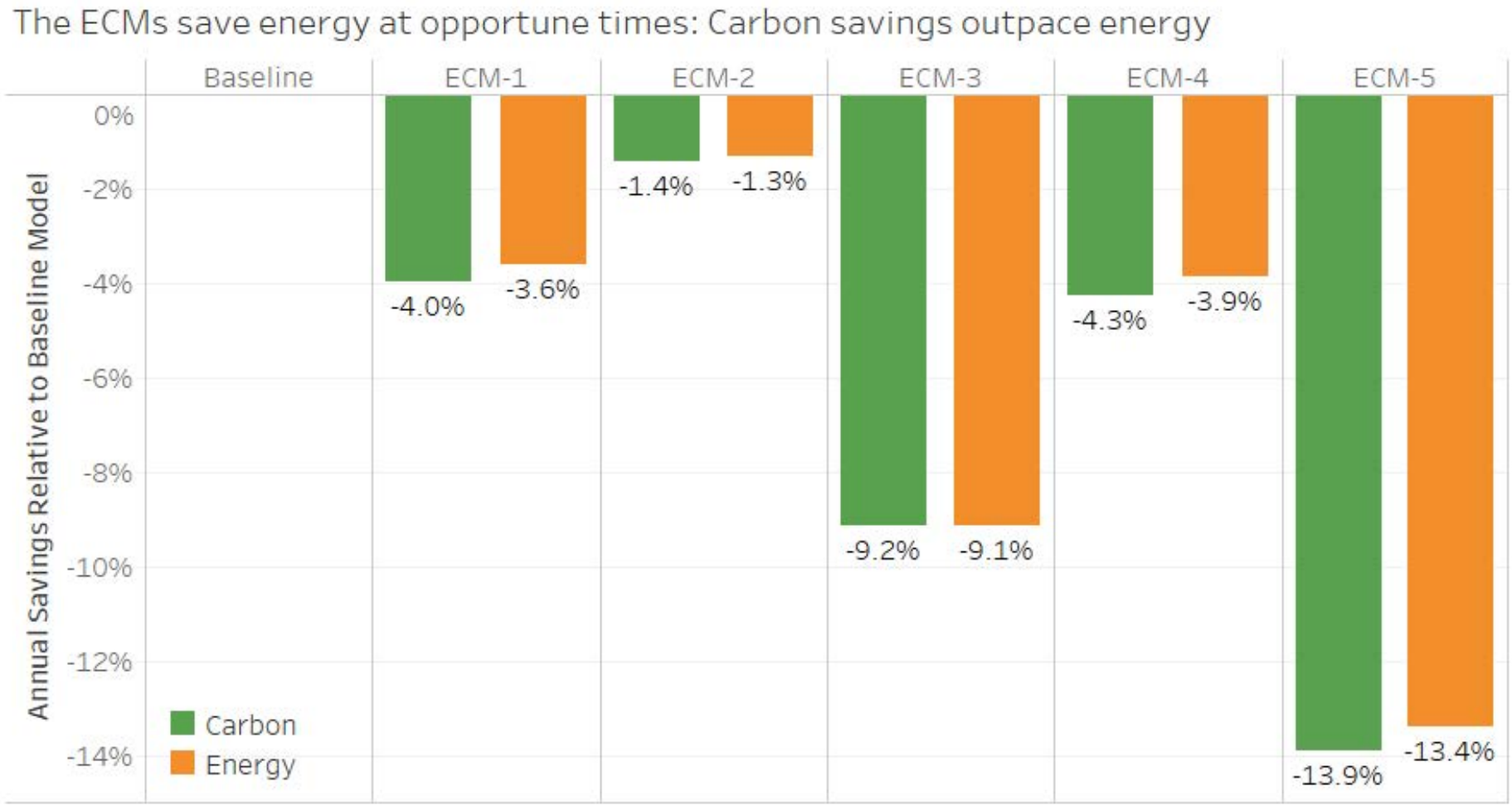
Additional Measures Cut Carbon Effectively



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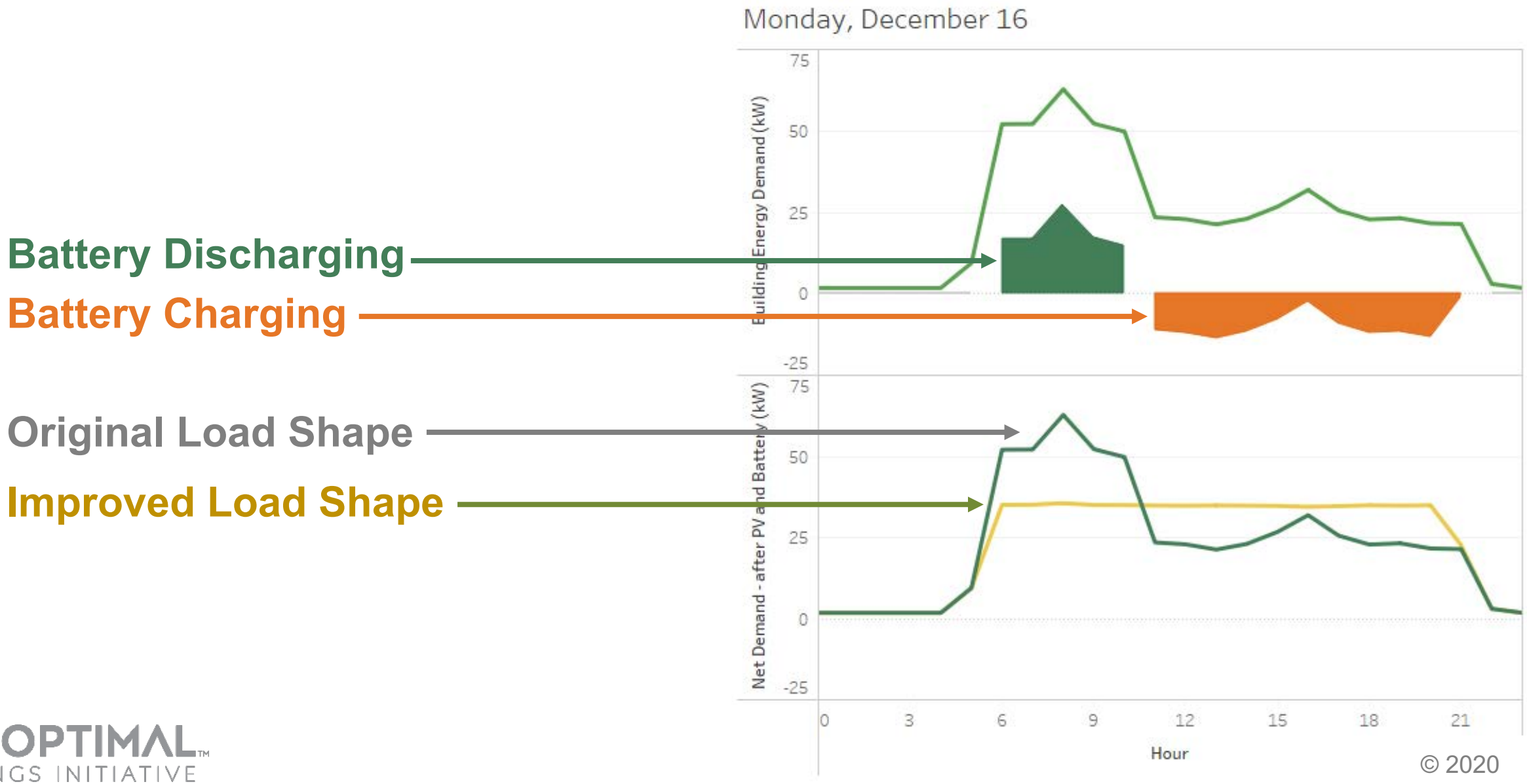
Battery Used to Change Load Shape



