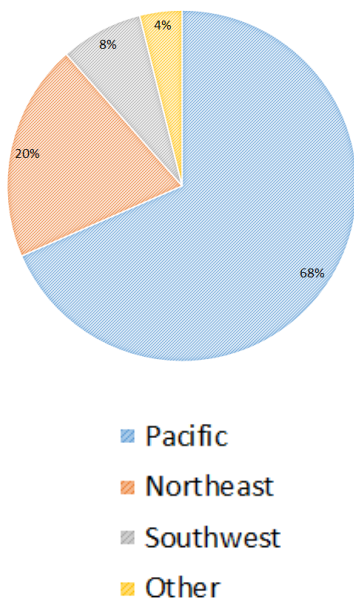


## ZERO NET ENERGY HOMES IN 2016: A NATIONAL SNAPSHOT

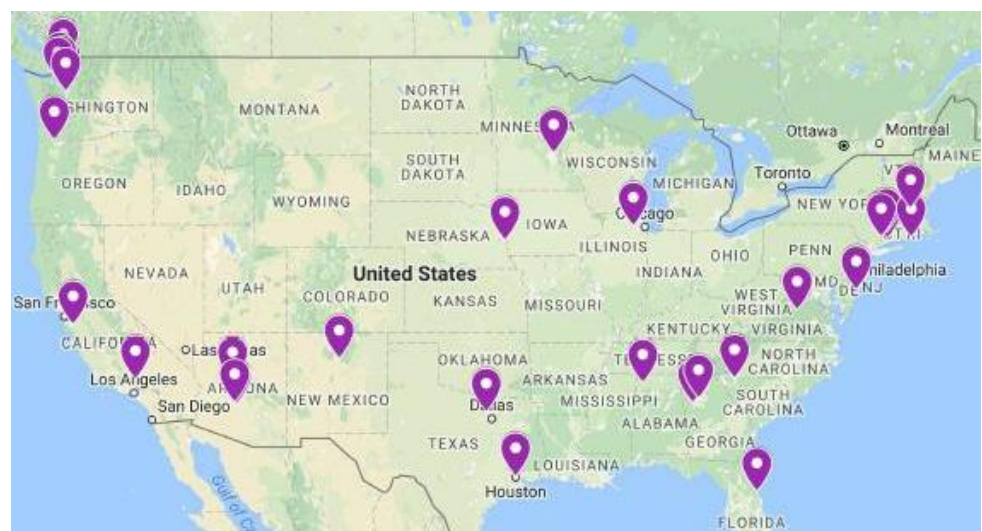
A recent study found there were 6,177 zero net energy (ZNE) housing units completed, under construction, or in design in the U.S. and Canada, with an additional 3,000 in the planning stages [Edminster, 2016]. Approximately 50% of these are single-family homes. Nearly 70% of the US projects completed or under construction are in the Pacific states, with another 20% in the Northeast.



### CASE STUDY REVIEW

Gas Technology Institute (GTI) completed a review of 36 case studies of single-family homes across the U.S. built to achieve ZNE goals. While the homes were spread across U.S. climate zones, both the marine and cold climates were best represented.

20 of the 36 case studies featured all-electric designs, with the remainder using at least one additional fuel, usually gas. Common features by region are further explored on the following page.



The Pacific states - Washington, Oregon, and California - share several commonalities which may provide insight into the prevalence of ZNE activity.

- a unique state building energy code which requires higher than typical efficiency performance
- is politically progressive on environmental issues
- its population centers are located in moderate climates, making ZNE performance more practical

## COMMON DESIGN ELEMENTS BY REGION

This case study review revealed several regional trends in ZNE design and approaches, outlined in the table below. Common across most designs, regardless of region, were the following: ENERGY STAR appliances, LED lighting, and air sealing (< 2 ACH 50).

Region	Pacific	Northeast and Midwest	Southeast
<b>Climate</b>	Marine	Continental Cold	Mixed Humid
<b>States</b>	CA, OR, WA	CT, RI, NE, MN, IL, MA, NJ	GA, AL, FL, SC, VA
<b>Walls</b>	-Advanced wall systems common, mostly structurally insulated panels (SIPs)	-Advanced wood framing common, including double stud walls -Most with either spray foam cavity insulation or exterior rigid foam sheathing	-2x6 advanced wood framing common -Varied cavity insulation types -Some with exterior rigid foam sheathing
<b>Roof/Attic</b>	-SIPs common, vaulted ceilings or un-vented semi-conditioned attics with insulation at roof deck also seen	-Vented attic design with > R60 blown-in cellulose	-About half with traditional vented attics -About half with spray foam applied under roof deck
<b>Water Heating</b>	-> 50% with some type of electric heat pump -One-quarter with gas tankless units	-50% with heat pump water heaters -25% with other fuels (gas, propane, and solar)	-Eclectic mix of gas tankless, electric heat pump water heaters, solar, electric storage systems
<b>Space Heating/Cooling</b>	->60% with electric ductless mini-split or air to water heat pump -50% with a heat recovery ventilator (HRV)	-> 60% with electric heat pumps -25% with gas furnace and electric AC	-50% with air source heat pumps -25% with electric ductless mini-split heat pumps
<b>Renewable Energy</b>	-75% with 6-10 kW PV systems	-Generally no system in place, but most "solar ready"	-Mostly none



ZNE designs in the Pacific Northwest heavily favor all-electric designs – a sentiment reinforced by builder interviews. In contrast, the Northeast and the Great Lakes region of the Midwest with higher heating loads more often employed multi-fuel designs. The two all-electric designs in the Northeast were both had heat pumps, solar water heaters, and PV systems larger than 5 kW.

A dozen of the surveyed homes had an electric charger in the garage for vehicle charging or were pre-wired for one. There was not a regional trend to the inclusion of this feature, but it may represent an increasingly common addition as the electric car market grows.

