

Zero Energy, Zero Premium

Best Practices for Any Price Bracket



Home Efficiency Forum
October 5, 2017
Portland, OR

Zero Energy, Zero Premium

Best Practices for Any Price Bracket

Today's goal:

Demonstrating how to get to Zero Net Energy

AFFORDABLY
and
PROFITABLY!

Zero Energy, Zero Premium

Best Practices for Any Price Bracket

Learning objectives:

- **UTILIZE** existing ZNE knowledge via case studies
- **EXPLAIN** the drivers behind the advance of ZNE
- **IDENTIFY** the key attitude needed to achieve ZNE affordably
- **CRITIQUE** home designs to identify ZNE improvements

Zero Energy, Zero Premium

Best Practices for Any Price Bracket

- 1 Current State of Residential ZNE**
- 2 ZNE Homes > Zero Carbon Communities**
- 3 California Case Study**
- 4 Getting to Zero *Affordably & Profitably***

1

The **CURRENT STATE** of Residential Zero Energy* in North America



Zero Net Energy (ZNE)
Net Zero Energy (NZE)
Zero Energy (ZE)
Zero Carbon (ZC)
plus or minus ...



TO ZERO AND BEYOND

Zero Energy Residential Buildings Study

2016 Inventory of residential projects on the path to zero in the U.S. and Canada

