

FEDERAL UTILITY PARTNERSHIP WORKING GROUP SEMINAR

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Golden, CO

Net Zero Energy Buildings: Are We There Yet?

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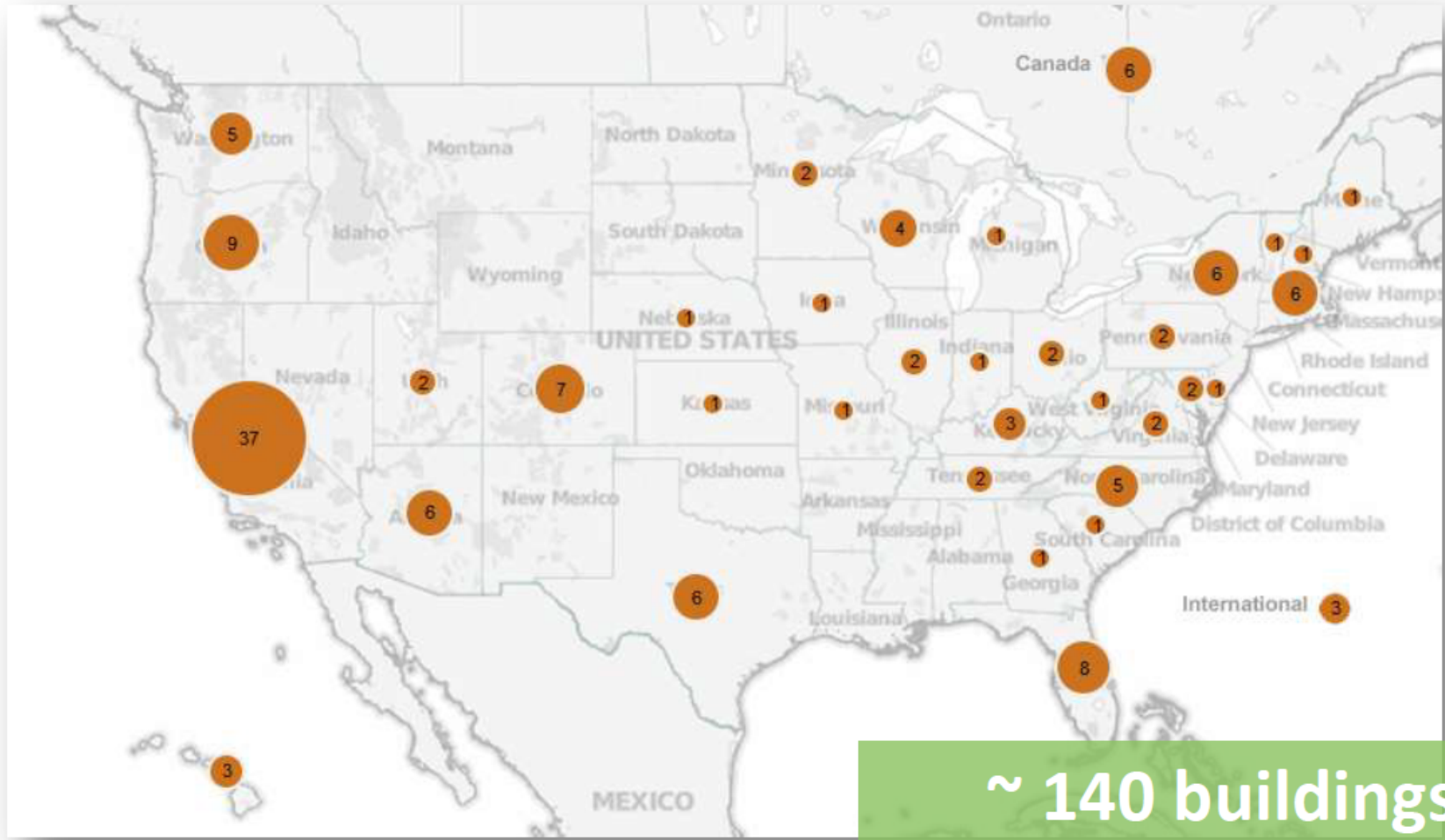
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COMMERCIAL ZEBOS ARE HERE!



Locations: 2013 ZNE Buildings



~ 140 buildings
in 36 states!

