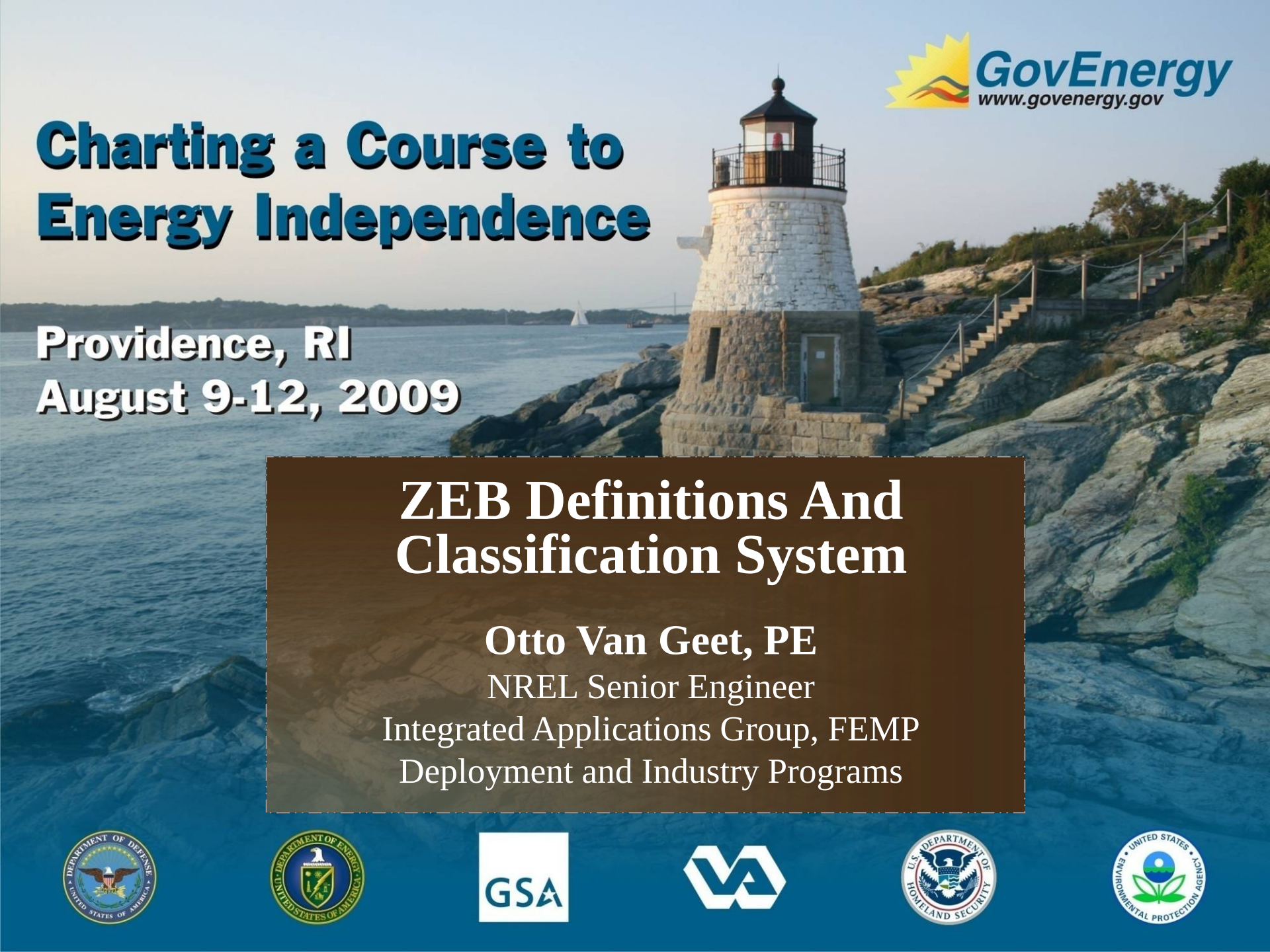

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Charting a Course to Energy Independence