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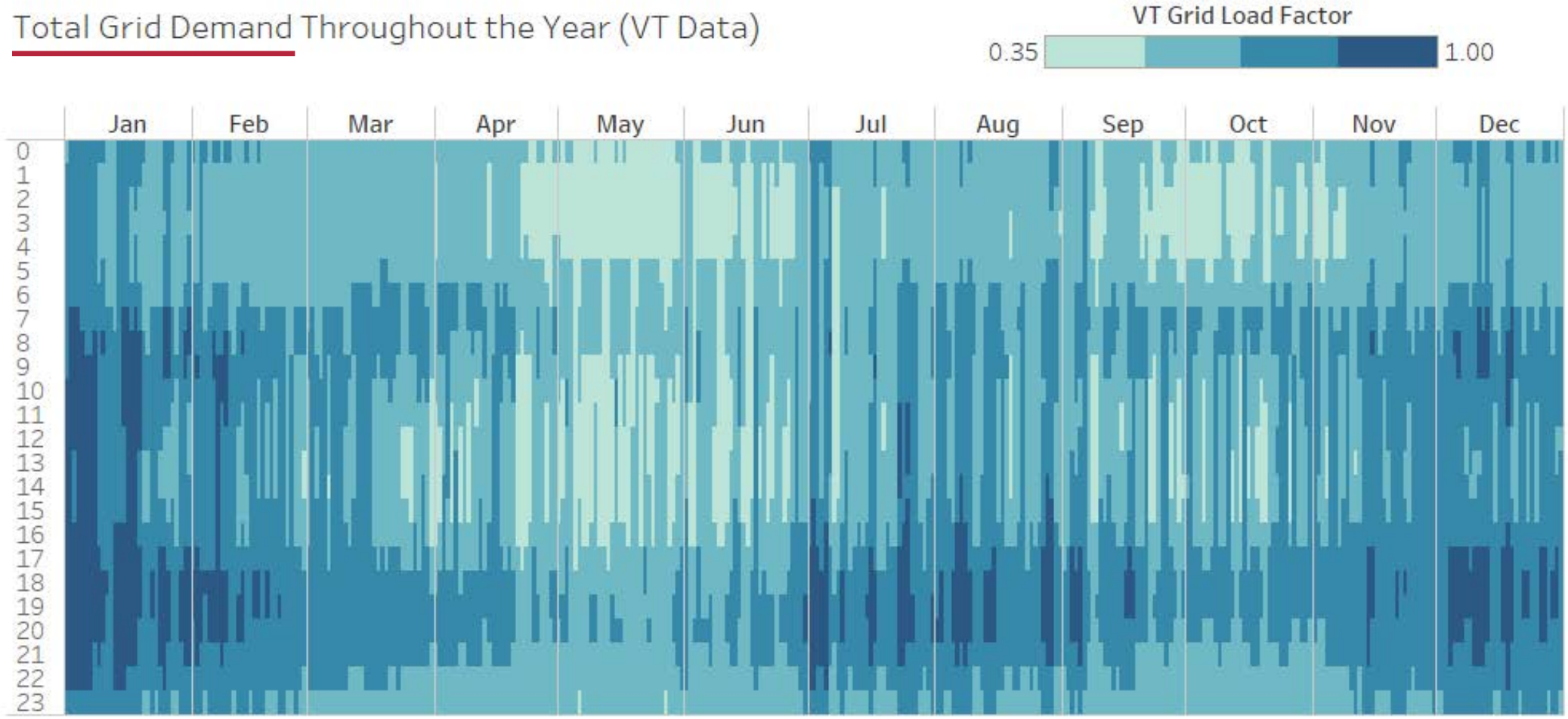
Thermal Energy Storage in a Vermont School

- 20,000 square foot secondary school
- All-electric
- 2,000 gallon thermal storage tank
- What is the benefit of thermal storage?
  - Improved chiller COP
  - Shifting loads away from:
    - peak demand hours (utility $$)
    - higher carbon hours (societal $$)
    - demand response hours (rate savings $$)