2013 Preliminary Results

Current Net Zero Energy Building Drivers

| Organization | Effort Type | Definition |
|--|------------------------|-----------------------------------|
| Living Building Challenge | certification | Site energy |
| Massachusetts | task force | Site energy |
| PG&E | pilot program | Site energy |
| University of California | campus-wide initiative | Emissions (CO ₂ only?) |
| GSA | working group | TBD |
| Federal Government | Executive Order 13514 | Site energy |
| <p><i>“... implement high performance sustainable Federal building design, construction, operation and management, maintenance, and deconstruction including by: (i) beginning in 2020 and thereafter, ensuring that all <u>new Federal buildings</u> that enter the planning process are designed to <u>achieve zero-net-energy</u> by 2030 ...” (Sec. 2. Goals for Agencies. (g)(i))</i></p> | | |

OBERLIN COLLEGE LEWIS CENTER



13,600 SF

Higher Education

Oberlin, OH

2000

Image courtesy of NREL PIX

HAWAII GATEWAY ENERGY CENTER

The image shows the exterior of the Hawaii Gateway Energy Center. A wide, multi-tiered concrete staircase with metal handrails leads up to the building's entrance. The building features a dark, textured facade and large windows with teal-colored frames. A prominent white metal truss canopy structure extends over the entrance area. The foreground is a dark asphalt surface, and the background shows a landscape with palm trees and a cloudy sky.

3,600 SF
Interpretive Center
Kona, HI

2005

DeAs Z SQUARED BUILDING

10,000 SF
Office Building
San Jose, CA

Image courtesy of EHDD Architecture

2007



LIVING LEARNING CENTER (TYSON RESEARCH CENTER)



2,968 SF

Higher Education

Eureka, MO

Image courtesy of inhabitat.com

2009

OMEGA CENTER FOR SUSTAINABLE LIVING



6,246 SF

Interpretive Center

Rhinebeck, NY

Image courtesy of BNIM

2009



LARGE SCALE
NET ZERO ENERGY

NREL RESEARCH SUPPORT FACILITY

A photograph of the NREL Research Support Facility building at dusk. The building is a large, modern structure with a mix of brick and light-colored panels. The sky is a deep blue, and the building's windows are illuminated from within. The foreground shows a paved courtyard area with some landscaping.

220,00 SF
Office Building
Golden, CO

Image courtesy of RNL

2010

NREL RSF THIRD WING



138,000 SF
Office Building
Golden, CO

2011

Image courtesy of RNL

SACRAMENTO MUNICIPAL UTILITY DISTRICT



335,000 SF

SMUD EAST CAMPUS - OPERATIONS CENTER
9750 KIEFER BOULEVARD

Office and Shop Buildings
Sacramento, CA

2013

Image courtesy of RNL and Stantec



Photovoltaic Array

EXPLORATORIUM AT PIER 15

A nighttime photograph of the Exploratorium at Pier 15 in San Francisco. The building is a modern, multi-story structure with a large glass facade that is brightly lit from within, revealing interior exhibits. The building is situated on a pier over the water, supported by numerous concrete pillars. In the foreground, a long, dark metal pipe runs along the pier. To the right, a covered walkway with a grid ceiling and warm lighting is visible. The sky is a deep blue, and the water reflects the lights from the building and the pier.

330,000 SF
Museum
San Francisco, CA

Image courtesy of EHDD Architecture and Integral Group

2013

DAVID AND LUCILE PACKARD FOUNDATION

40,000 SF
Office Building
Los Altos, CA

Image courtesy of EHDD Architecture and Integral Group

2013

BULLITT CENTER



50,000 SF
Office Building
Seattle WA

Image courtesy of Bullitt Foundation and Miller Hull Partnership

2013

WAYNE ASPINALL FEDERAL BUILDING



40,000 SF

Historic Renovation

GSA Courthouse

Grand Junction, CO

Image courtesy of GSA, Beck Group and Westlake Reed Leskosky

2013







COMMUNITY SCALE



GREENSBURG, KS
Rebuilding...
STRONGER, BETTER, GREENER!
www.greensburgks.org • www.facebook.com/greensburgkansas



Net Zero at What Scale?

- Net Zero for single projects (residential and commercial) is being done now
- Opportunity to ramp up single project net zero capabilities to a larger scale
- Net Zero Campus/Community/Base
 - Take advantage of energy systems integration
 - Reduce costs through economies of scale
 - \$/watt for PV is significantly less when procured as a larger buy
 - Account for load diversity in district heating and cooling systems
 - Development guidelines to ensure best practices are put in place
 - Integrate other loads into the net zero boundary
 - Transportation
 - Food
 - Industry

*Net Zero is appropriate at ALL scales!
But especially at the scale you are working at...*

NREL CAMPUS



Net Zero Campus Efforts at NREL

NREL Campus Net Zero by 2020 is the Goal!

