



We Partner to Build the New
CLEAN ENERGY ECONOMY

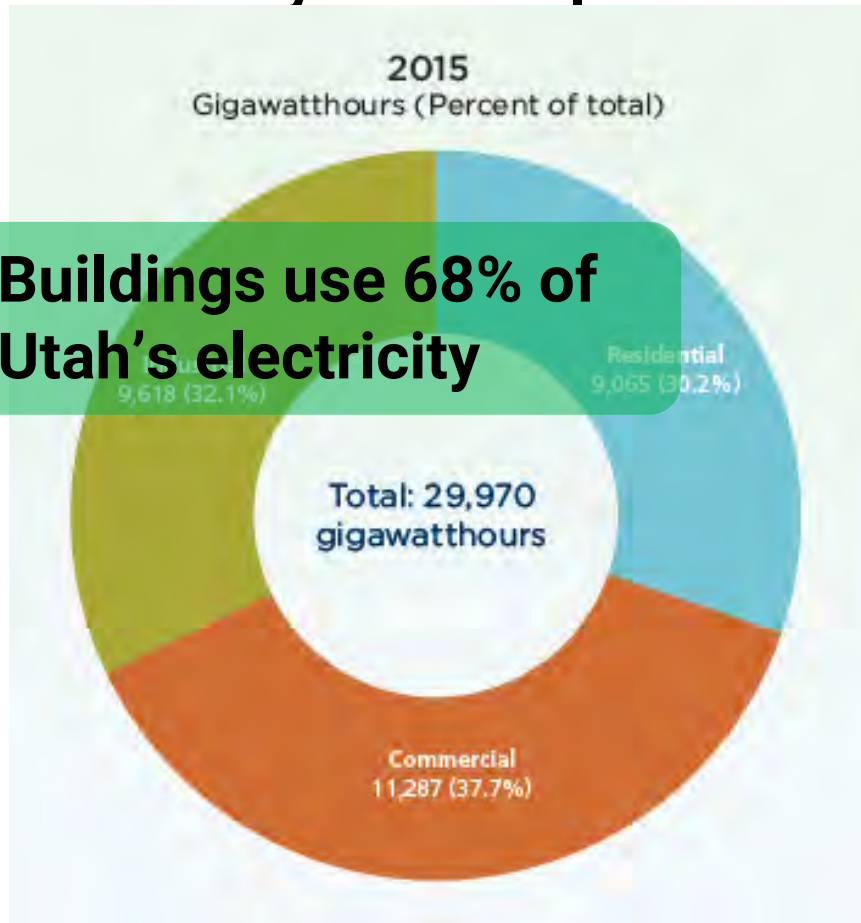
Kevin Emerson, MSc, LEED GA
Energy Efficiency Program Director



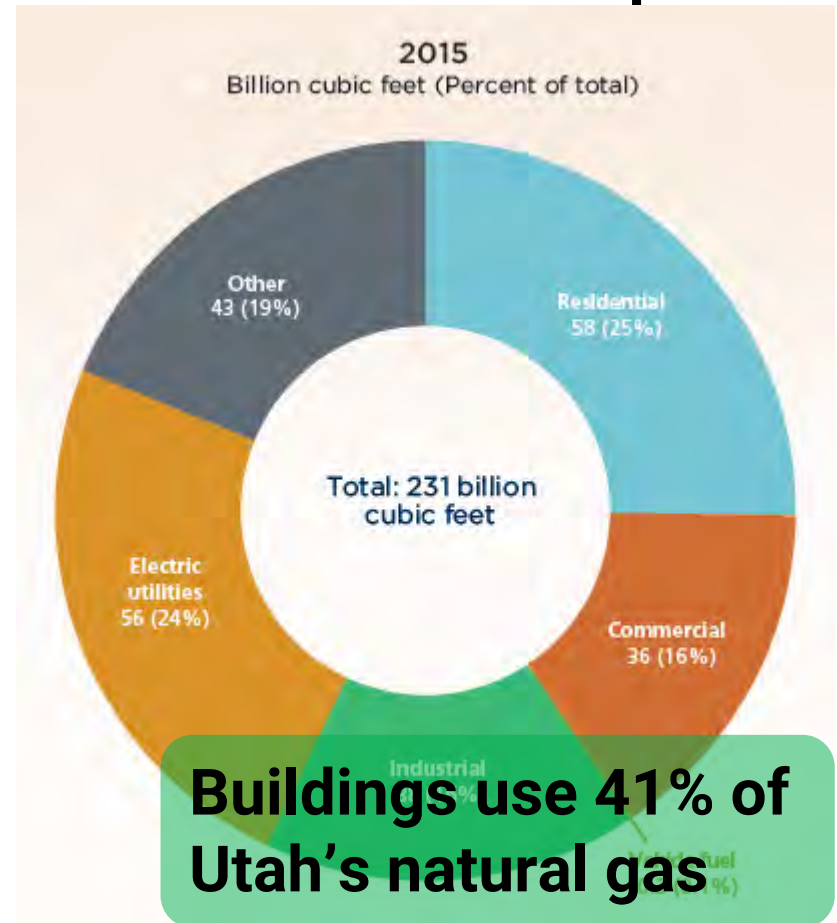
Session 1: Background & the Zero Energy Building Market

Buildings & Energy Consumption in Utah

Electricity Consumption



Natural Gas Consumption

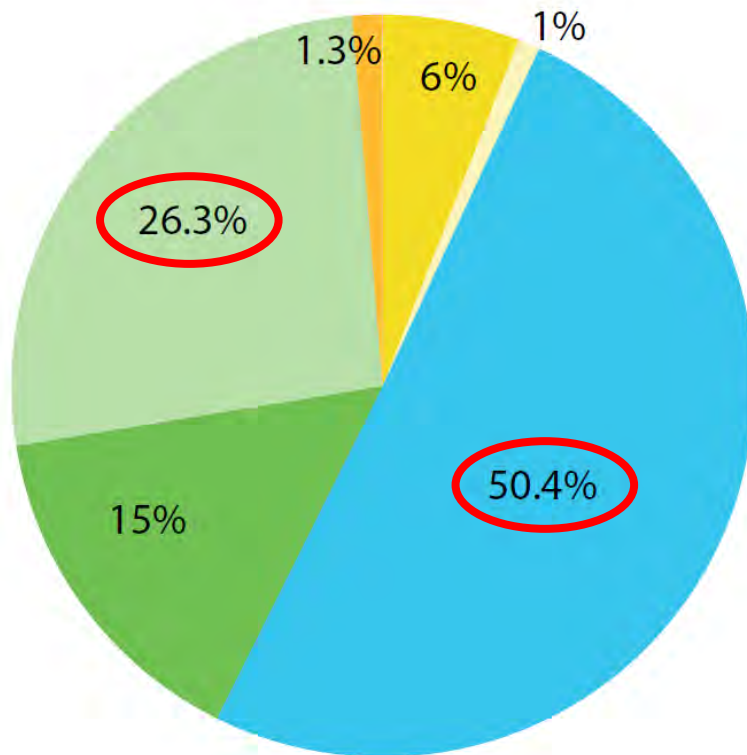


Buildings & Climate Change

Salt Lake City Community Greenhouse Gas Emissions Inventory (2015)