Providence, RI
August 9-12, 2009

# ZEB Definitions And Classification System

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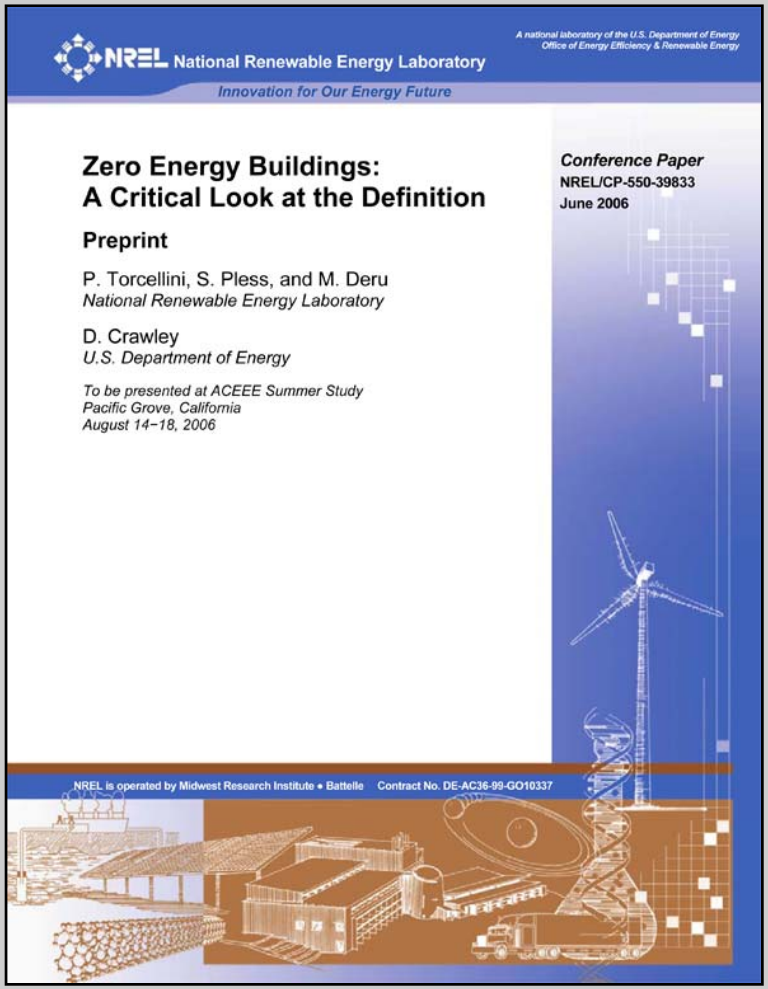
# National Renewable Energy Lab




- Zero Energy Buildings: A Critical Look at the Definition
- Assessment of the Technical Potential for Achieving Net Zero-Energy Buildings in the Commercial Sector
- Zero Energy Building: A Classification System Based on Renewable Energy Supply Options

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# ZEB Definitions

- Net Zero **Site Energy** Building
- Net Zero **Source Energy** Building
- Net Zero **Energy Cost** Building
- Net Zero **Energy Emissions** Building

# ZEB Hierarchy

**Supply-Side**

0. Reduce site energy though low-energy building technologies

**On-Site Supply**

1. Renewable energy within building footprint
2. Renewable energy within site

**Off-Site Supply**

3. Renewable energy off site to generate energy on site
4. Purchase off-site renewable energy sources

From NREL technical paper Zero Energy Buildings: A Classification System based on Renewable Energy Supply Options