JUNE 2017

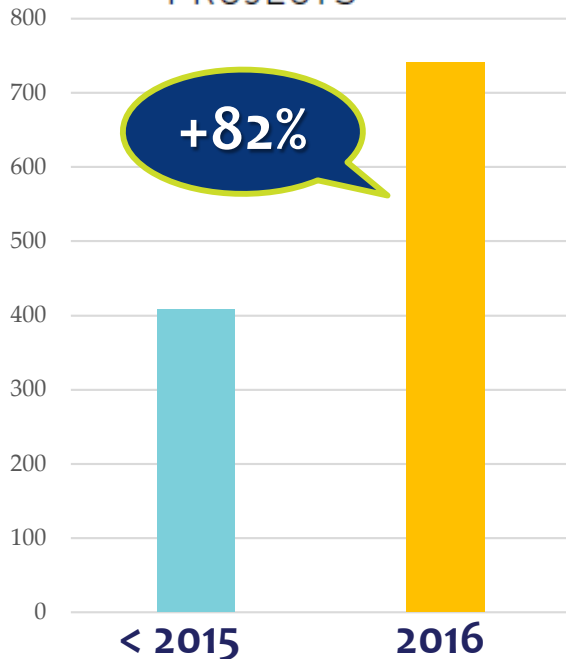
RESIDENTIAL ZE GROWTH 2015-2016

equivalent of 16,406 cars each year and 77,929 tons of CO₂ emissions eliminated



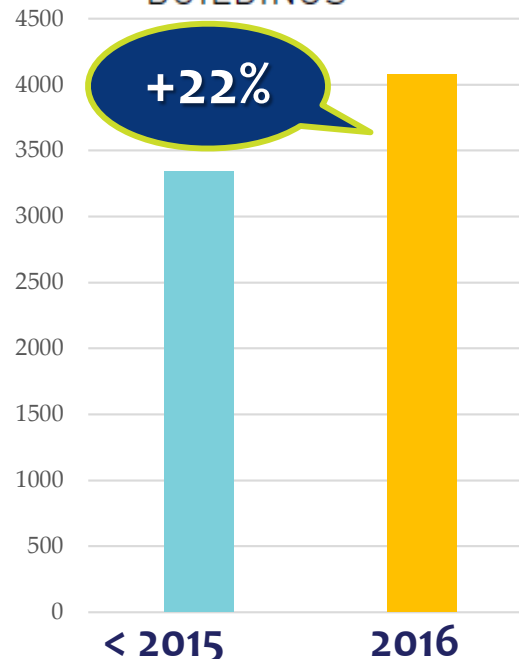
741

PROJECTS



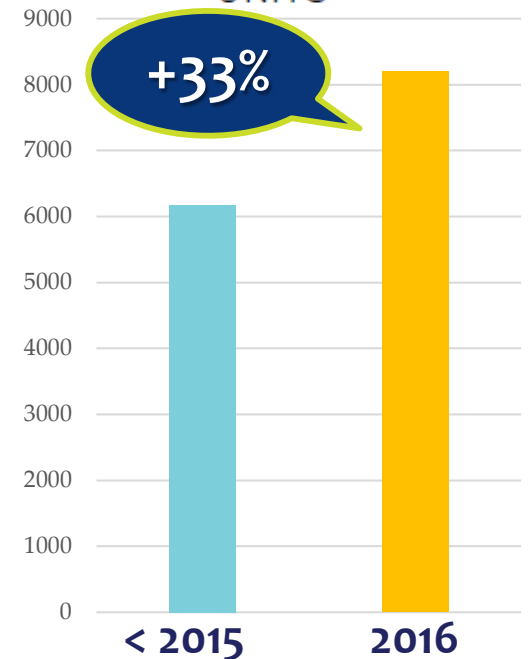
4,077

BUILDINGS

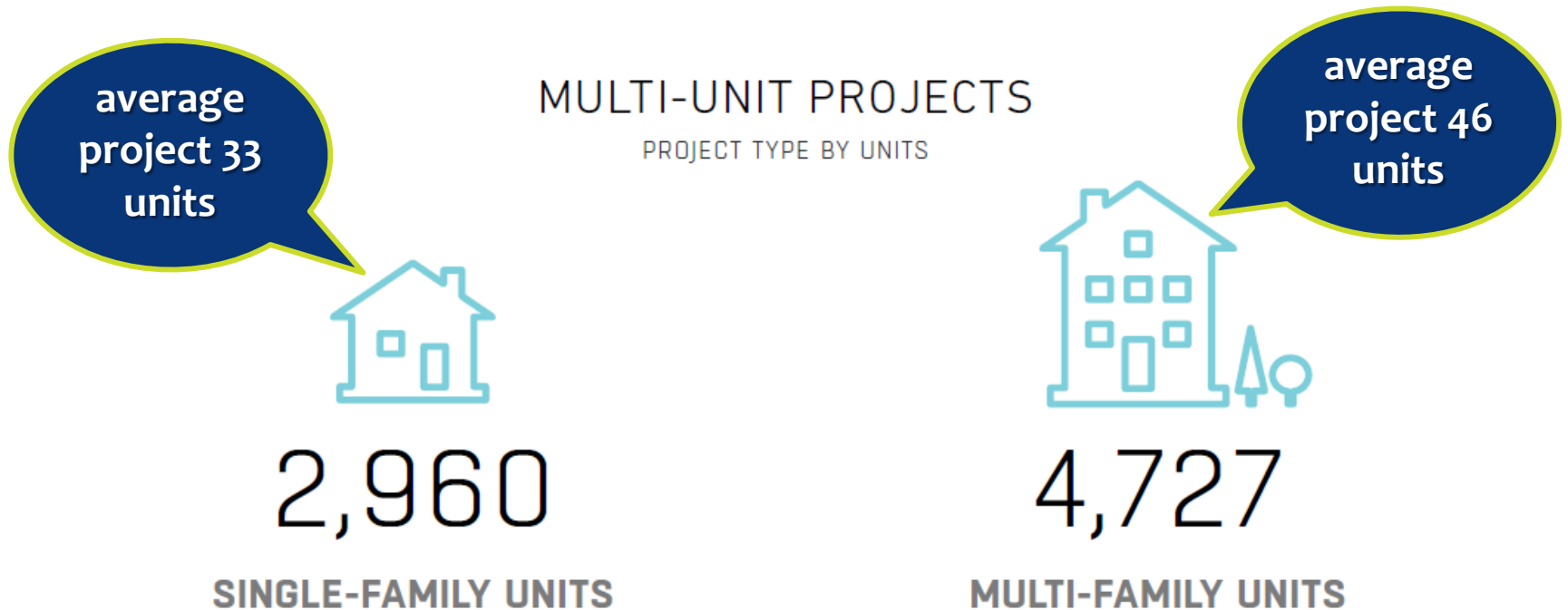


8,203

UNITS



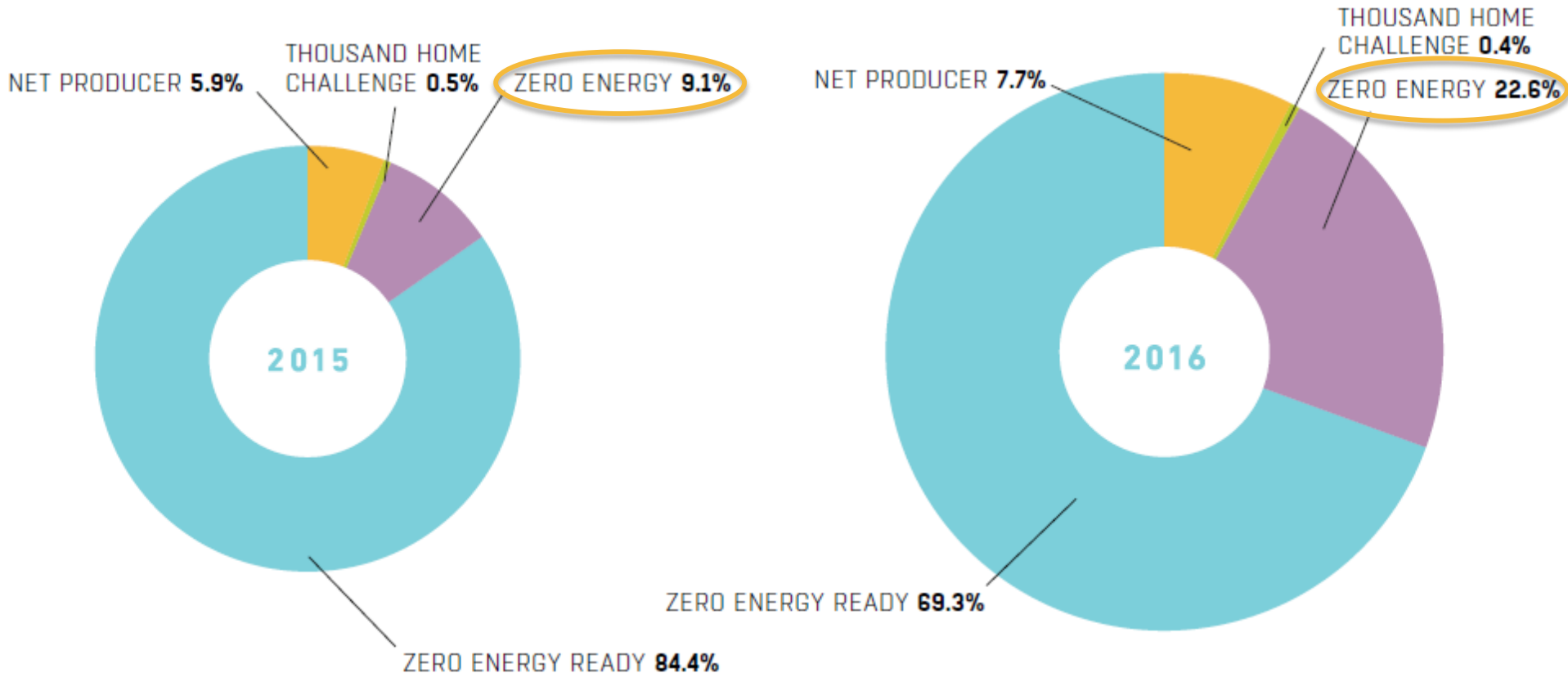
94% of ZE PROJECTS >1 Unit



Multi-unit projects are projects greater than 2 units, including both single family detached projects and multi-unit buildings

The remaining 6% (516) are single-unit projects

UPWARD SHIFT in Energy Performance



THOUSAND HOME CHALLENGE: existing home deep energy reduction projects (retrofit/behavior)

MORE GROWTH on the Horizon!



COMPLETED

5,593

UNITS

594

PROJECTS



UNDER CONSTRUCTION

1,478

UNITS

97

PROJECTS



IN DESIGN

1,129

UNITS

51

PROJECTS



PLANNED

29,948

UNITS

40

PROJECTS

YOWZA!

Custom & Luxury ZE Homes

Early
adopters



Daniel Smith & Associates Architects



Arkin-Tilt Architects



reKU Design



HKS/Hill-Glazier Studios (courtesy Blake Marvin)

Affordable & Multifamily ZE Homes

2nd
wave



K. Boodjeh Architects



The Pacific Companies



K. Boodjeh Architects

Spec & Production ZE Homes



Thriving Communities



The Paul Davis Partnership

3rd wave ~
up and coming!



One Sky Homes



Meritage

Spec & Production ZE Homes

- Meritage Homes claims to build more than 80 ZE homes each year.
- KB Homes recently unveiled its most recent ZE prototype, dubbed Double Zero 3.0.
- PulteGroup is building a prototype ZE home.
- Avi Homes and Pacesetter Homes are the first builders to start construction in a new master-planned community near Austin, TX ... Whisper Valley will be home to 7,500 ZE homes.
- Addison Homes in SC recently shifted to a ZE focus.
- TC Legend Homes in Bellingham, WA, [identifies] their projects as positive energy homes.
- Greenhill Contracting offers 4 ZE neighborhoods in NY ranging from affordable to luxury.
- Thrive Home Builders in CO has 10 different ZE projects, all DOE ZE Ready, 3 ZE standard, 2 ZE optional

Courtesy of Zero Energy Project (1/20/17) and Thrive (9/22/17)