2015 Carbon Footprint

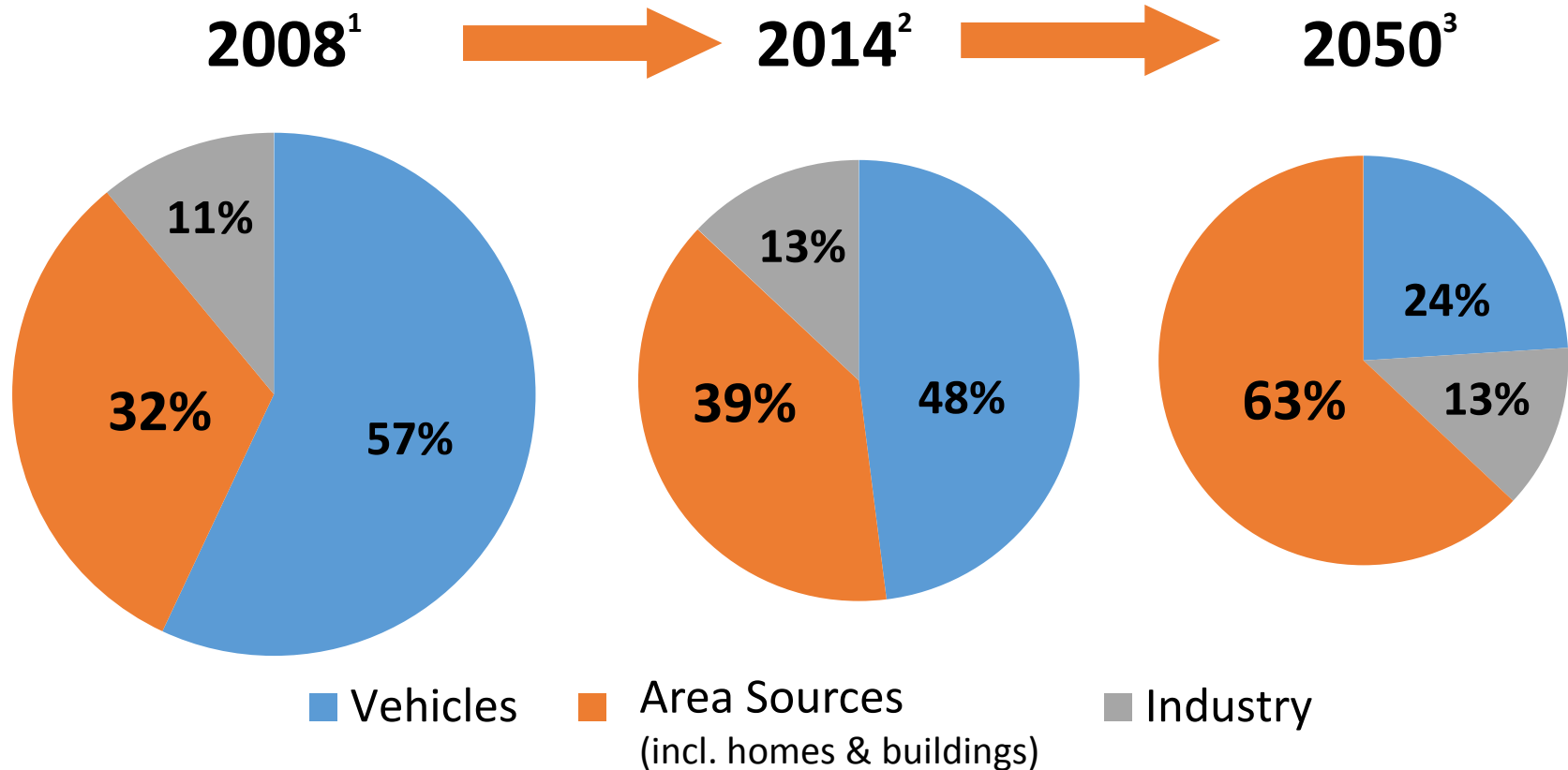
mT CO₂e: 4,769,171



Emissions Sources, Salt Lake City

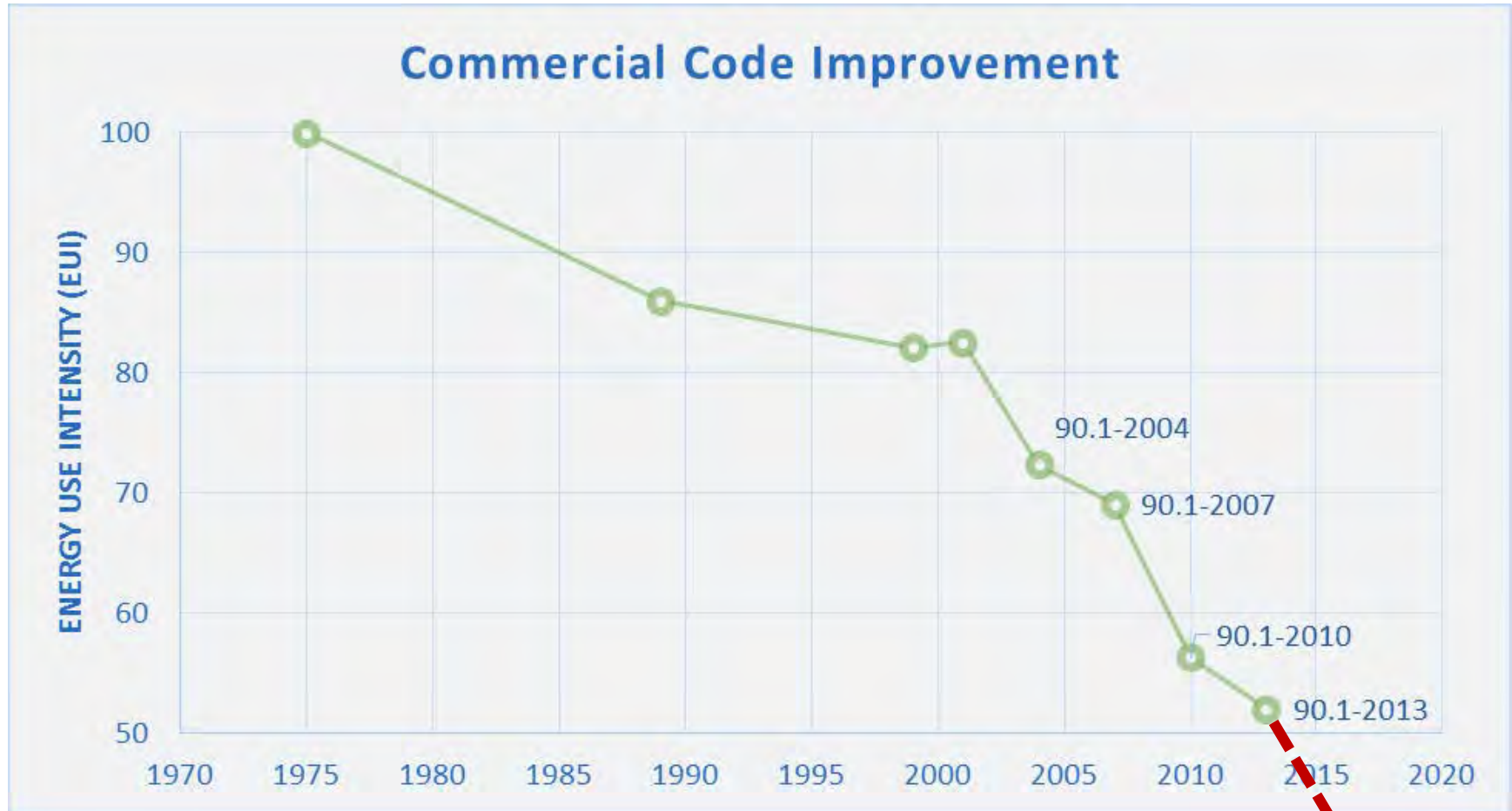
- Aviation fuels
- Diesel
- Electricity
- Gasoline
- Natural gas
- Other (compressed natural gas, landfill, & propane)