# ZEB Renewable Energy Supply Option Hierarchy

| ZEB Classifications | Option Number | ZEB Supply-Side Options | Examples |
|---|---|---|---|
| | 0 | Reduce site energy use through low-energy building technologies | Daylighting, high-efficiency HVAC equipment, natural ventilation, evaporative cooling, ground source heat pumps, etc. |
| | **On-Site Supply Options** | | |
| **ZEB:A** | 1 | Use renewable energy sources available within the building's footprint | PV, solar hot water, and wind located on the building. |
| **ZEB:B** | 2 | Use renewable energy sources available at the building site and connected to the building electrical or hot water distribution system | PV, solar hot water, low-impact hydro, and wind located on parking lots, adjacent open space, etc, but not on the building. RE output directly connected to building systems. |
| | **Off-Site Supply Options** | | |
| **ZEB:C** | 3 | Use renewable energy sources available off site to generate energy on site | Biomass, wood pellets, ethanol, or biodiesel that can be imported from off site, or waste streams from on-site processes that can be used on-site to generate electricity and heat. |
| **ZEB:D** | 4 | Purchase certified off-site renewable energy sources | Utility-based wind, PV, emissions credits, or other "green" purchasing options, as certified by programs such as Green-E. Hydroelectric is sometimes considered. |

# ZEB Renewable Energy Supply Option Hierarchy

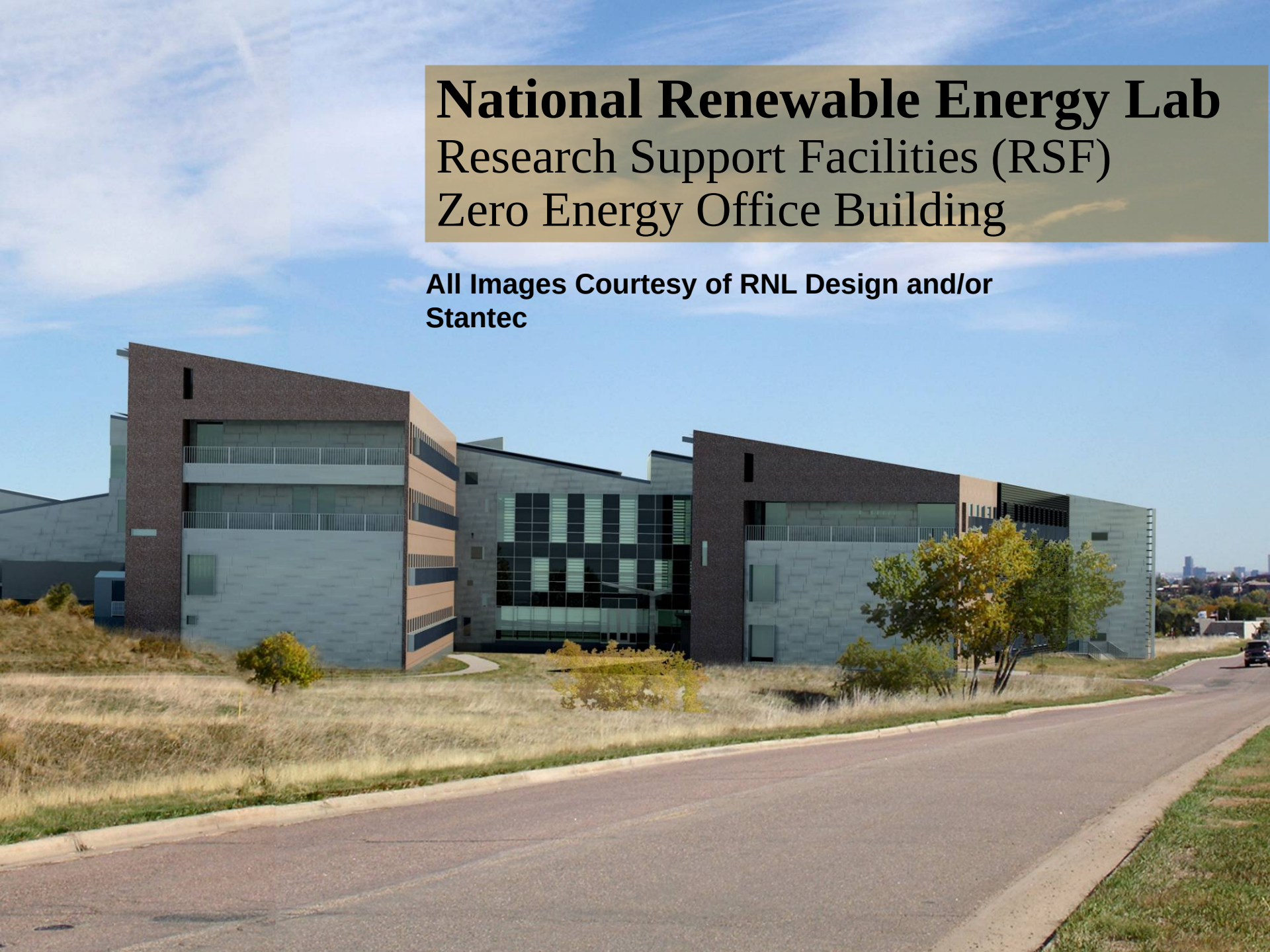
| ZEB Classifications | Option Number | ZEB Supply-Side Options | ZEB Definitions |
|---|---|---|---|
| | 0 | Reduce site energy use through low-energy building technologies | |
| | **On-Site Supply Options** | | |
| **ZEB:A** | 1 | Use renewable energy sources available within the building's footprint | Yes: ZEB Site, ZEB Source, ZEB Cost, ZEB Emissions |
| **ZEB:B** | 2 | Use renewable energy sources available at the building site and connected to the building electrical or hot water distribution system | Yes: ZEB Site, ZEB Source, ZEB Cost, ZEB Emissions |
| | **Off-Site Supply Options** | | |
| **ZEB:C** | 3 | Use renewable energy sources available off site to generate energy on site | Yes: ZEB Site,<br>Difficult: ZEB Source, ZEB Cost, and ZEB Emissions |
| **ZEB:D** | 4 | Purchase recent certified off-site renewable energy sources that result in additional generation added to the grid | Yes: ZEB Source, ZEB Emissions<br>Difficult: ZEB Cost<br>No: ZEB Site |