- All new facilities net zero
 - Low-load facilities net zero on site
 - 360,000ft² office buildings, Site entrance buildings, parking garage offsets for office buildings
 - High load facilities best-in class efficiency
 - Off-site new large scale wind
- Retrofit of old facilities
 - Lab continuous control improvements
 - Lighting upgrades from T12 to LED
- Wood chip fired district hot water system
- Large Scale Campus Renewables
 - Wind, solar
- Development of a Net Zero Campus energy model
 - Integrated model for buildings, electrical transportation, thermal district system, electrical distribution system
- Net Zero Campus Informatics

What Had to Change?

- Top-down requirement for energy priority, on par with project schedule, budget, and quality
- Organization-wide involvement and continuous communication about NZEB performance

| Aspect | NZEB Distinction |
|---|--|
| NZEB procurement | Integrate NZEB and energy use intensity requirements into project contracts |
| Design and modeling | Require use of advanced energy modeling tools to understand how all design decisions impact NZEB goals |
| Energy efficiency robustness | Develop understanding of risks associated with each energy efficiency technology prior to implementation |
| Aggressive plug and process load reduction | Engage user groups and all procurement activities to ensure that highest efficiency equipment is installed and is only on when actually needed |
| Renewable energy integration | Plan early for large PV arrays on roof area and over site parking |
| Energy performance assurance | Provide metering and performance feedback, occupant education, change management for occupants and future programming, community outreach |

Who Had to Change?

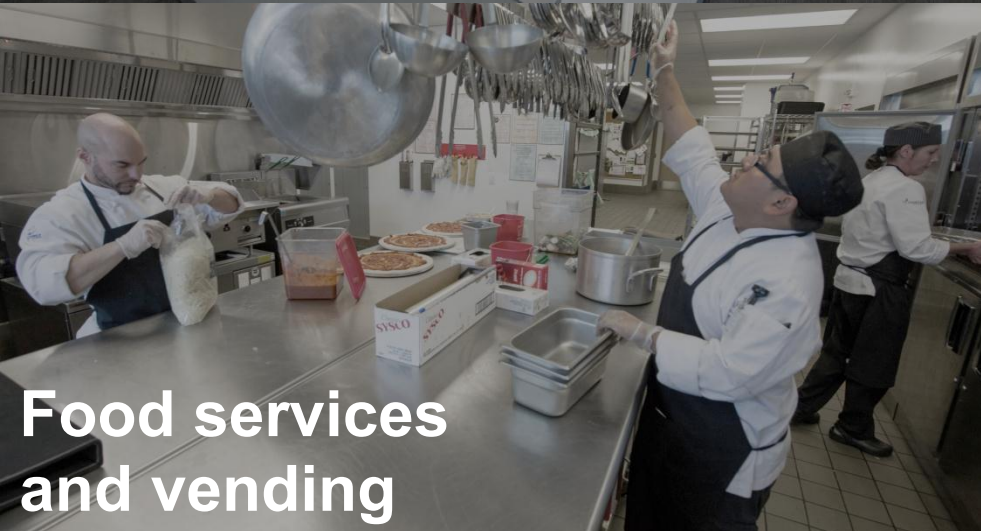
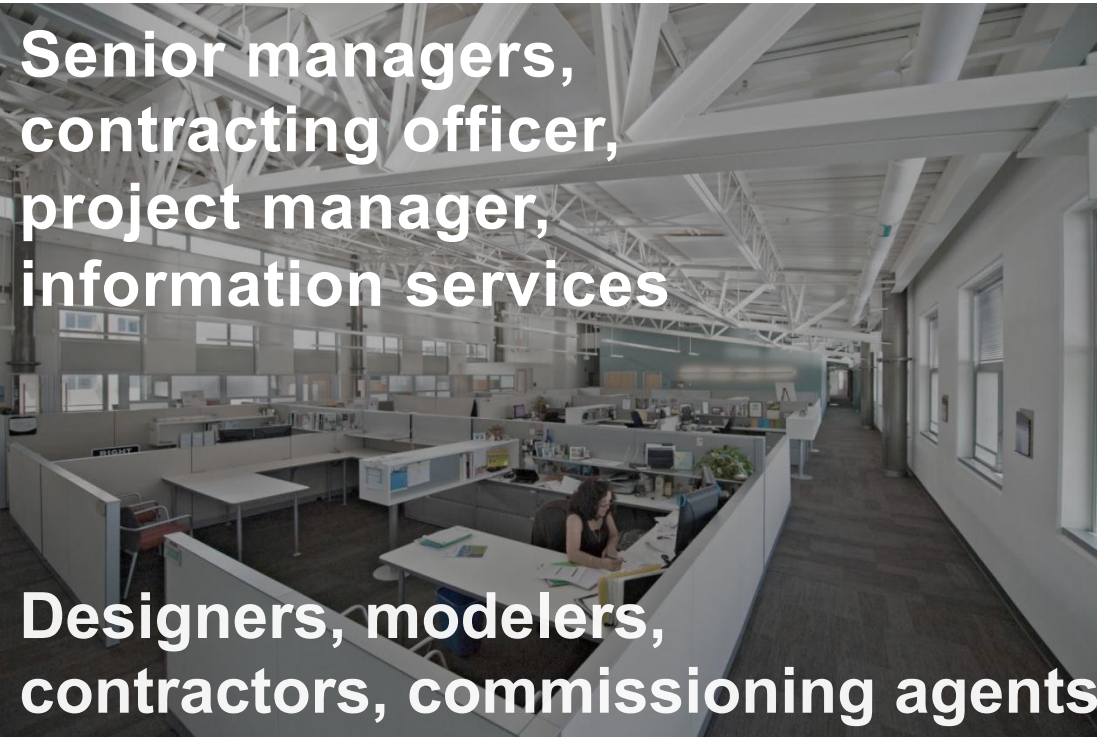
Senior managers,
contracting officer,
project manager,
information services