Local Air Pollution Sources in Utah (Typical Winter Day)



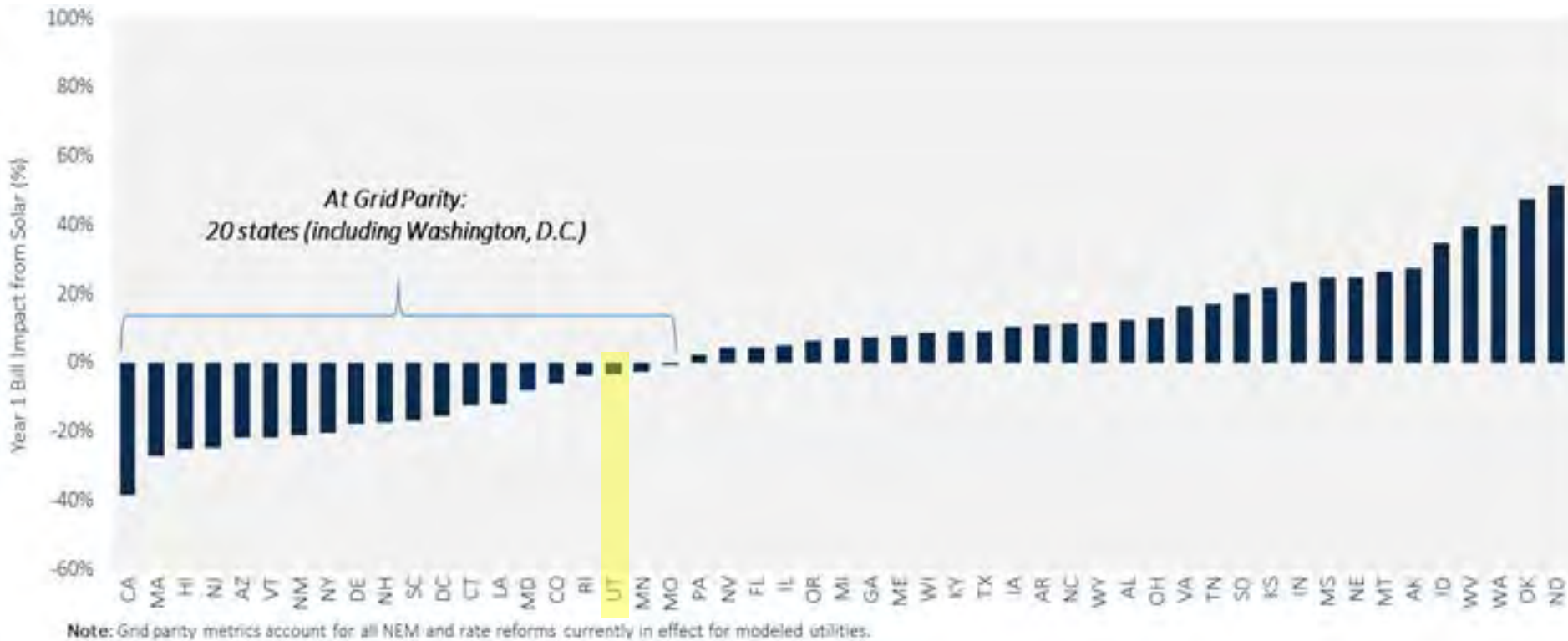
Source: 1-Utah Division of Air Quality (2013); 2-Utah Division of Air Quality presentation to Utah Clean Air Action Team (July 2014); 3-Envision Utah (2015)