Thermal Energy Storage in a Vermont School



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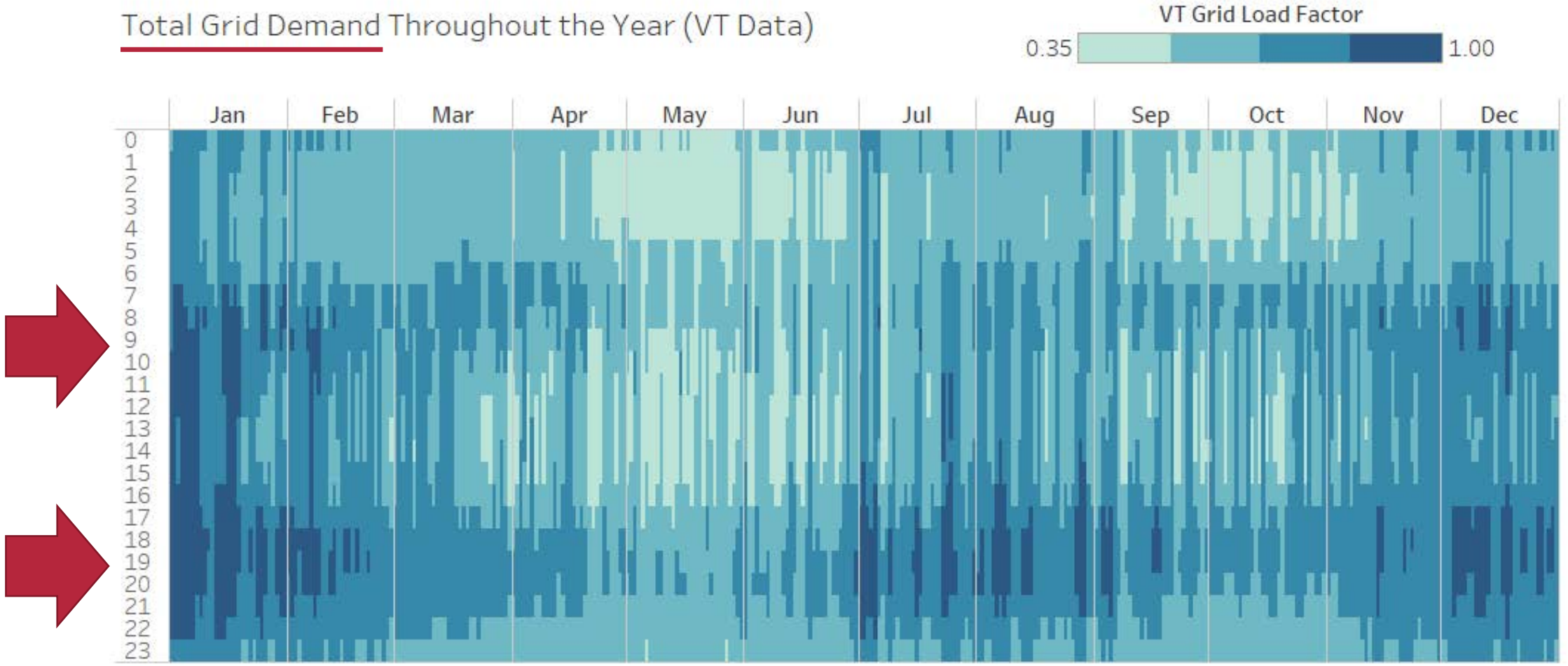
Thermal Energy Storage in a Vermont School



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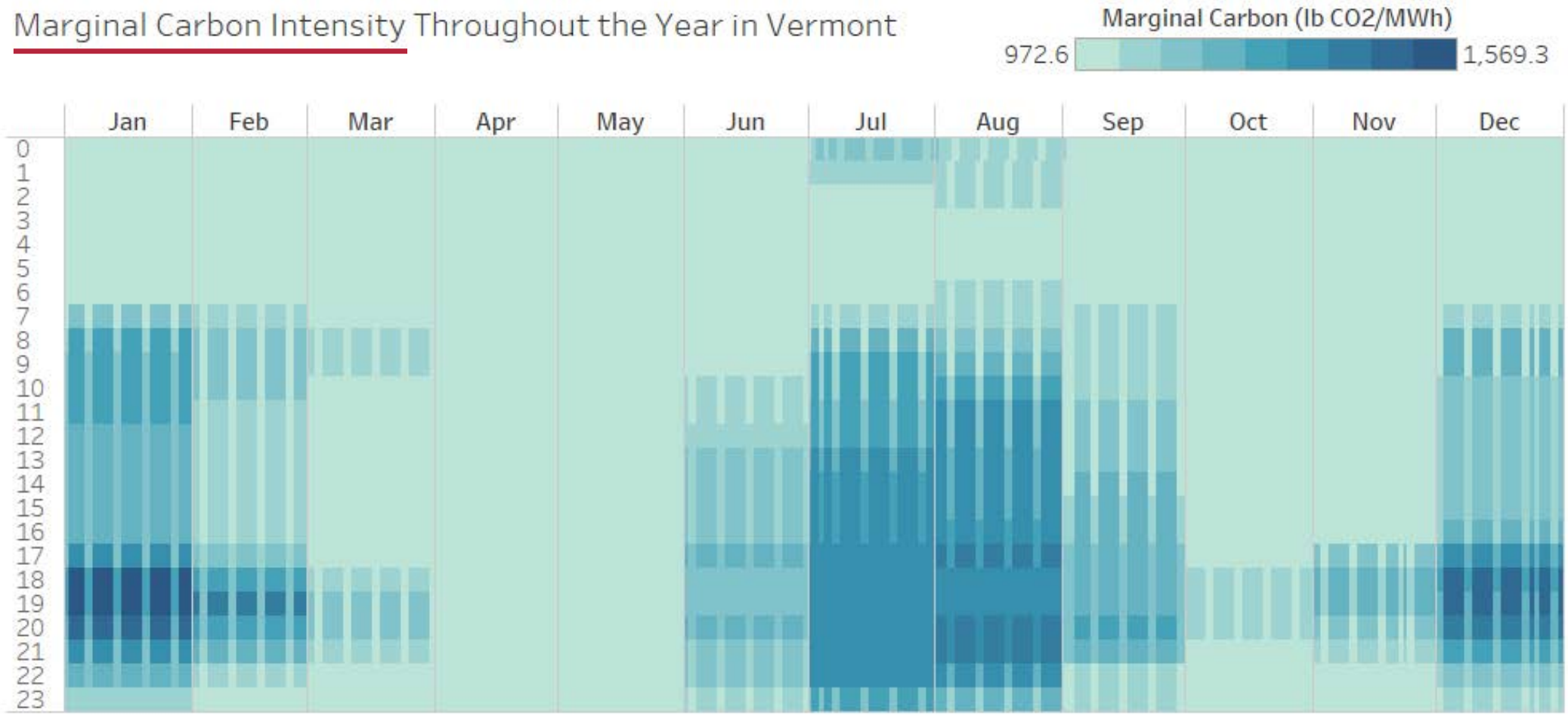