Designers, modelers,
contractors, commissioning agents

Building occupants

Food services
and vending

Building manager,
operations and
maintenance, utilities,
custodial, security



Feasibility of Net Zero Energy Buildings

- Case studies show that net zero energy buildings (NZEBS) can be procured with a 0%–10% premium on typical construction costs
- Payback periods of 12–15 years for higher modeled premiums (NBI 2012)
- Based on NREL's experience and results from case studies, the lower bounds of initial capital cost premium are possible when a project team:
 - Selects energy efficiency as a project priority
 - Integrates simple and passive efficiency strategies
 - Downsizes or eliminates heating, ventilation, and air conditioning (HVAC) equipment based on passive envelope design
 - Specifies readily available and tested technology
 - Implements experimental strategies only when necessary
 - Maximizes the use of modular and repeatable design strategies

Executive Order 13514 Goals

“... establish an integrated strategy towards sustainability in the Federal Government and to make reduction of greenhouse gas emissions a priority for Federal agencies ...” (Preamble)

“... implement high performance sustainable Federal building design, construction, operation and management, maintenance, and deconstruction including by: (i) beginning in 2020 and thereafter, ensuring that all new Federal buildings that enter the planning process are designed to achieve zero-net-energy by 2030 ...” (Sec. 2. Goals for Agencies. (g)(i))

NZEBs Are Next Logical Step For NASA



NASA ZEB Roadmap

To guide NASA's incremental transition to developing and operating NZEBs as Agency standard practice