And ... ZE is happening at **COMMUNITY SCALE**

Fujisawa Sustainable Smart Town, Japan



Pecan Street, Austin, TX



Lancaster, CA

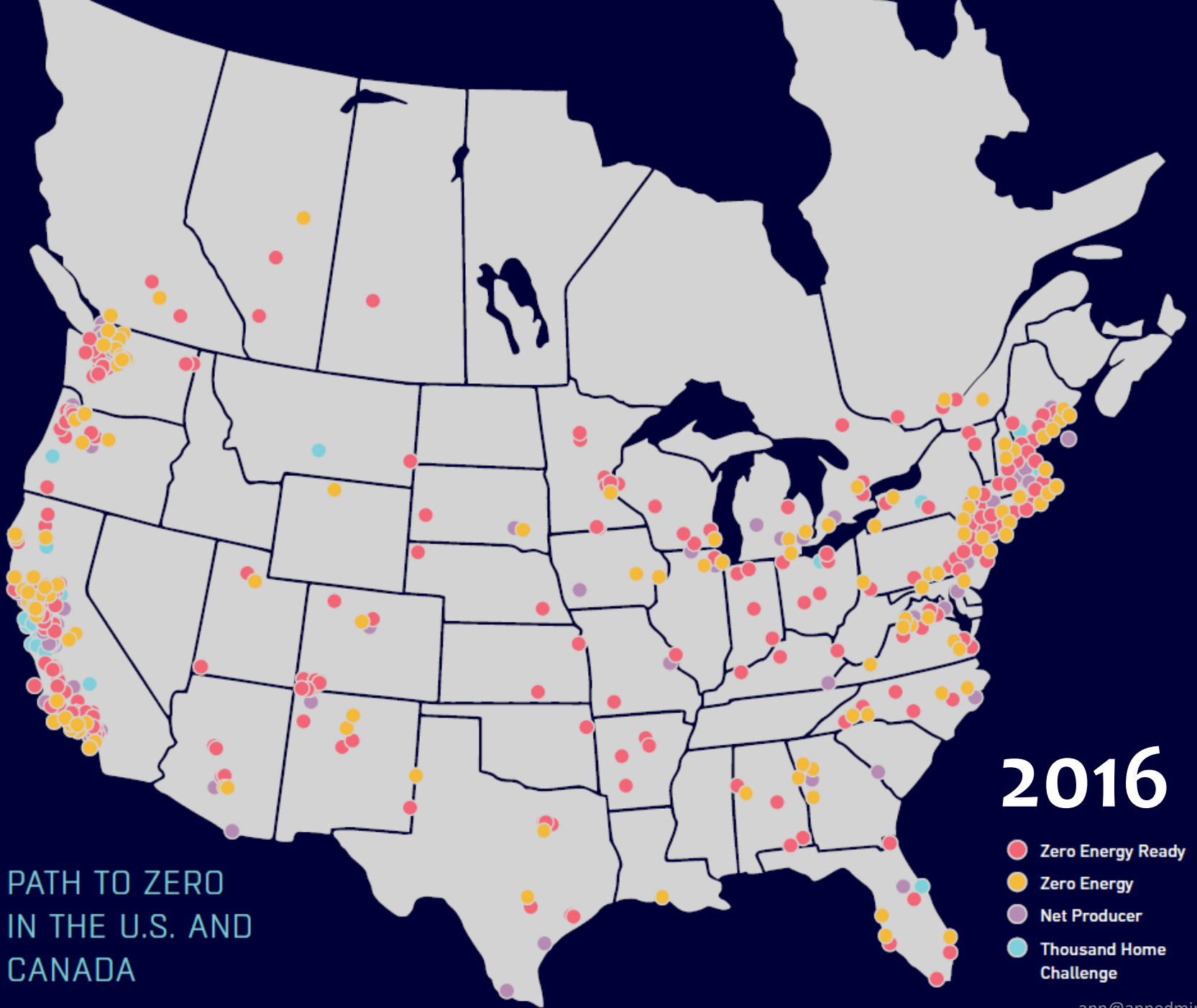
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**From
ZNE Homes
to Zero Carbon
COMMUNITIES**