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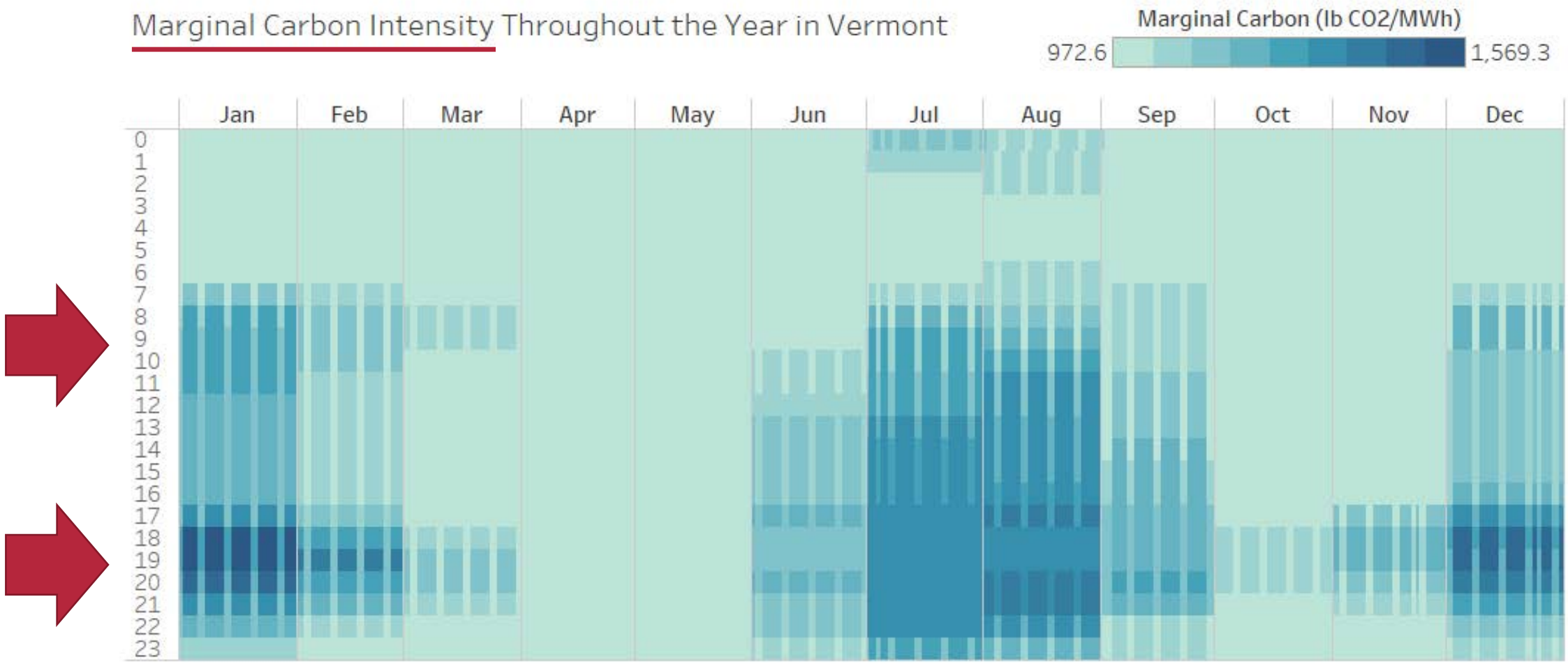
Thermal Energy Storage in a Vermont School



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Thermal Energy Storage in a Vermont School

	Default Deployment	Simple Schedule
Operation	Charge until full Discharge until empty Rinse and repeat	Charge midnight to 7am Discharge 8am to 11am Charge noon to 5pm Discharge 5pm to 10pm
Energy vs. No storage scenario	0.5% Penalty	8.9% Savings
Carbon vs. No storage scenario	0.5% Penalty	9.7% Savings

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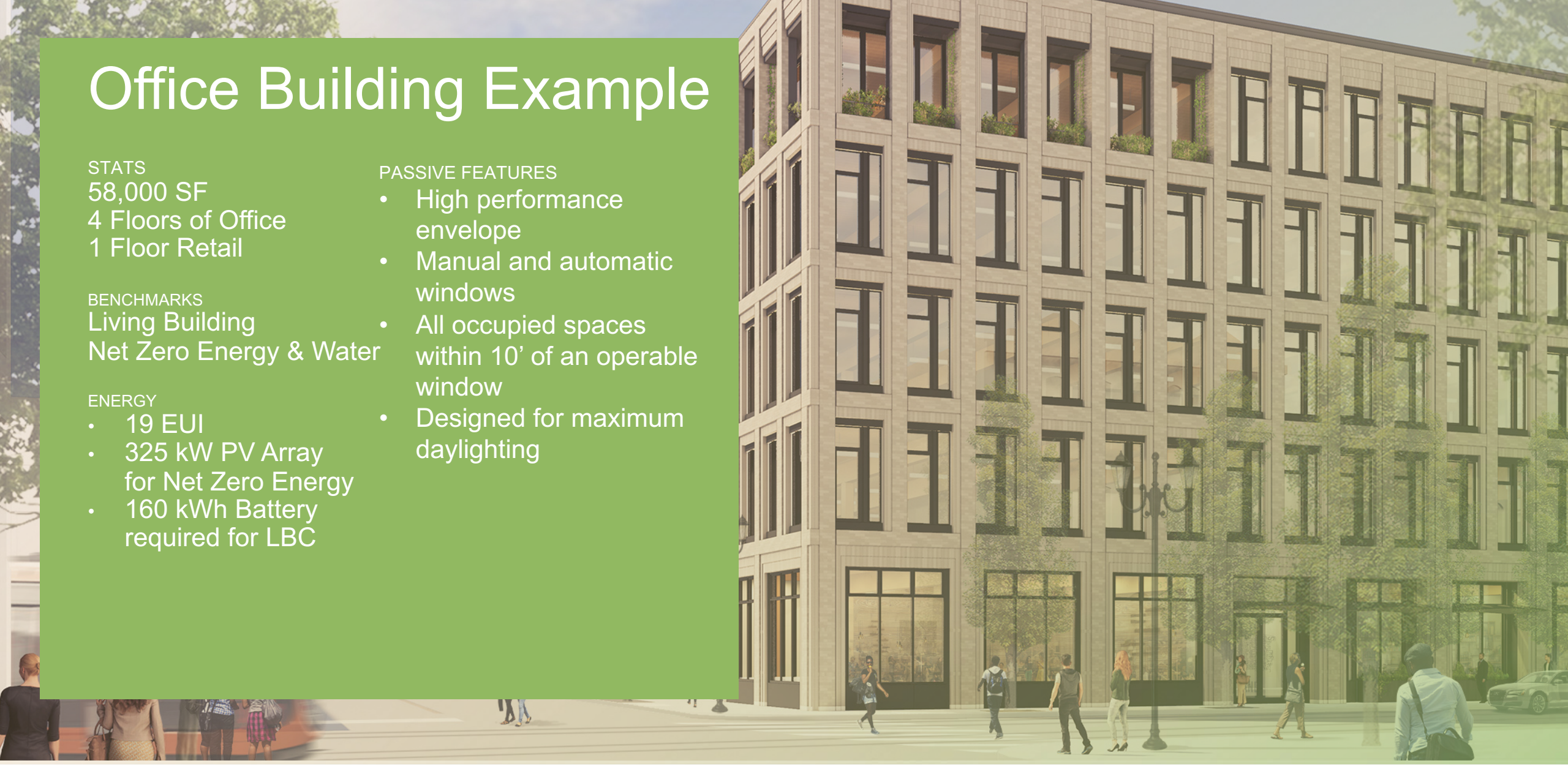
Office Building Example