Strategic

- Establish clear interpretation of EO 13514 sections related to NZEBs

Organizational Proficiencies

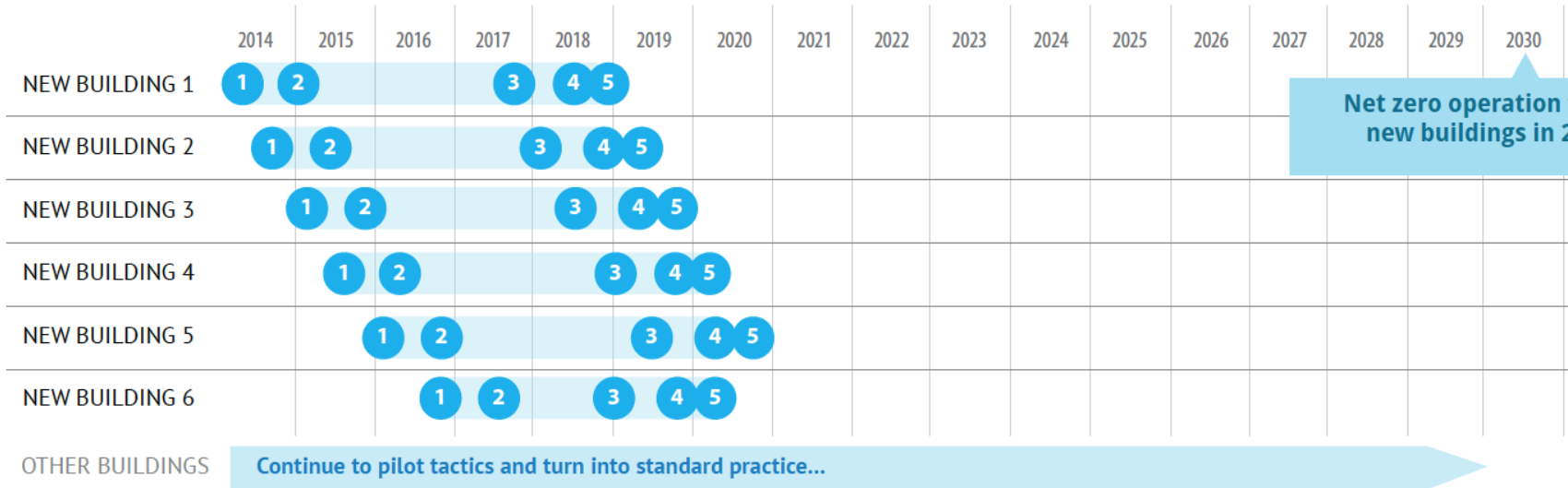
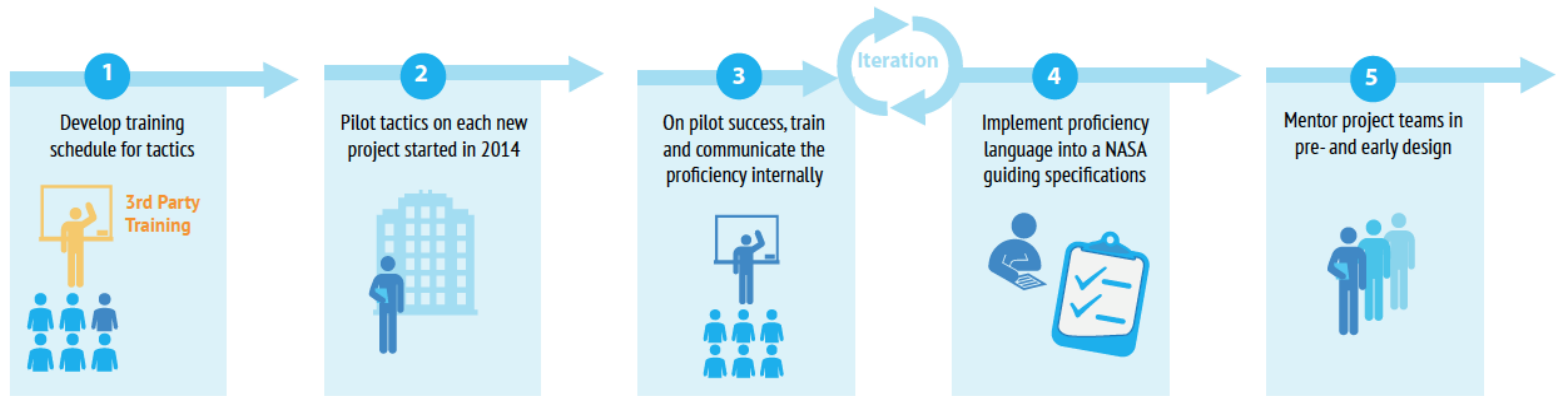
- Identify 6 key proficiencies essential to NASA's transition to NZEBs

Tactical

- Prioritize 57 tactics for Agency-level and building-level transition

| Proficiency | Tactic Count | Example Tactic |
|---------------------|--------------|--|
| NZEB Workflow | 8 | Define performance assurance capability |
| Acquisition Process | 12 | Use integrated project delivery process |
| Energy Efficiency | 20 | Use passive design strategies |
| Renewable Energy | 6 | Apply NZEB classification process |
| Operations | 9 | Require submetering of building end uses |
| Achieve NZEB | 2 | Incorporate tactics to achieve NZEB design |

Time-Phased Approach



Net zero operation for all new buildings in 2030

Application of Executive Order 13514 For NASA

NZEB definition: annual, **site energy goal** for new buildings

Step 1. Best-in-class energy efficiency (EE), demand-side energy use intensity (EUI)