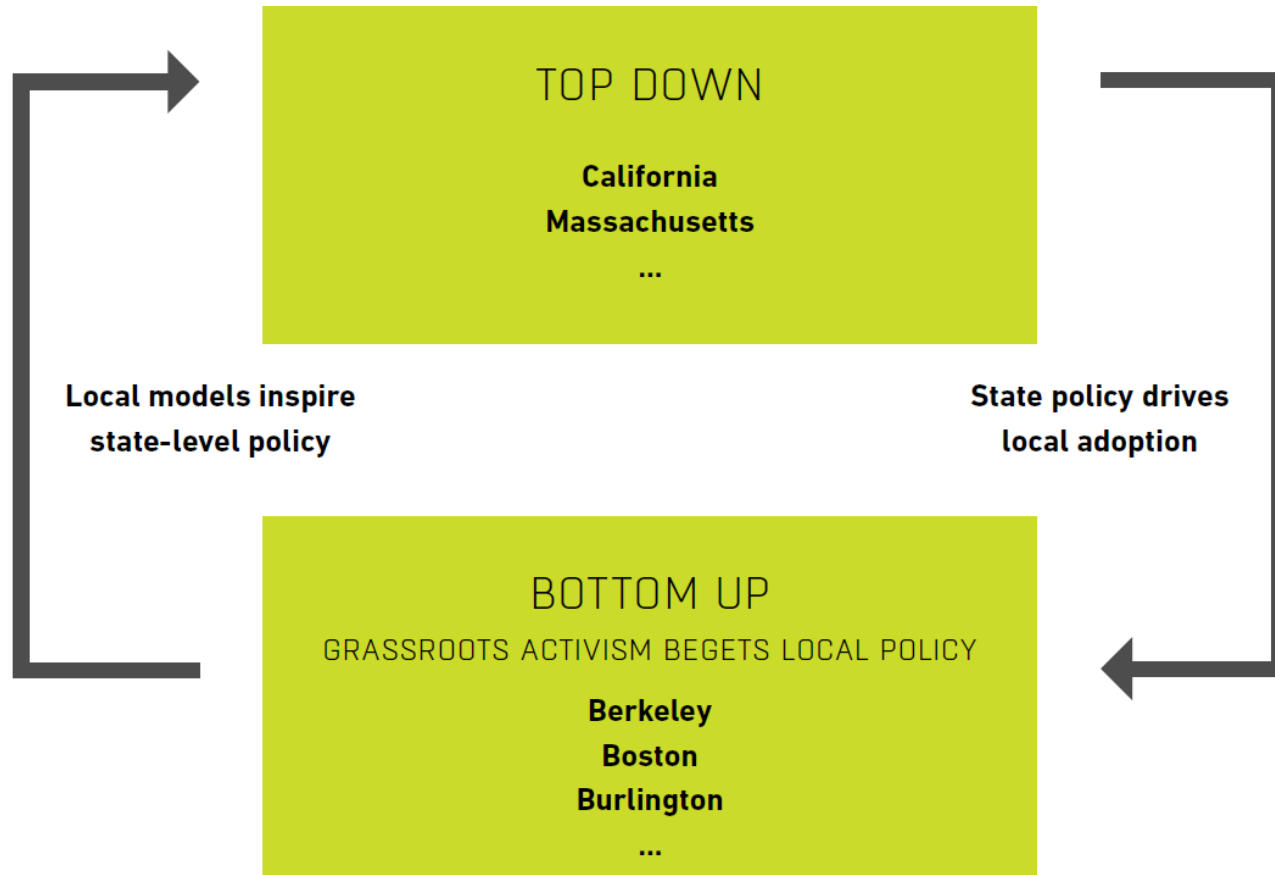
2016

- Zero Energy Ready
- Zero Energy
- Net Producer
- Thousand Home Challenge

PATH TO ZERO
IN THE U.S. AND
CANADA



The Virtuous Circle of ZE Policy & Grassroots Action



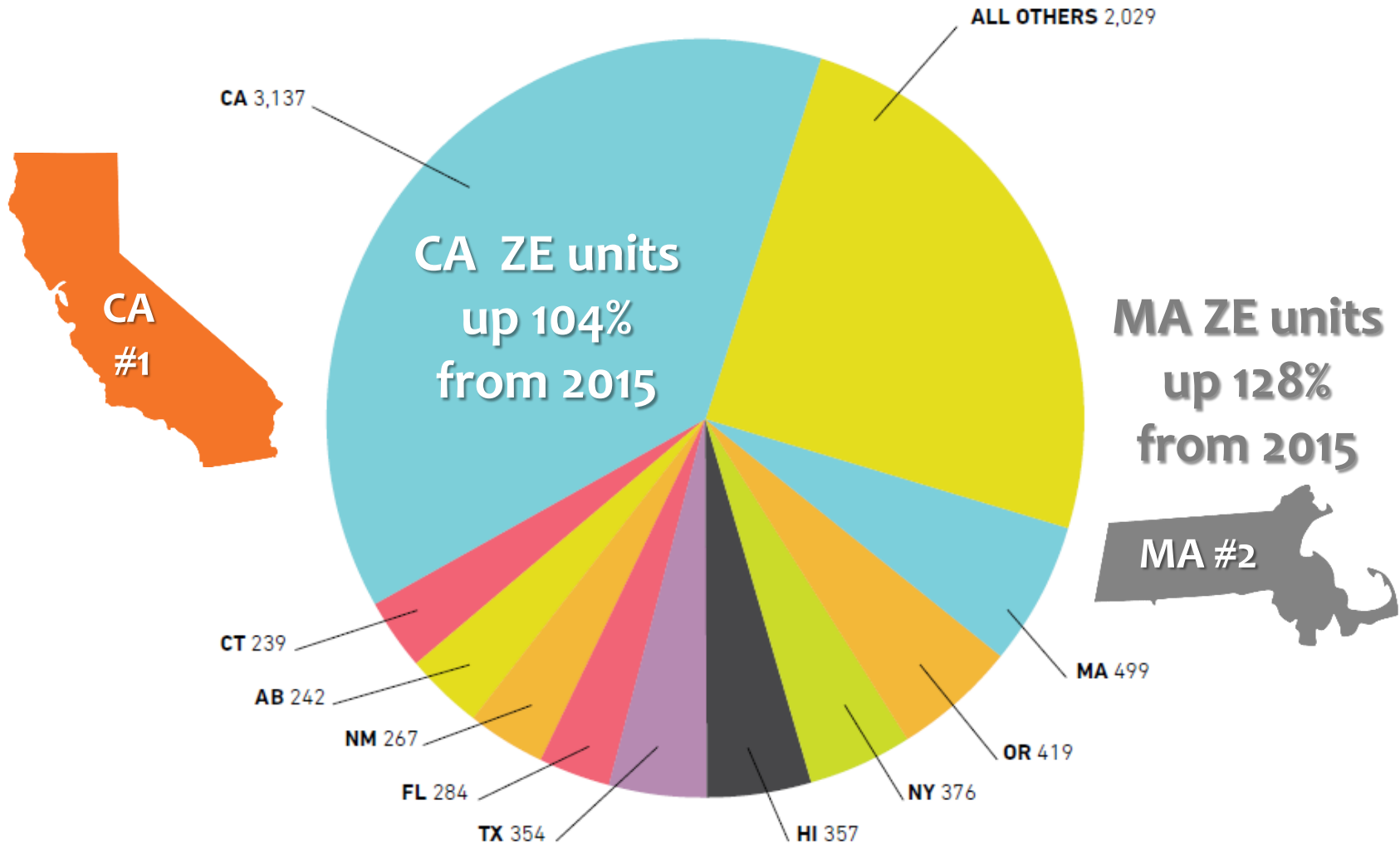
Grassroots Action Drives Growth

WHERE	WHAT	WHO
NEW YORK	#4 in units #3 in builders	Greenhill Contracting (New Paltz): 31 ZE units
CALIFORNIA	#1 in units and builders	Redwood Energy (Arcata): 1,581 ZE units (mostly multifamily)
ALBERTA, CA	#10 in units	8 individual builders: numerous large ZE projects
NEW MEXICO	#13 in per- capita units	Palo Duro Homes (Albuquerque): 16 ZE projects
MAINE	#10 in per- capita ZE units	BrightBuilt Home (Portland): 79 projects