STATS
58,000 SF
4 Floors of Office
1 Floor Retail

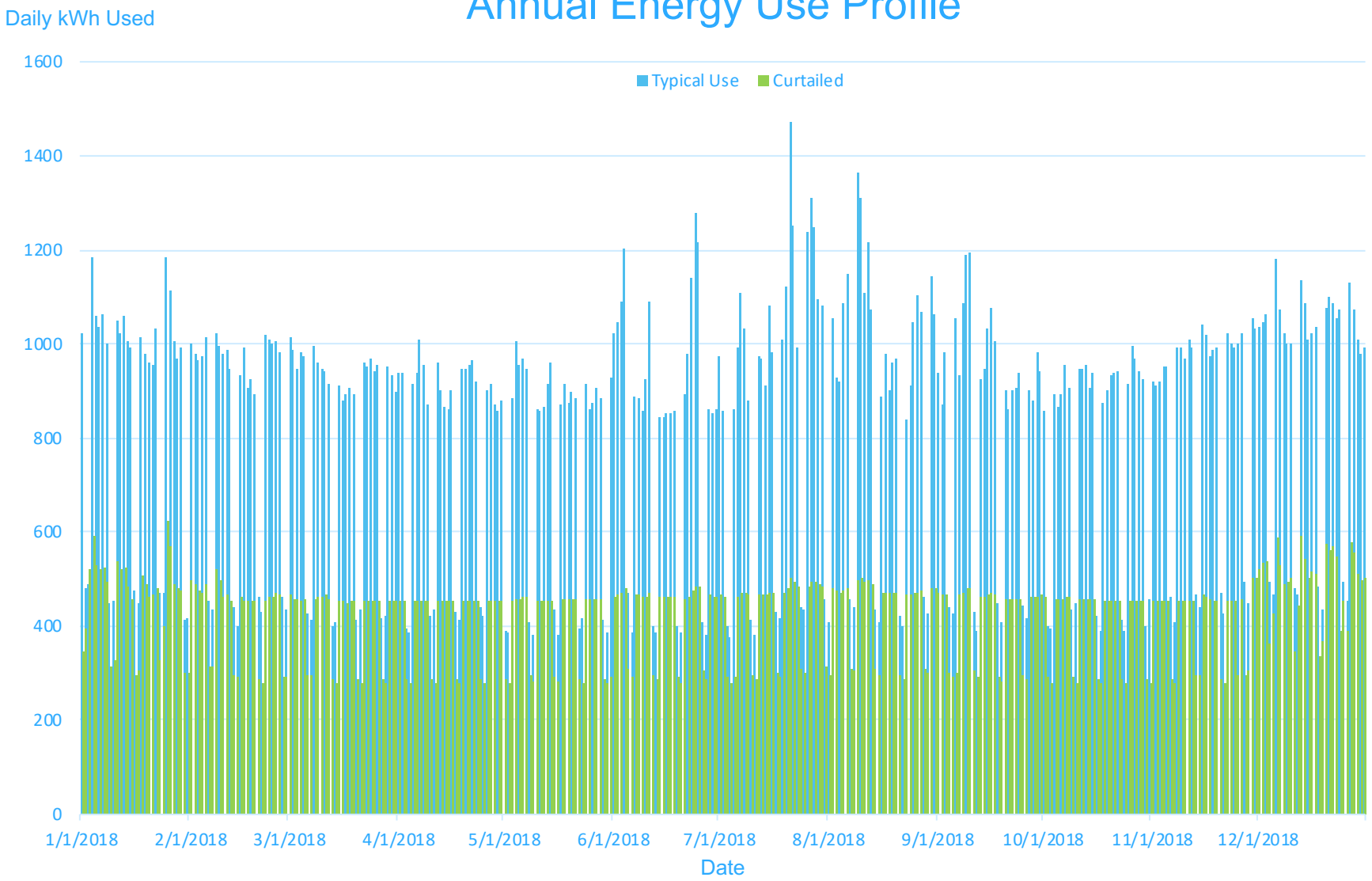
BENCHMARKS
Living Building
Net Zero Energy & Water

ENERGY
- 19 EUI
- 325 kW PV Array for Net Zero Energy
- 160 kWh Battery required for LBC

PASSIVE FEATURES
- High performance envelope
- Manual and automatic windows
- All occupied spaces within 10’ of an operable window
- Designed for maximum daylighting



- Lights Off
- Temperature Set Back
- Ventilation Off
- Plug Loads reduced to laptops only
- Elevator not used
- Cold Domestic Water Only