# National Renewable Energy Lab

## Research Support Facilities (RSF)

## Zero Energy Office Building

**All Images Courtesy of RNL Design and/or Stantec**

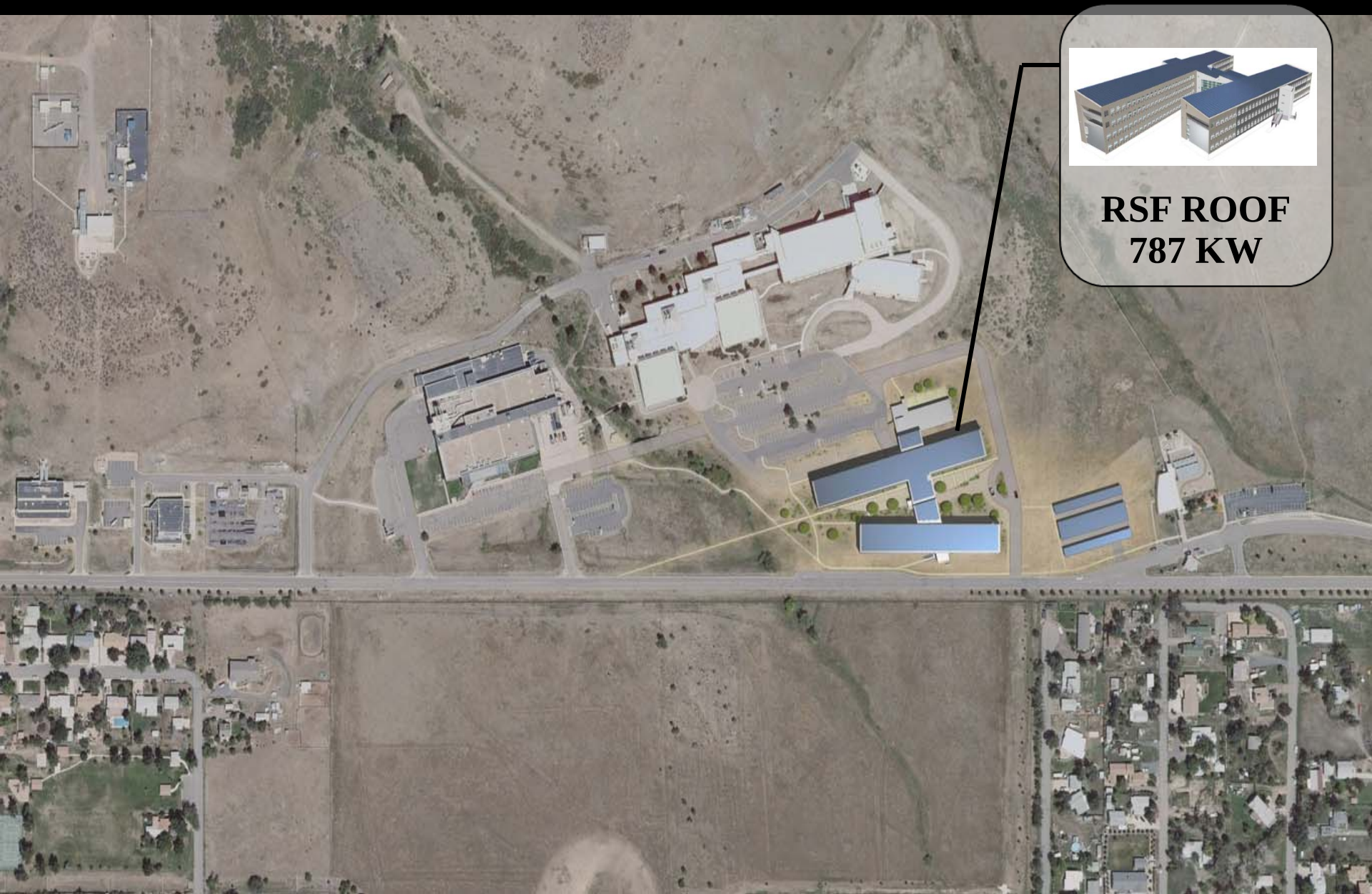


# Research Support Facility (RSF)

## Use of renewable/recycled energy

- Roof is PV array
- 25,000 BTU/sq ft
- Includes everything, even the datacenter
- Renewable Fuels Heating Plant
- Model for new buildings
- Contains NREL Data Center – uses waste heat from Data Center to help heat building