Energy Efficiency Improvements from ASHRAE 90.1

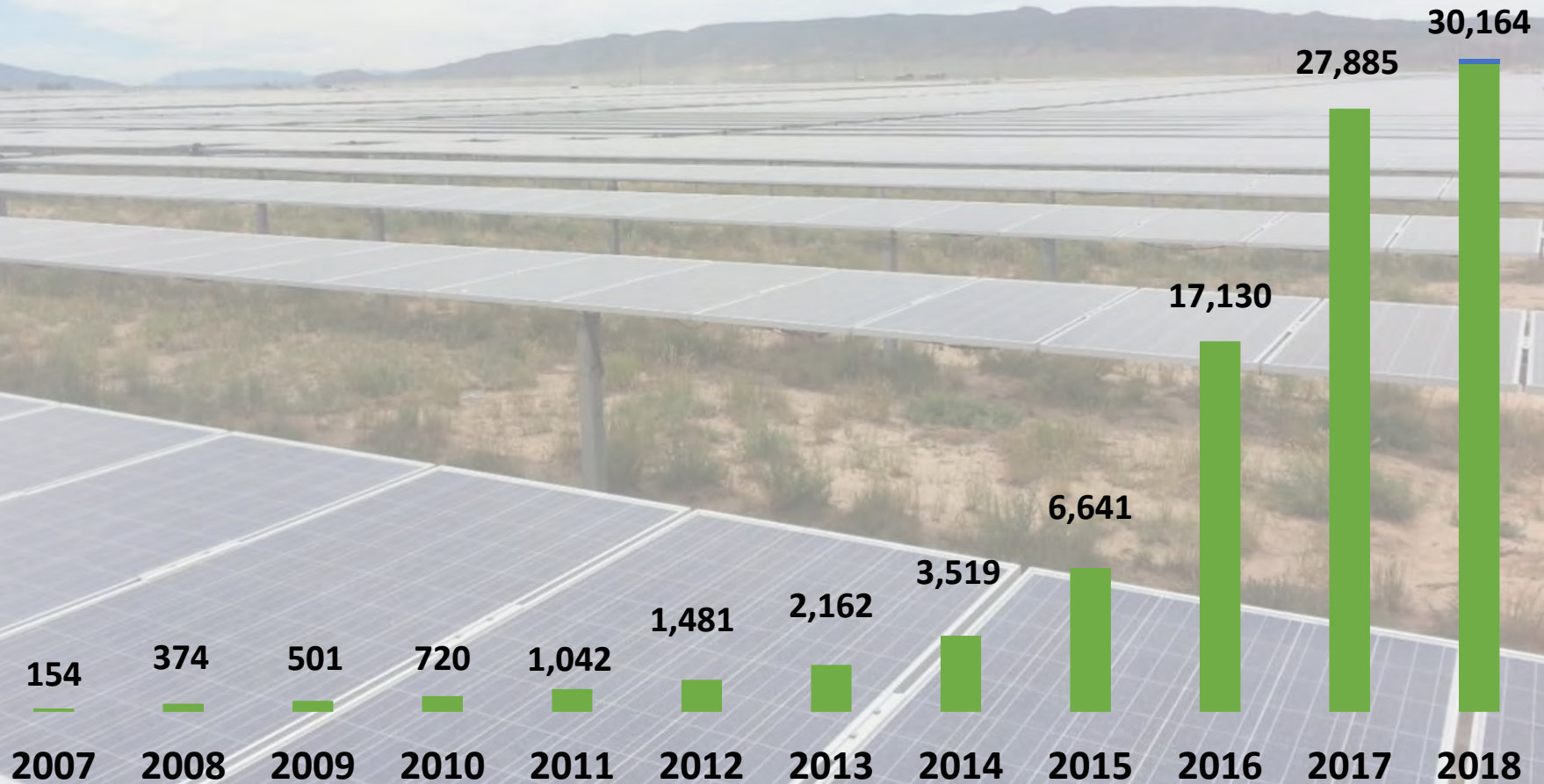


18 EUI

Residential Solar is at “Grid Parity”



UTAH SOLAR MARKET: Homes & Businesses with Solar



What is a **Zero Energy Building**?

“Generally speaking, a **zero energy building produces enough renewable energy to meet its own annual energy consumption requirements**, thereby reducing the use of nonrenewable energy in the building sector.”

- U.S. DOE



ILFI Zero Energy Certification

- Performance based (12 mo. of utility data)
- Applicable to commercial, single-family, multi-family, institutional buildings
- Third-party certification
- Low energy use intensity and 100% on-site renewable energy generation
- No on-site combustion is allowed

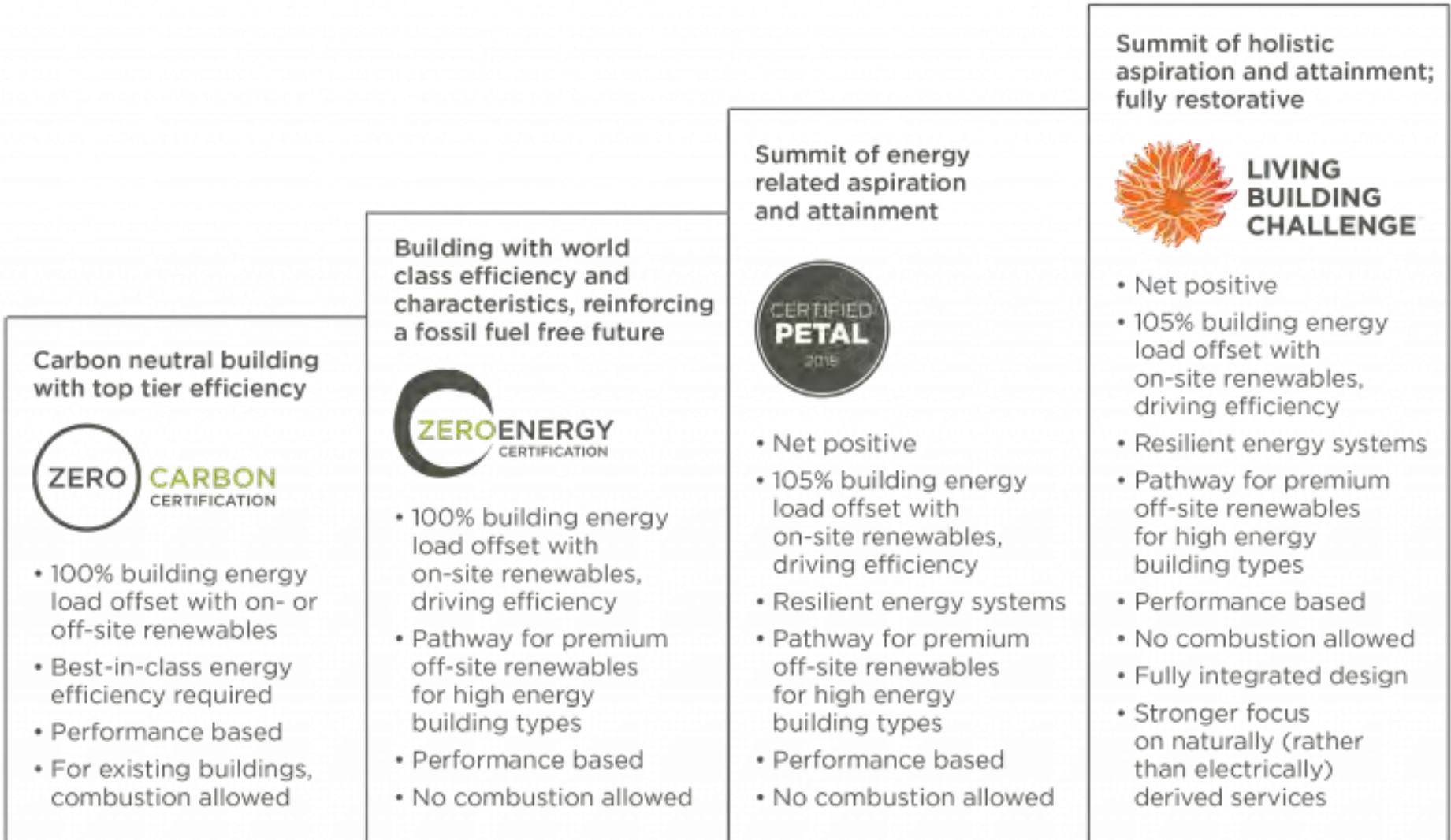


ILFI Zero Carbon Certification

- Performance based (12 mo. of utility data)
- Same wide applicability
- Third-party certification
- Best-in-class energy efficiency (28 kbt/ft²/year in Climate Zones 3 and 6 or **32 kBtu/ft²/year** in Climate Zone 5)
- 100 percent of energy offset with on- **or off-site renewable energy generation**
- On-site combustion is allowed for existing buildings