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Slides: PAE Engineers

- Lights Off
- Temperature Set Back
- Ventilation Off

→ Passive Design Features

70% OF REDUCTION

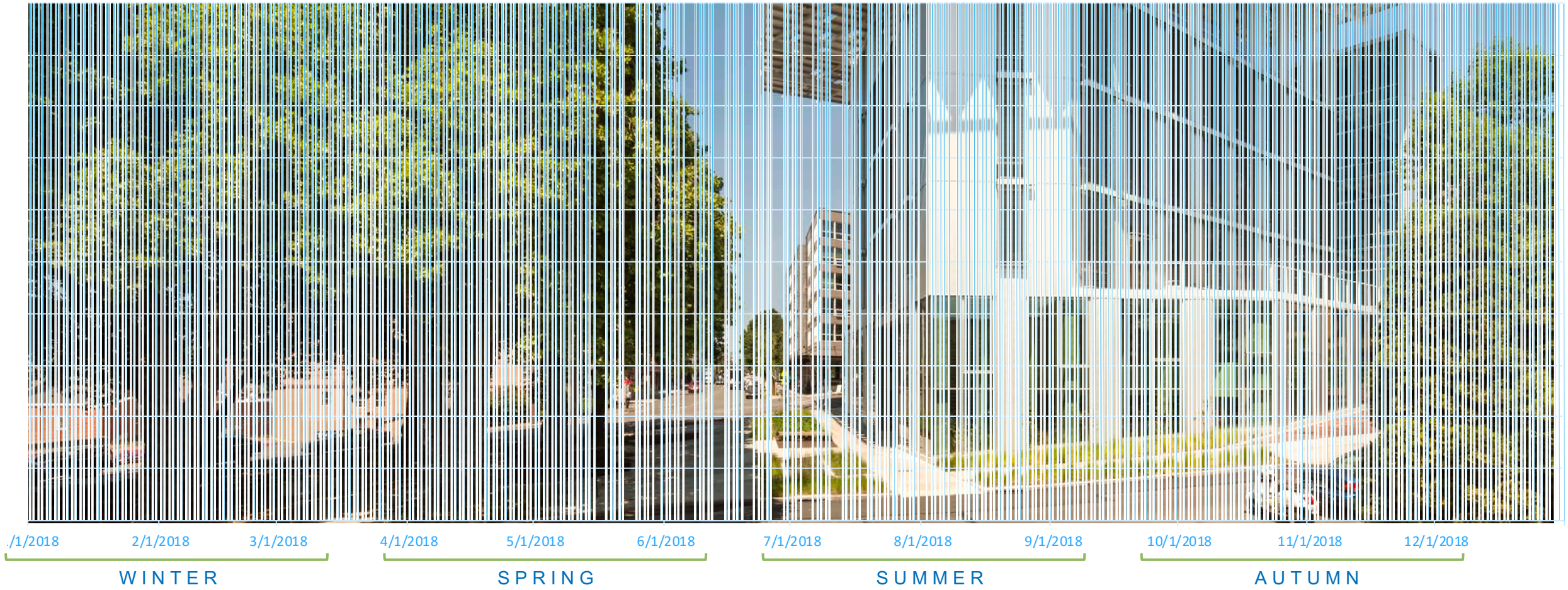
- Plug Loads reduced to laptops only
- Elevator not used
- Cold Domestic Water Only

→ Usage curtailment

30% OF REDUCTION

Days at Risk of an Empty Battery when Islanding

No curtailment, Net Zero with LBC-Size Battery (160 kWh)
8 Resilient Workdays

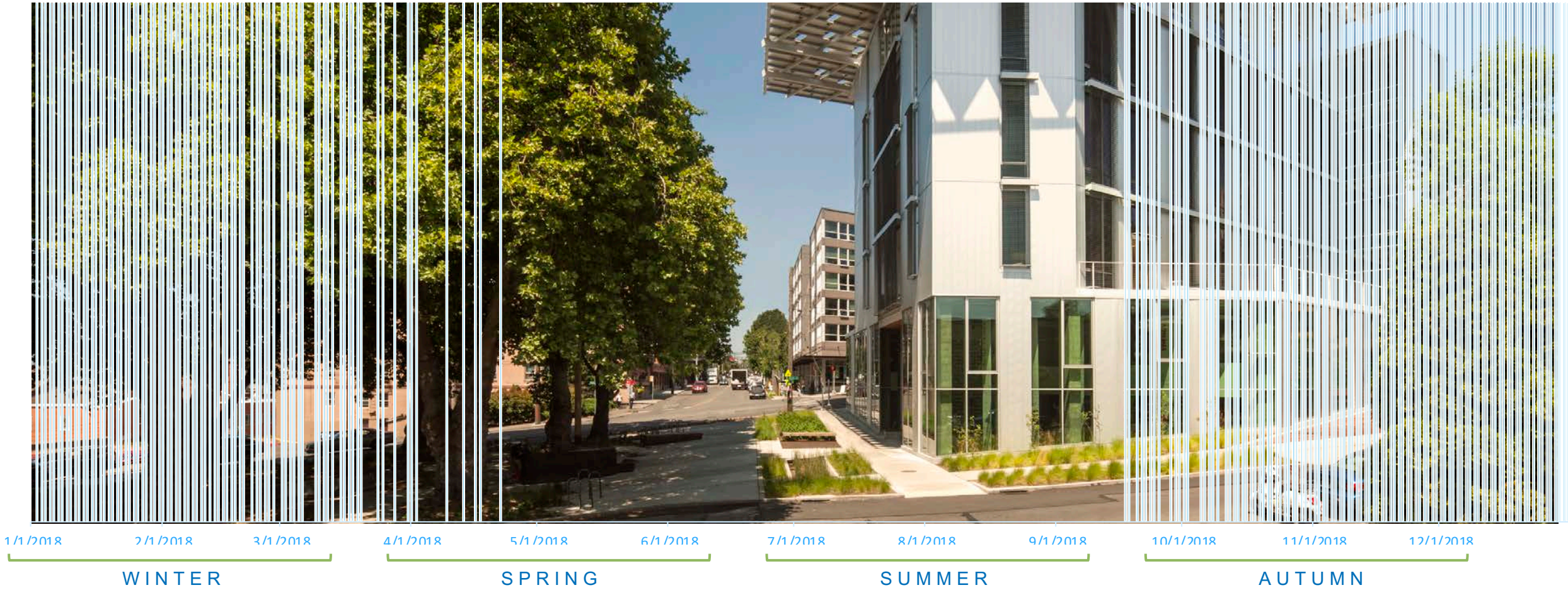


GRIDOPTIMAL™ BUILDINGS INITIATIVE

Slides: PAE Engineers

Days at Risk of an Empty Battery when Islanding

With energy curtailment, Net Zero with LBC-Size Battery (160 kWh 124 Resilient Workdays