*Most in
North
America!*

ZE Policy Drives Growth

Top states have ZE policies & programs



The Virtuous Circle

Case Study: Boston & MA

TOP DOWN ↓

Boston* creates
E+ Program Net+
Competition
MA launches ZE Challenge

MA creates
Pathways to
Zero grant
program

E+
Roxbury
Net+
finished

E+
Roxbury
operating
at Net+

2010

2011

2012

2013

2014

2015

2016

2017

Carter
Scott ZE
project
recognized

Carter, Rick Gilles,
Mary Biddle attend
NZEK Summit, learn
about CA programs

Carter, Rick,
Mary present CA
programs to MA
officials

*Any LOCAL
examples?*

BOTTOM UP ↑

* BPDA, City of Boston, with utilities National Grid and Eversource



**ZNE buildings
are instrumental
in reducing
community
CO₂**

***ZNE buildings are
training wheels
for carbon-neutral
communities***

3

California
Stockton (Central Valley)
CASE STUDY

Habitat for Humanity of San Joaquin County

This project is about
affordability and
high performance



Photo: Matthew Baker

Pacific Gas & Electric Co. ZNE Production Builder Demonstration Project

Developer: Habitat for Humanity of San Joaquin County

Consultants: Ann Edminster, Rick Chitwood, Steve Easley

Project Objectives

- Help production builders achieve ZNE, affordably
- Identify ways to reduce barriers to the design, construction, and operation of ZNE homes in California
- Inform PG&E's future program offerings

Project Overview

BASICS

- 1,200 sq. ft.
- 3 bedrooms + 2 baths

ENCLOSURE

- Extensive advanced framing
- Air sealing & infiltration testing

HVAC

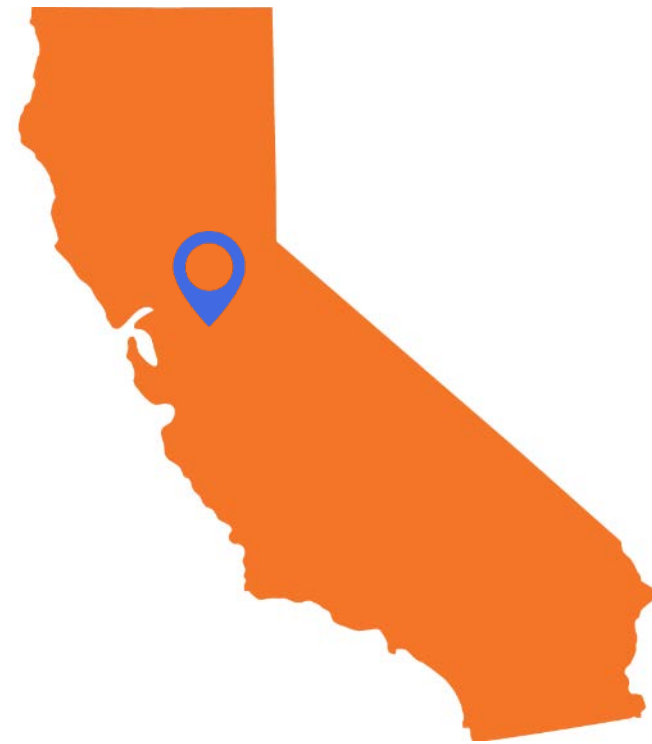
- In conditioned space
- Sized based on field research

DHW

- Highly efficient layout

SOLAR

- Homes include photovoltaics (PV)



Stockton, CA

HDD 2,702

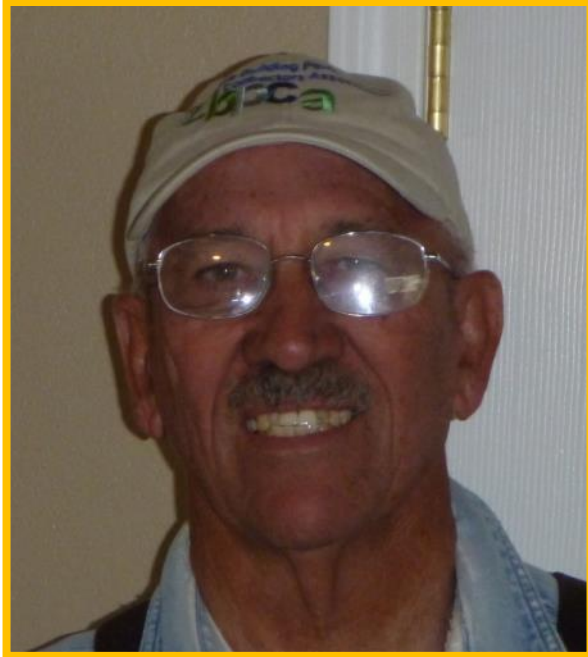
CDD 1,470

Portland, OR

HDD 3,367

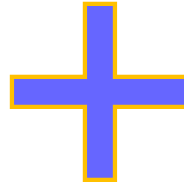
CDD 814

Project Team



George Koertzen
Habitat for Humanity
Project Manager

- X decades, construction experience
- 7 yrs, modular housing manufacturing production manager
- 2 yrs, panel plant owner
- 6 days ZNE education classes



