

TO ZERO AND BEYOND

Zero Energy Residential Buildings Study

2018 Inventory of residential projects on
the path to zero in the U.S. and Canada

INTRODUCTION

This, our fourth report on zero energy (ZE) residential activity in the US and Canada, provides an overview of findings (data-derived results) and inferences (our interpretation of what those results mean) from our year-over-year inventories of growth in this rapidly popularizing housing type. While still a very small fraction of the housing industry as a whole, ZE is booming and bursting with positive energy! (Pun intended.)

TEAM ZERO (then the Net Zero Energy Coalition) began the inventory project in 2015 to answer the most commonly recurring questions our members and other ZE stakeholders asked:

How many ZE homes *are* there?
Is this thing catching on?
How quickly is this infant industry growing?

We realized that being able to answer these questions would be very empowering – it would provide solid evidence of the wide diffusion of ZE practices across the US and Canada, and dispel doubts about the viability of building ZE homes in different markets, climates, and political jurisdictions. It might even inspire non-ZE designers and builders to reach for ZE performance levels.

Tracking the growth in ZE homes has yielded more benefits than we anticipated. Besides being able to answer questions about growth and diffusion, it has enabled us to discern trends and identify correlations, which we've reported on each year. (All of our annual inventory reports are available on our website, www.teamzero.org.) And increasingly, we've been able to answer other questions from our stakeholder community: How many ZE homes, or builders, are there in my area? Who is building those homes? What is the typical project size?

In future inventories, we plan to expand our data collection to include more information of value to different segments of our stakeholder community, including fuels used in ZE homes, types of mechanical systems installed, and more.

The more we know about the ZE housing stock, the more knowledge we can put into the hands of those who are helping transform our built environment to have ZERO negative impact, and accelerate the transition to a clean energy economy.

TEAM ZERO offers its sincere thanks to all those whose contributions of time and data have made this inventory possible. Your generosity is nurturing this fledgling industry into a full-blown housing phenomenon!