ILFI Third Party Certifications



Common “Zero Energy” Terms

Common Terms	What does it mean?
Zero Energy Building “ Certification ”	Awarded third-party certification by ILFI
Zero energy “ Verified ”	12-months performance data verified by NBI
Zero energy “ Emerging ”	In process toward zero energy
“Near net zero,” “zero energy capable,” “zero energy ready”	Ultra-low energy, no renewables, no “zero energy” goal

Number of Zero Energy Buildings **482**

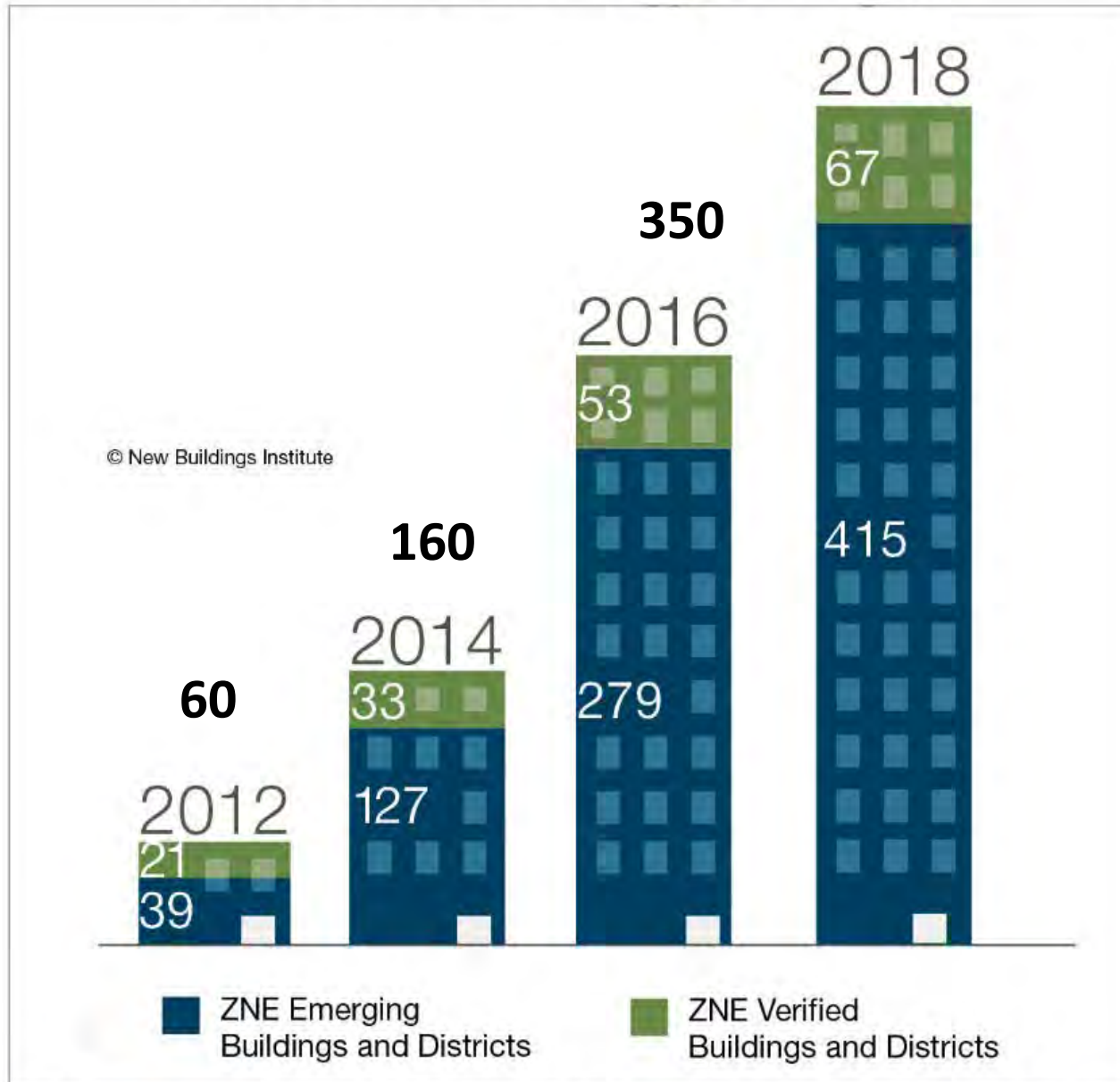


Fig 2. There are now 67 ZE Verified and 415 ZE Emerging projects documented by NBI.