Unskilled Workers
Student trainees
Homeowners
(sweat equity)

Enclosure Highlights

- R-42 attic insulation
- R-21 walls & floor
- R-5 rigid insulation on walls
- Careful air sealing
- Windows U.28, SHGC .20
- No plumbing in exterior walls
- **MANY** advanced framing measures



Advanced Framing →

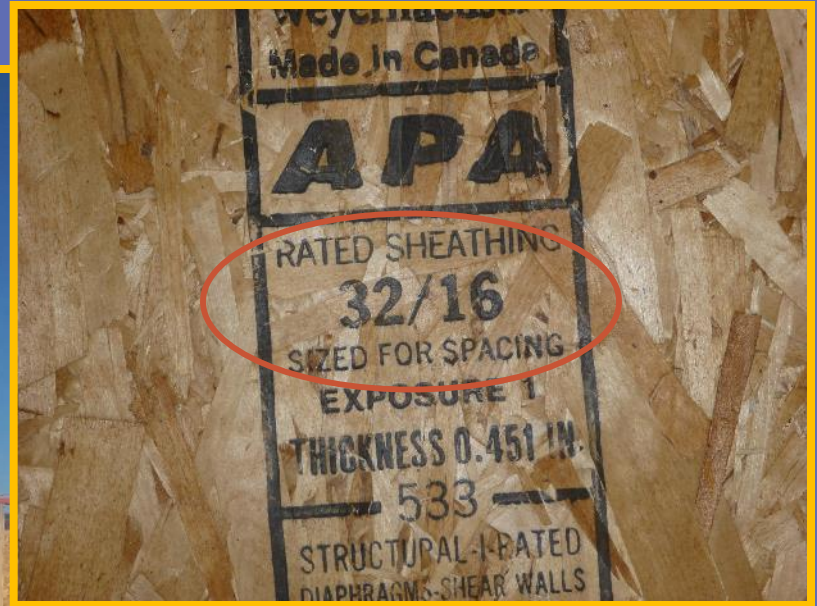
- 24" OC
- Single top plates
- Windows fit framing (no up-charge for custom size)

60-ft LVLs, no lapping needed

12.5% Framing Factor

35.5% Framing Factor (Sacramento 2014)

**Less than
50% CA avg**



Steel C-channel
joins horizontal
OSB & guides stud
placement

2-Stud Corners



**Installed with screws
to allow removal for
insulation installation**

Engineered Headers

No Extra Framing At Exterior Wall Intersections

- All studs shown on plans



Drywall Clips

- Less cracking
- Less lumber
- Less labor



Gable-end Truss Assembly



Lookouts, fascia, roof & gable-end sheathing, venting, house wrap – all done on the ground