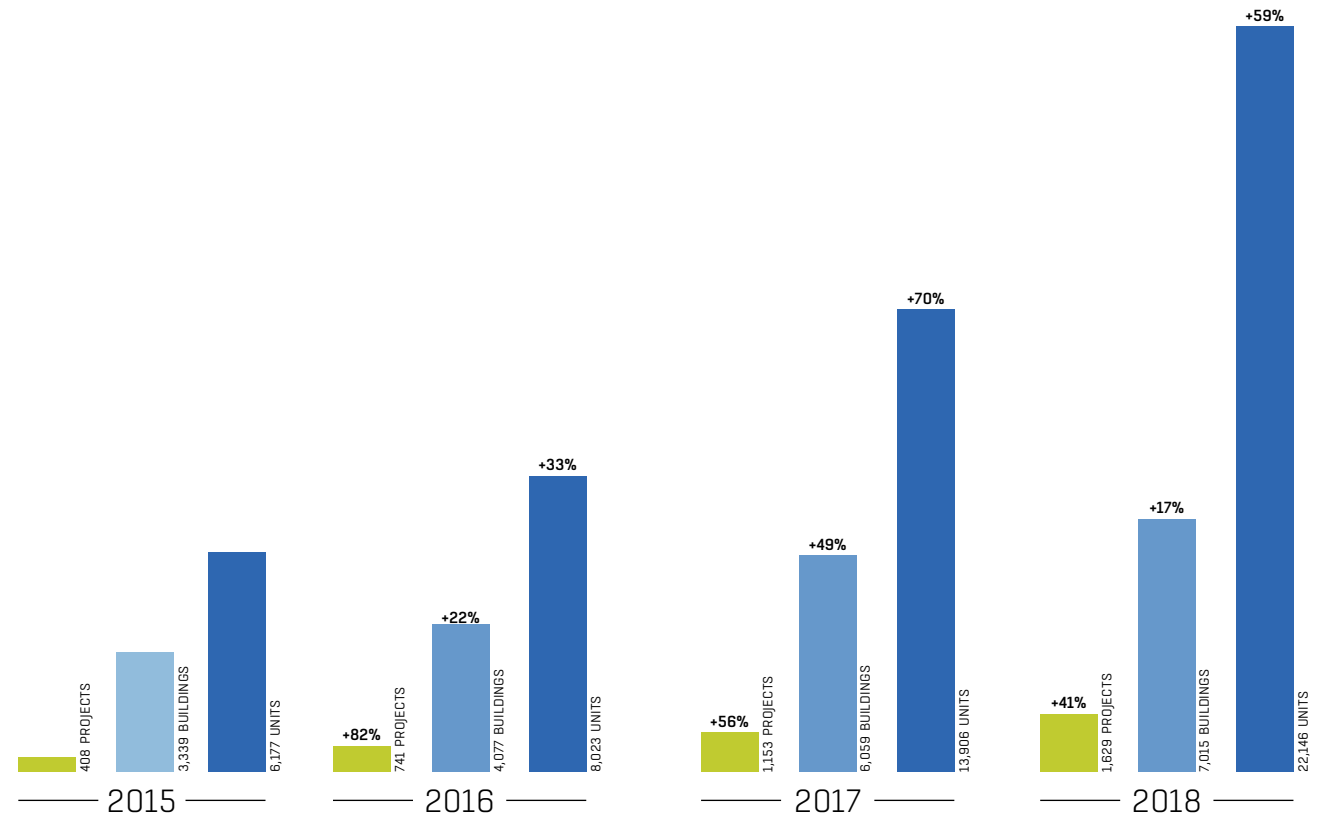


A FEW NOTES ABOUT OUR FINDINGS:

1. Within this report, we use the term “zero energy” expansively. While it suggests precision, in fact, since the inception of this project in 2015, we have sought to include all residential ZE developments that are designed to achieve energy performance in the realm of zero. All projects designed with this aim contribute to creating a clean energy future and help us understand how ZE housing markets in the US and Canada are evolving.
2. For reasons stated below, TEAM ZERO does not represent any of the information contained herein to be highly precise or definitive; it is, rather, indicative of the ZE activity in the US and Canada.
3. The inventory relies on individuals to report on their projects’ performance based on their best understanding of our category definitions (page 10); we do not verify the performance of individual projects.
4. We believe that the ZE housing stock is considerably larger than this inventory reports. We know we can’t possibly reach every designer, builder, developer, or owner of a ZE home, and over time expect that we are actually capturing less of the overall ZE activity because, as ZE activity increases, the community becomes more diffuse and there is more and more spontaneous engagement with ZE by individuals and organizations who gravitate to this work spurred by news media, and not necessarily by direct exposure to other ZE practitioners. They haven’t yet found us so we don’t know them, and they haven’t heard about the inventory. All of this is good – it suggests strongly that ZE is catching on even faster than we know.
5. The bulk of this report focuses on units in design, in construction, and completed, omitting units in the planning stage. This is because development projects in planning are highly uncertain. Some may never come to fruition; others may take much longer to be realized than their developers ever imagined. Careful followers of the inventories may note that this year Sacramento has disappeared from the rankings of top ZE cities; this is due to a large planned ZE project that appeared in prior inventories that was abandoned. A snapshot of projects in the planning stage is given on page 10.
6. Numeric discrepancies may appear from year to year, because the inventory is dynamic. As in the Sacramento example, projections change; errors are also found and corrected, and our stakeholders update their project information.

FINDINGS

The growth our contributors reported in 2018 was once again very robust – the number of ZE housing units increased by 59% over the prior year's inventory: 22,146 total units in design, in construction, and completed, as compared with 13,960 units in those combined categories in 2017.¹



Some other macro findings this year include:

Larger multi-unit buildings are increasingly dominating the ZE housing stock, evidenced by lower increases in number of projects (41% over 2017) and number of buildings (17% over 2017) as compared with the growth in units.

Performance is shifting upwards – there has been a 7.2% migration from the zero energy ready category to zero energy (73.8% and 21.7% in 2017, now 66.6% and 29%, respectively). Net positive units are holding steady at 4.5% of the total (page 9).

ZE activity reported in Canada was up by a hefty margin, with a 240% increase in the number of units over 2017.