Building Ownership Type Distribution

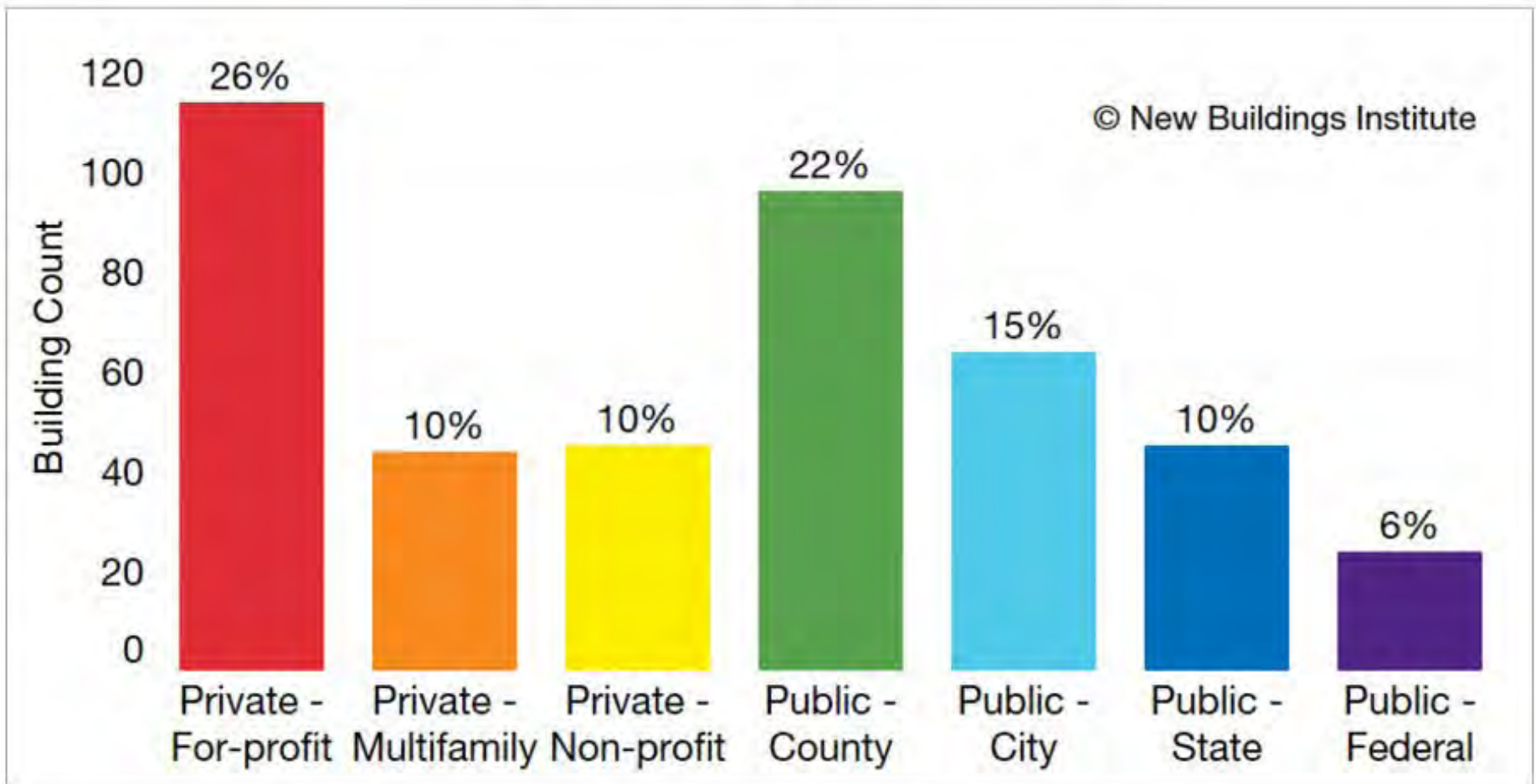


Fig 8. Buildings owned by for-profit companies now making up 26% of the List.

2018 Buildings List Project Locations

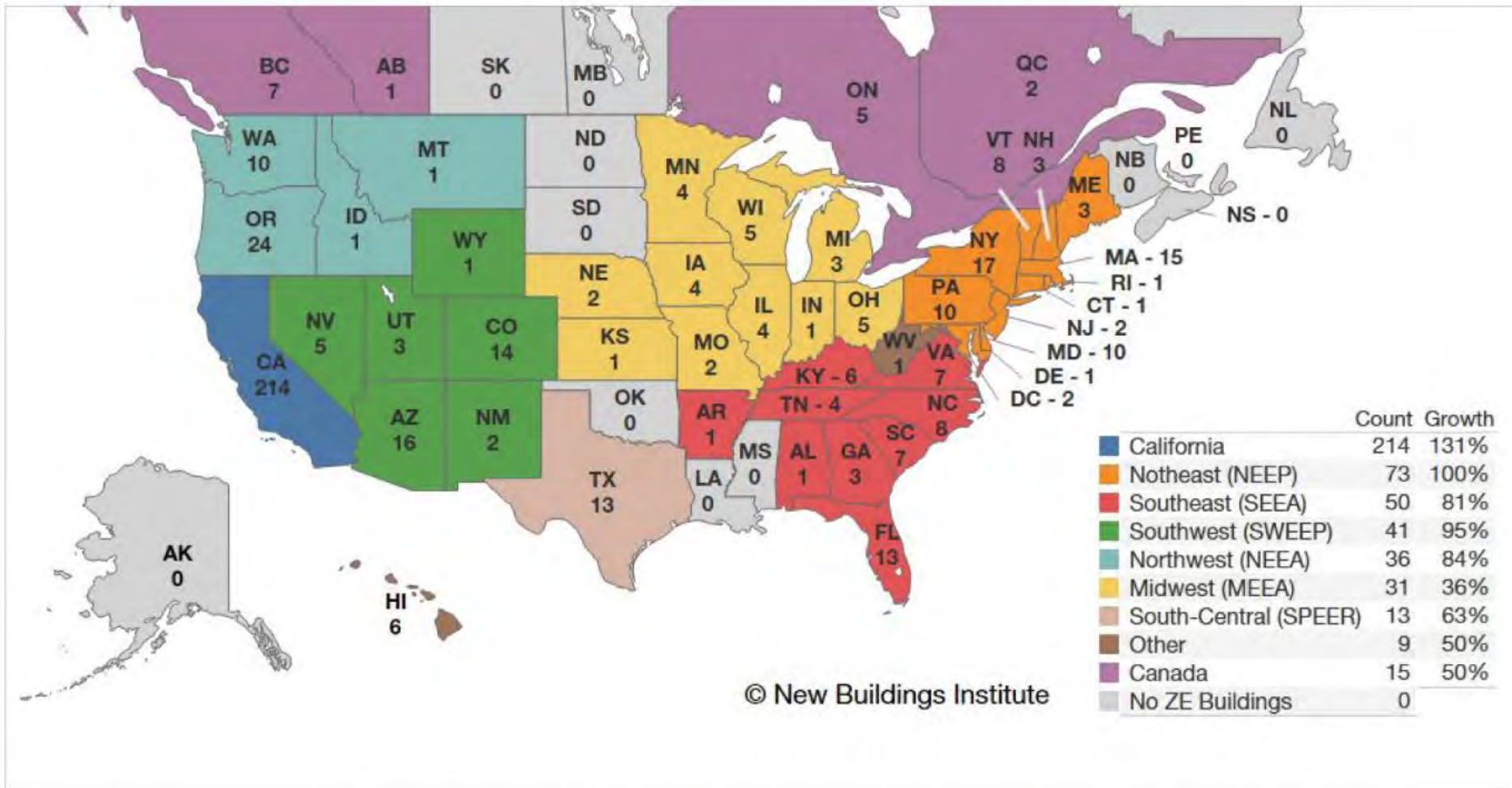
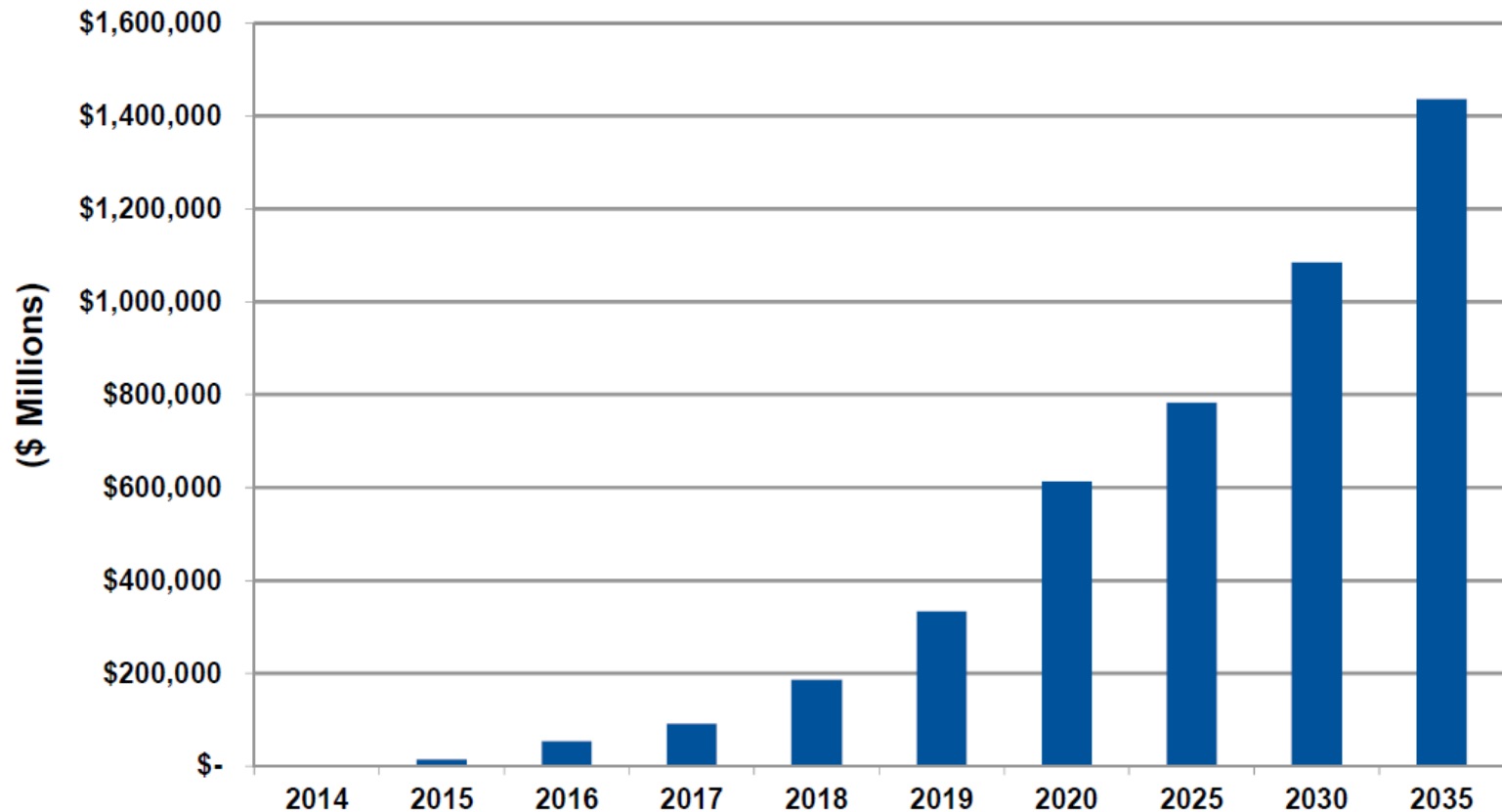