# Site, Source, Cost, Emissions ZEB:A



# Site, Source, Cost, Emissions ZEB:B

# Site, Source ZEB:C

**NREL Wood Chip Boiler**

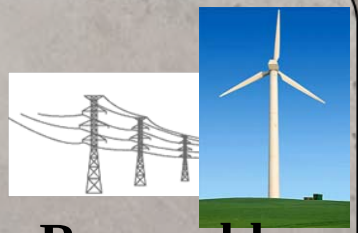
**RSF ROOF 500 KW**

**RSF PARKING 100KW**

# Source, Emissions ZEB:D

Renewable Fuels Heating Plant

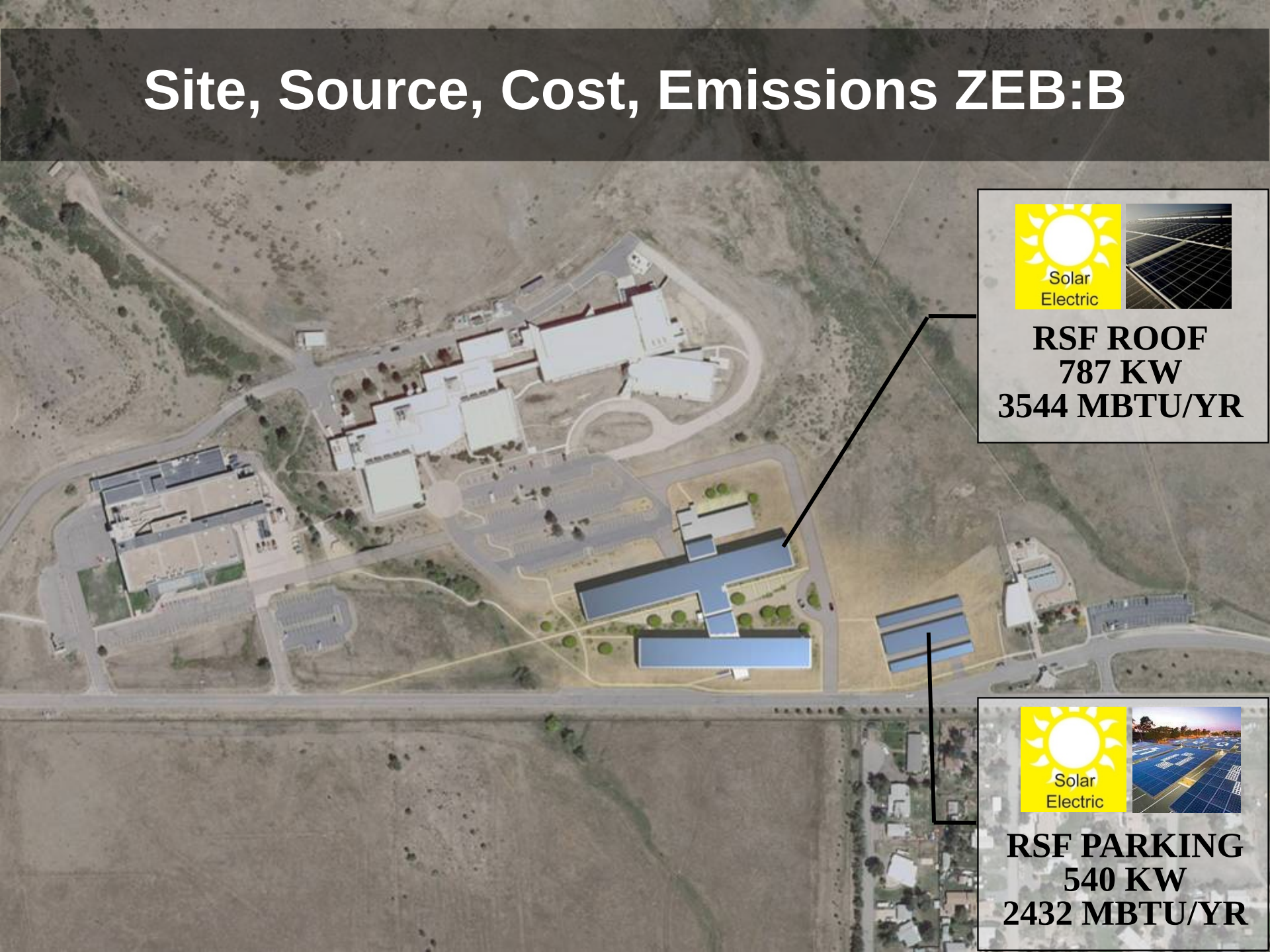
RSF ROOF 100 KW



Renewable Energy Credits

RSF PARKING 100KW

# Site, Source, Cost, Emissions ZEB:B



# Next Step: What is a Net Zero Energy Campus

- Uses energy derived from a renewable source to meet 100% of the “direct uses” of energy within the boundary of the campus for all buildings, campus infrastructure (energy for water, waste, lighting, etc) and transportation systems.
- First step is energy efficiency, once it is fully exploited, supplement with renewable energy (first on-site and then off-site). The time frame to reach zero can be phased as long as it is defined.
- See NREL technical report: “A Definition of a “Zero Net Energy” Community”
- Work funded in part by FEMP.

# Beauty in the Numbers

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