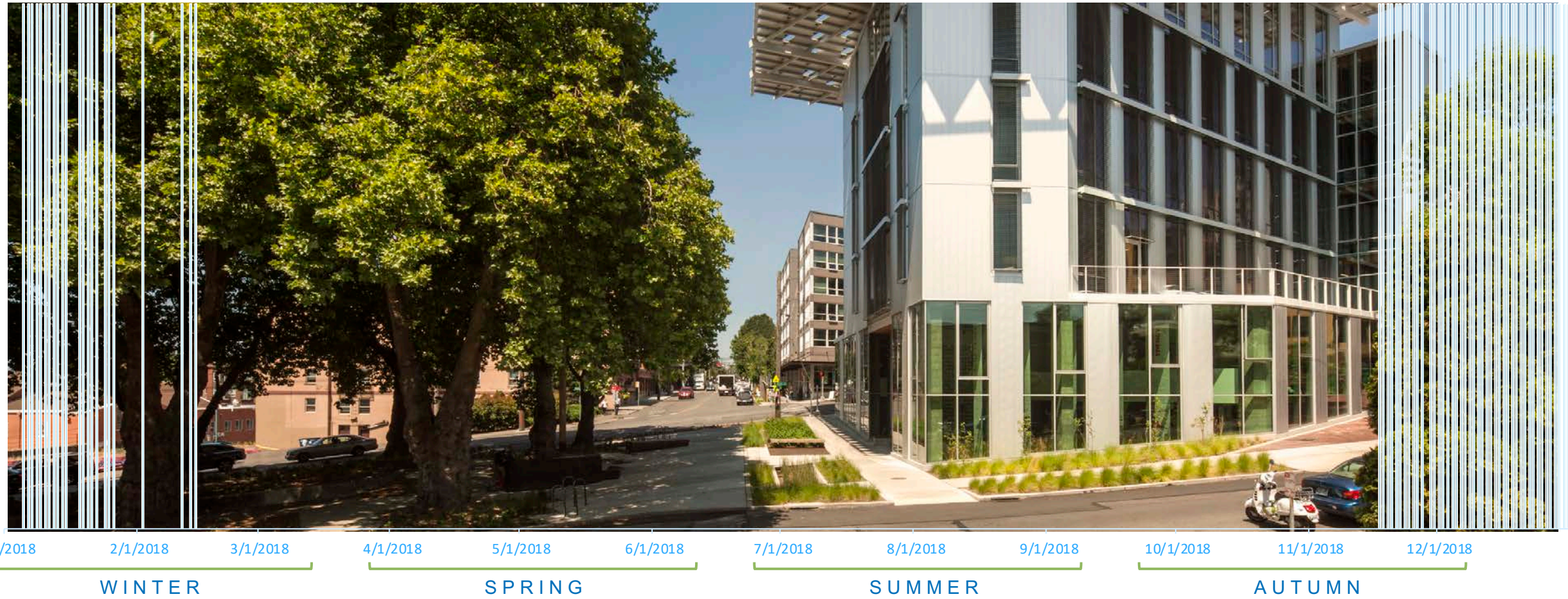


GRIDOPTIMAL™ BUILDINGS INITIATIVE

Slides: PAE Engineers

Days at Risk of an Empty Battery when Islanding

Increase battery from LBC-minimum to about
100% of a typical daily load 1000 kWh
210 Resilient Days



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Slides: PAE Engineers

Looking Ahead

Cincinnati Police Station, Cincinnati, OH | Credit: Darrin Hunter, Dish Design LLC

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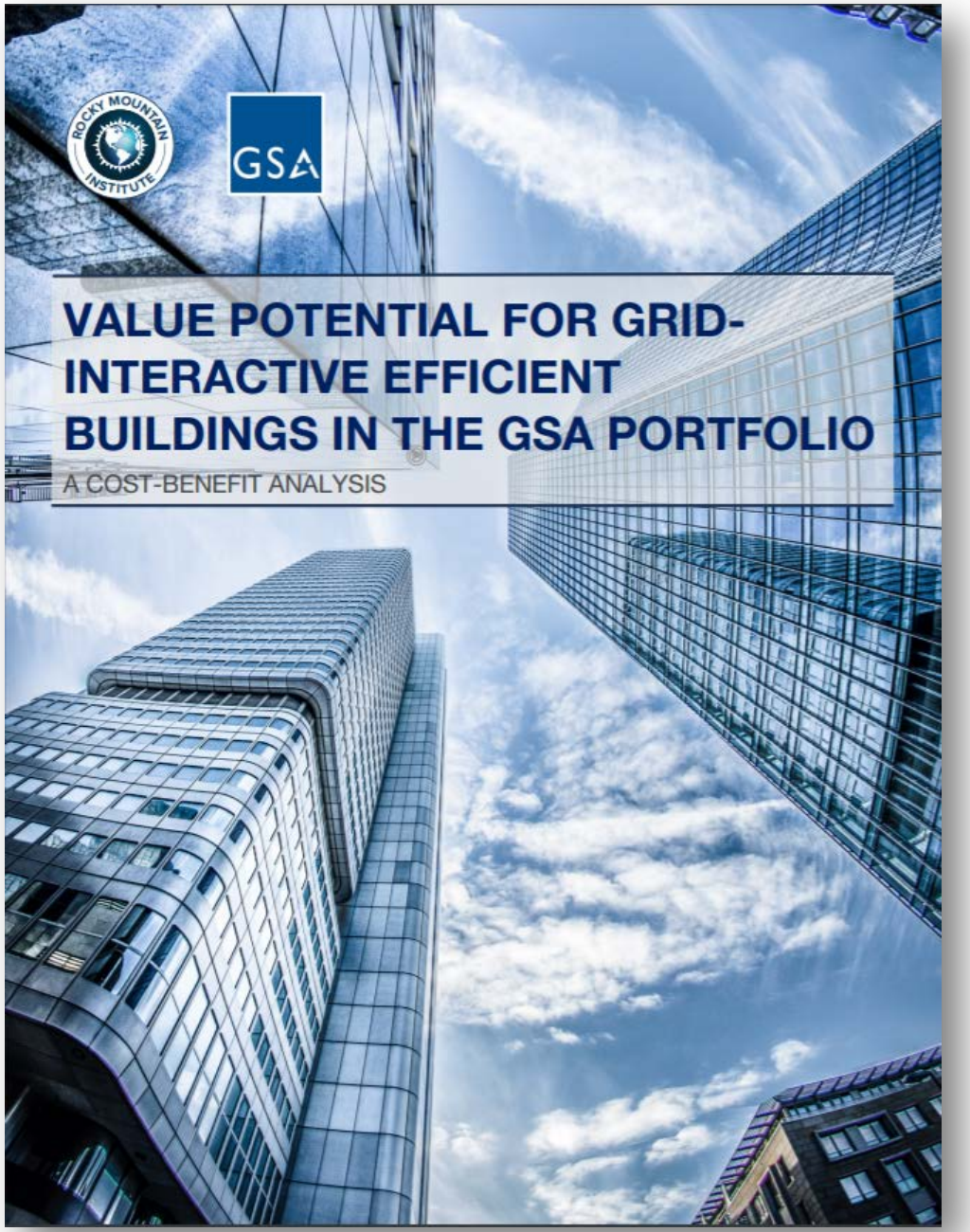
What's coming down the line?