Fig 3. ZE Projects by region and state/province. The legend shows regional growth trends in projects since our 2014 List.

The Growing Zero Energy Building Market

Chart 1.1 Total Zero Energy Building Revenue, World Markets: 2014-2035



(Source: Navigant Research)

Source: Navigant Research (2014) as reported by Construction Dive <https://www.constructiondive.com/news/report-global-net-zero-energy-building-market-to-reach-14t-by-2035/433521/>

Zero Energy Building Resources

Organizations

- International Living Future Institute
<https://living-future.org/>
- New Buildings Institute | Zero Net Energy
<http://newbuildings.org/hubs/zero-net-energy/>

Certification

- ILFI Net Zero Energy Building Certification
<https://living-future.org/net-zero/certification/>

Reports of interest

- A Common Definition for Zero Energy Buildings (2015)
<https://www.energy.gov/eere/buildings/downloads/common-definition-zero-energy-buildings>
- 2018 Getting to Zero Status Update and List of Zero Energy Projects
<https://newbuildings.org/resource/2018-getting-zero-status-update/>
- Cost Control Strategies for Zero Energy Buildings
<https://buildingdata.energy.gov/cbrd/resource/1655>
- The Design-Build Process for the Research Support Facility
<https://buildingdata.energy.gov/cbrd/resource/1309>



Zero Energy Case Studies



**Session 2:
Survey of Zero Energy
Building Systems**

Survey of Zero Energy Building Systems

Highlight common practices in key energy systems:

- **Building Envelope**
- **Lighting**
- **HVAC & Ventilation**
- **Plug Load**
- **Renewable Energy**
- **Nine buildings**
- **Zero Energy, Zero Energy Ready**
- **2 in Canada**
- **Climate Zones 1, 3, 4, 5**
 - Tribal Headquarters
 - Public Schools
 - Multifamily Housing
 - Bank
 - U.S. Federal Government
- **Sources**
 - New Buildings Institute
 - U.S. Department of Energy

Building Envelope

Goals: High insulation levels, high performance windows, and conscious efforts to reduce thermal bridging and infiltration

Findings:

- Walls: R-14 + thermal mass, R-22, R-24, R-30, R-38 (SIPS)
 - Blown-in cellulose
 - Three layers of fiberglass batts
 - 2" of rigid insulation (R-14) with 3" of concrete on outside, 6" of concrete on inside for thermal mass
- Ceiling: R-30, R-35, R-60 (SIPS)
- Windows: U-factor 0.24-0.30; SHGC 0.26 (low-e, argon gas, double glaze)
- Lower window-to-wall ratio - 25%
- Air tight construction