50% reduction versus ASHRAE Standard 90.1-2010 starting in 2020

Step 2. Maximize zero-emitting roof/building-integrated RE

All buildings meet a minimum 20% of the RE requirement at this step

Step 3. Maximize zero-emitting site/center RE

All low-load buildings should meet NZEB design at this step

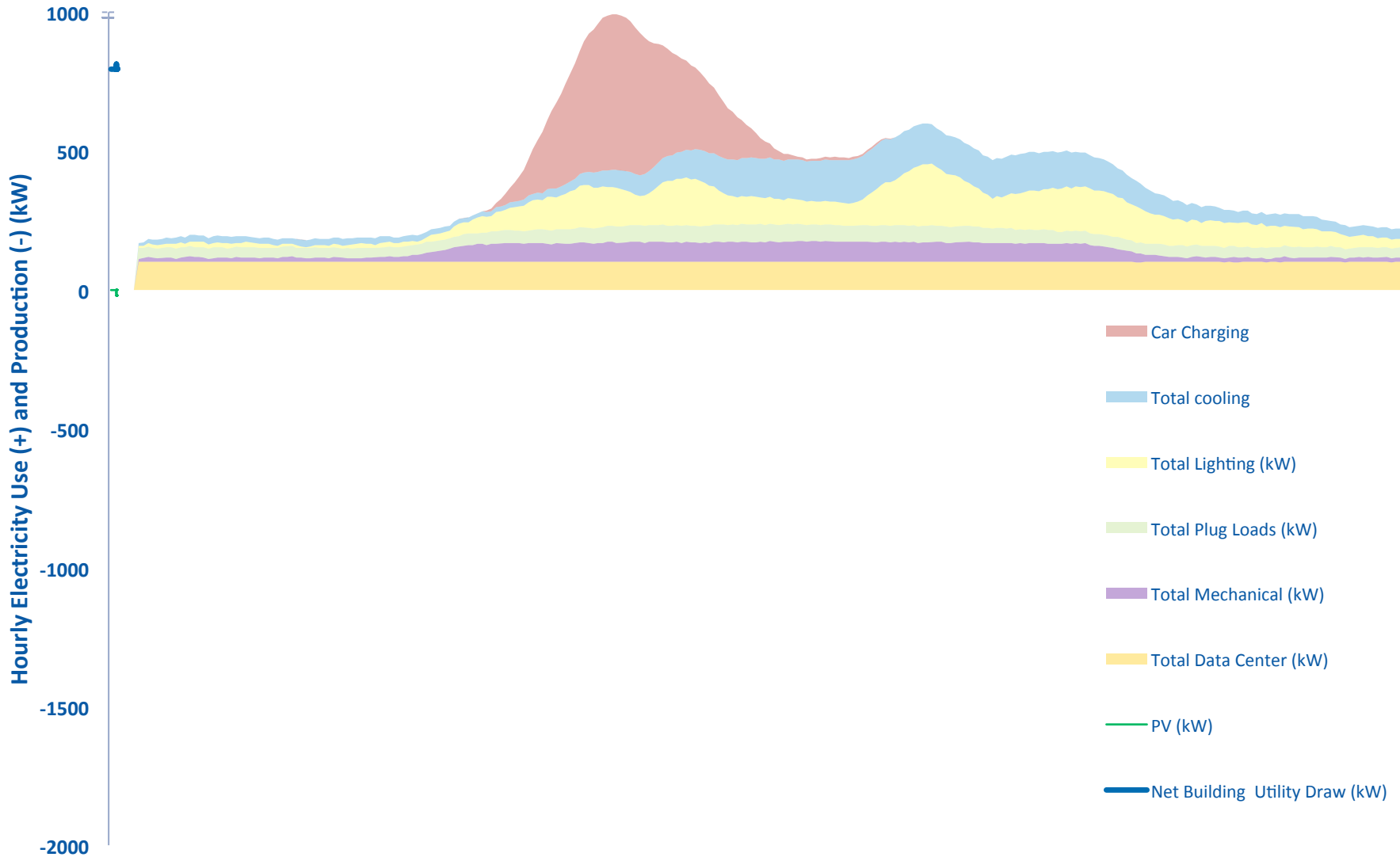
Step 4a. Consider imported RE from offsite

Evaluate current federal requirements and benefits beyond NZEB compliance, and perform a greenhouse gas LCA with guidance from EMD

Step 4b. Consider purchase of regional utility “green power”

Maximum 20% power purchase credits versus the RE requirement

Uncontrolled Load Profile for a Net Zero Office Building



Thanks and Questions

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