- GridOptimal version 1 metrics expected Q2 2020
- LEED Pilot Credit
- LEED Carbon credit – Grid Harmonization + Energy
- Utility programs
- **Utility rates: Real-time pricing**

Grid-Integration Value

Value Potential - GSA

- $50 million in annual cost savings to the GSA
- $70 million in value to grid users by reducing generation and transmission and distribution costs, benefiting all ratepayers



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Grid Resiliency

Puerto Rico, 9/22/17 (NBC)

Grid Integration Features in Buildings Support Resiliency Goals

- Independent power sources (PV) may allow grid-independent operation (islanding)
- Passive features support building habitability during no-power operation
- Staged start up capabilities can support faster grid recovery after outages
- On-site energy storage can provide emergency support for communities (communication, refrigeration, etc.)

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Call to Action!

What can you do?

- Join the initiative
- Pilot a new project
- Keep an eye out for guidance coming out of the initiative
- Sponsor the upcoming Forum

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San Francisco Public Utilities Commission, San Francisco, CA | Credit: KMD Architects

Interested in Learning More?

Visit the web page: https://newbuildings.org/gridoptimal/

- Factsheets
- Recorded Webinars
- Articles

Join the GridOptimal Buildings Initiative! Make your voice heard and help define the future of buildings and the grid. Contact us:

alexi@newbuildings.org | mark@newbuildings.org

kevin@newbuildings.org

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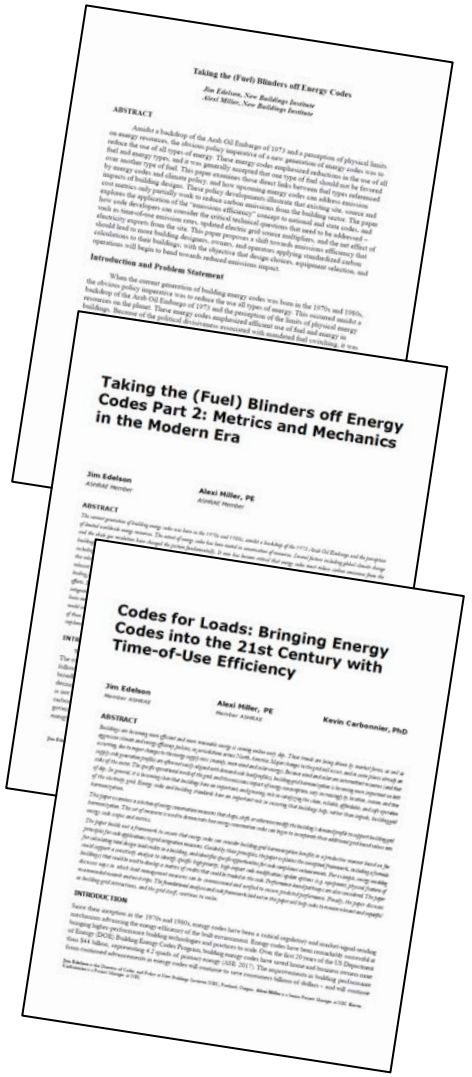
Additional Resources

- New Buildings Institute – GridOptimal Initiative
  - https://newbuildings.org/resource/gridoptimal/
- Rocky Mountain Institute - GEBs Homepage
  - https://rmi.org/gebs
- U.S. General Services Administration – GEBs Advice Letter
  - https://www.gsa.gov/cdnstatic/Bldg%20Grid%20Integration%20Advice%20Letter%202-21-19%20-%20508.pdf
- DOE BTO – GEBs Homepage
  - https://www.energy.gov/eere/buildings/grid-interactive-efficient-buildings
- Berkeley Lab – FlexLab
  - https://flexlab.lbl.gov/
- NASEO/NARUC – States Working Group
  - https://www.naseo.org/issues/buildings/naseo-geb-resources

Codes for Loads Thought Leadership

- Three NBI white papers
  - Alexi Miller, Jim Edelson, & Kevin Carbonnier
- Considering and scoping IECC code proposal(s) for new informative appendix
  - Allows a jurisdiction to select most-critical load hours and credit targeted building load modifications during those hours
- <u>Framework:</u>
  - Sum of LOAD CREDITS ≥ Jurisdiction's threshold
    1. Formula for Load Credits – related to load (kW) modification
    2. Must be Commissioned
    3. Can be minimum requirement or Section 406 credit



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Save the Date!

GETTING TO **zero** FORUM 2021

March 15-17, 2021

New York City

Leading policymakers, design professionals, building owners and commercial real estate representatives, and others will gather at the **2021 Getting to Zero Forum.** Participants will share perspectives on the growth of ZE, learned about best practices for successful projects and collaborated on opportunities for ZE to transform the built environment.

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Thank you!

Ralph DiNola

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San Francisco Public Utilities Commission, San Francisco, CA | Credit: KMD Architects

GREENING THE GRID: GRID FRIENDLY BUILDINGS

February 27th 2020 | 32BJ

SPEAKERS

Ralph DiNola | CEO, New Buildings

Ellen Honigstock | Director of Education, Urban Green Council (Moderator)

Charles Marino | Director of Energy Services, AKF Group

Christopher Wetzel | Associate, Jaros Baum & Bolles

GREENING THE GRID: GRID FRIENDLY BUILDINGS

February 27th 2020 | 32BJ

UNLOCKING THE GRID: GETTING RENEWABLES TO NYC

Join us for Urban Green Council's 2020 Conference – June 17, 2020