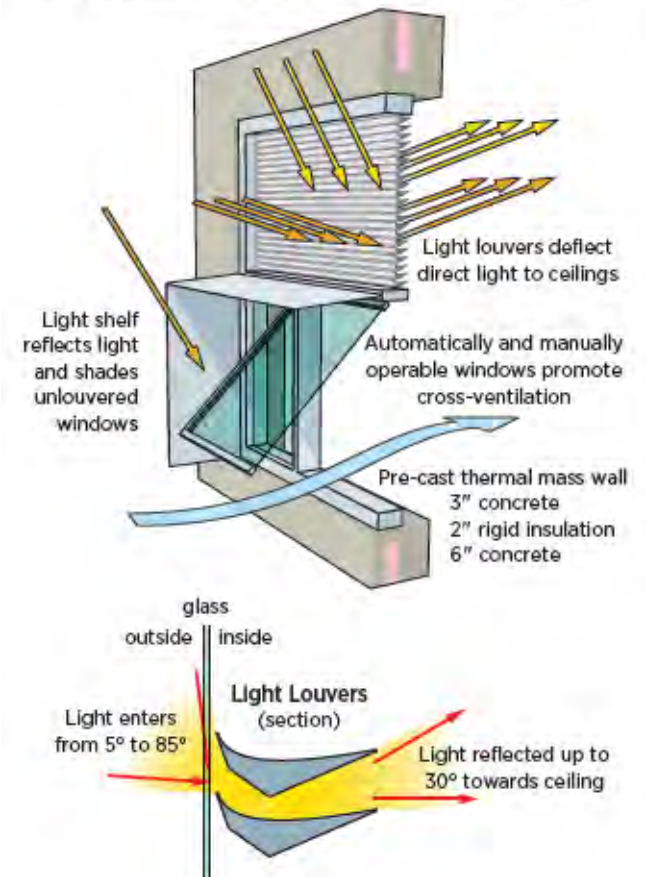
Lighting & Daylighting

Goals: Daylighting as the primary source of illumination, plus LED lighting and controls

Findings:

- Daylighting
- Open floor plan to get light into building
- Orientation
- Skylights, Solatubes
- Louvered sun shades to reflect light onto ceiling
- Occupancy sensors – turn off lighting when not in use
- Light sensors – turn off lighting/dim LEDs when daylight is high
- Manual switches to turn lights off
- All lighting turned off at end of day by Building Automation System
- LED task lighting

Light Louvers and Sunshade Overhangs



A light louver daylighting system reflects sunlight to the ceiling, creating an indirect lighting effect. Fixed sunshades limit excess light and glare. *Illustration from RNL*

HVAC & Ventilation

Goals: Reduce energy consumption needed for heating, cooling, and ventilation

Findings:

- Ground source heating
- Indirect-direct evaporative cooling
- Technologies such as packaged roof top units are almost totally absent
- Use waste heat (from mechanical systems to heat boilers)
- Operable windows
- Variable flow fans
- Demand-control ventilation
- Preheats air with “transpired solar collector”

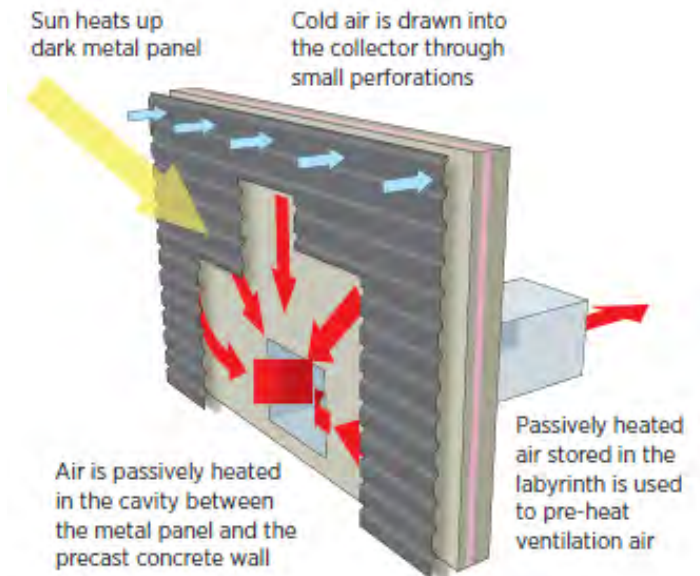


Diagram showing how the transpired solar collector works.
Illustration from RNL

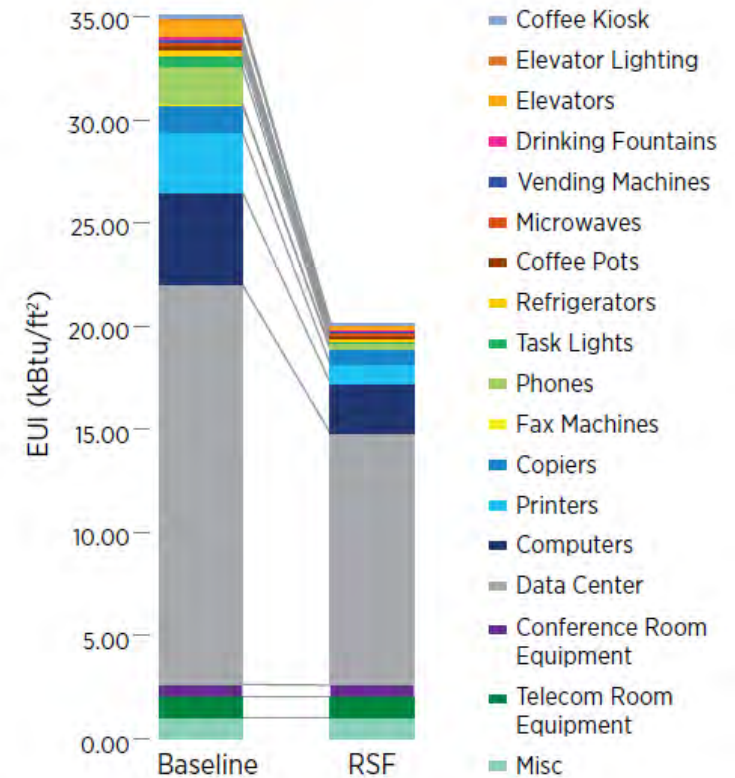
Plug Load

Goals: Attention to plug load equipment like high-efficiency appliances and computers, and plug load controls

Findings:

- Careful appliance selection, including printers, copiers, laptops, VOIP phones, task lighting
- Occupancy sensors to put inactive workstations to sleep
- Eliminate the cooler on the drinking fountain
- Make energy systems visible to increase awareness and encourage conservation

FIGURE 4 Impact of Reduced Plug Load



The cumulative result of these strategies was a 31.8% reduction in plug loads. This reduction does not include additional savings from advanced server technologies, unoccupied hour controls, or higher efficiency kitchen appliances and office equipment.

Figure by Stacy Buchanan, NREL

Renewable Energy

Goal: On-site renewable energy sufficient to meet/exceed the annual energy delivered

Findings:

- Solar PV was part of all but 1 project
- Helped get many projects to EUI 0 or negative EUI



ZEB Case Studies Reviewed

- Kinard Core Knowledge School [LINK](#)
- Wampanoag Tribal Headquarters [LINK](#)
- Bagatelos Architectural Glass Systems [LINK](#)
- The North Face/ VF Outdoor [LINK](#)
- Dr. David Suzuki Public School [LINK](#)
- zHomes Multifamily project [LINK](#)
- TD Bank [LINK](#)
- Turkey Foot Middle School [LINK](#)
- U.S. Department of Energy Field Office [LINK](#)

Case studies from New Buildings Institute and U.S. Department of Energy

Zero Energy Case Studies