Porch overhang
eliminates need
for support post

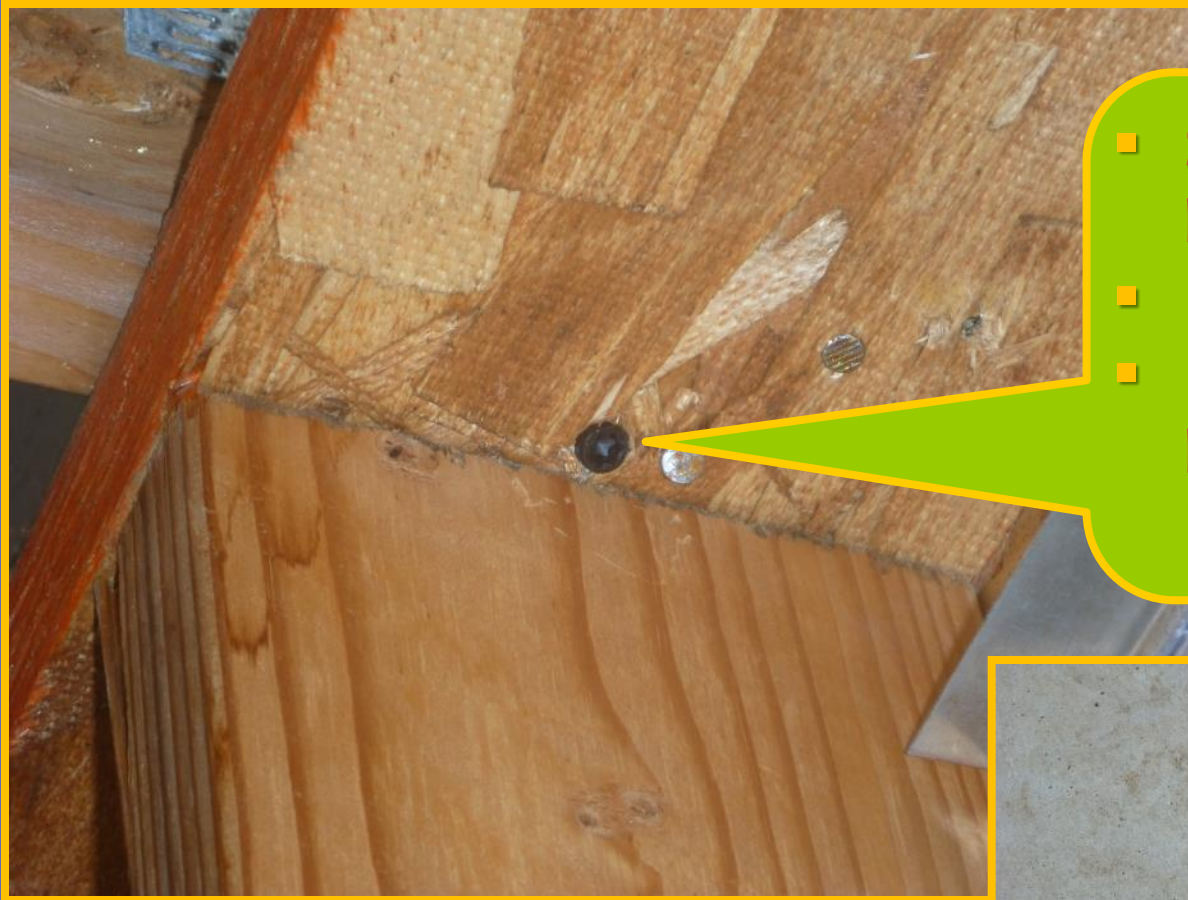


No harness work needed
(harness required on 4:12 roof
within 3 ft. of gable end)



- 
- Less blocking
 - Reduced thermal bridging

**Raised-heel trusses;
OSB spliced below top
plate at C-channel**



- Stronger than H1 bracket
- Faster to install
- Eliminates hard-to-seal air leakage path

Simpson SDWC Truss Hold-down Screw





All Wiring At Studs & Plates

Infiltration Reduction Strategies

- Hatches don't penetrate insulated assemblies
- Fixed windows at appropriate locations
- No recessed lights



Knee wall
above garage



Air Sealing

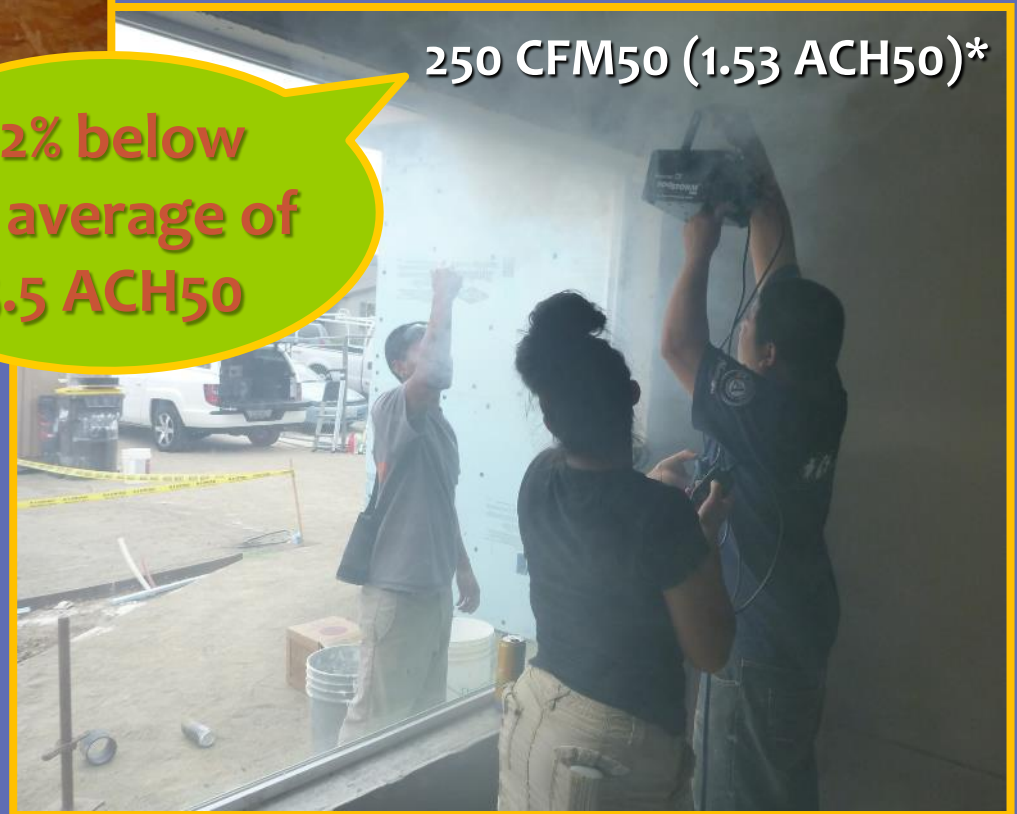
- Preliminary blower door after ceiling drywall
- Smoke testing

162 CFM₅₀ (1 ACH₅₀)*

72% below
CA average of
5.5 ACH₅₀

250 CFM₅₀ (1.53 ACH₅₀)*

House 1	House 8	House 9	House 10
776 CFM ₅₀	572 CFM ₅₀	469 CFM ₅₀	250 CFM ₅₀
4.75 ACH ₅₀	3.6 ACH ₅₀	2.9 ACH ₅₀	1.53 ACH ₅₀



* Temporary doors sealed at preliminary; not sealed at final.