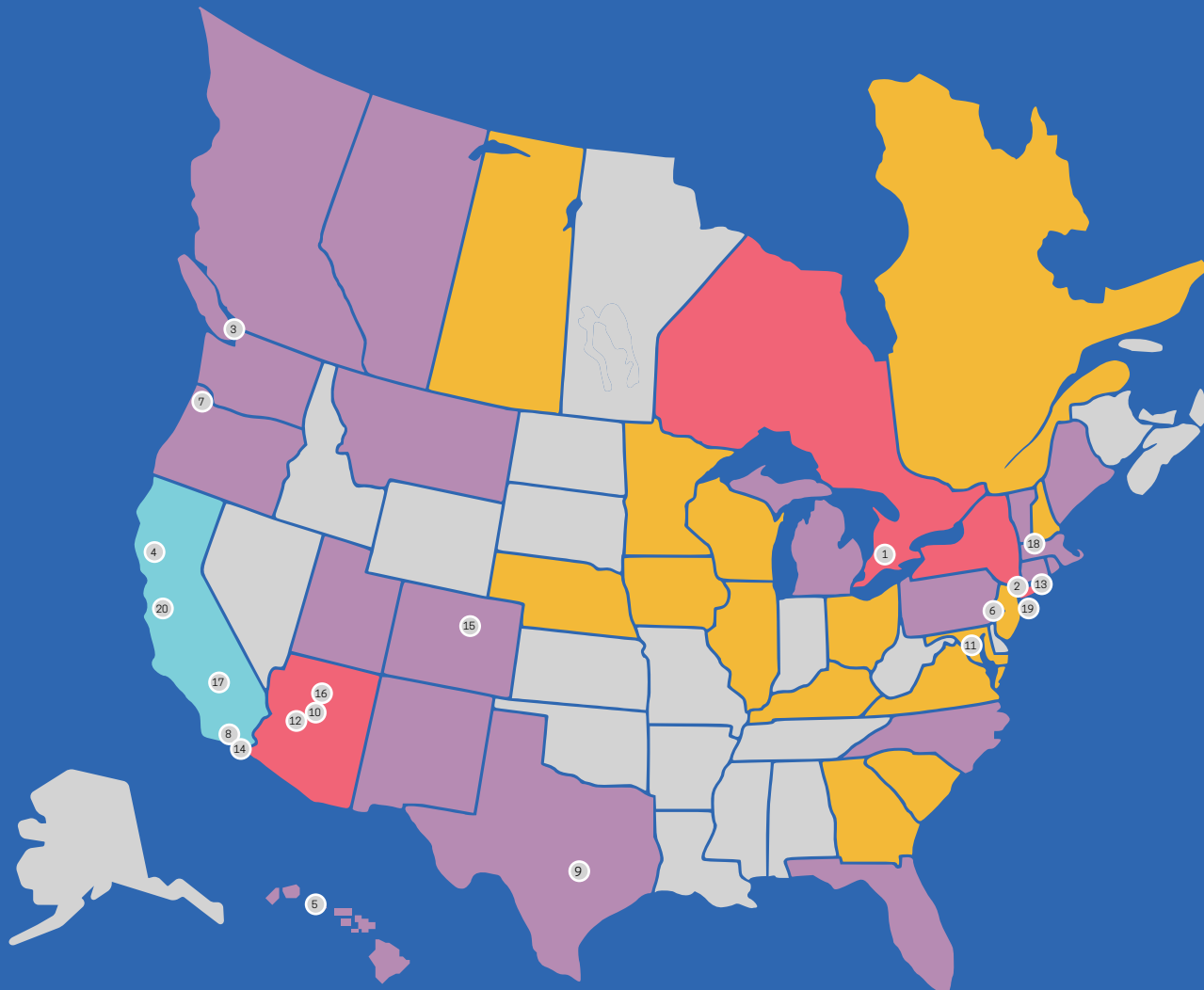
As we've observed in the past, a city or region's dominance is often driven by a single project; in this case, **West 5 Phase 2, in London, drove Ontario to third largest state/province** (page 5), with 1,900 of Ontario's total 2,221 units!

Multifamily projects now represent 71% of the total ZE residential stock – although multifamily ZE has shown steady gains over single-family since we started the inventory in 2015, this is a substantial increase over 2017 (60%).

In Canada (page 5), multifamily is even more dominant than in the US, with 90% of its ZE units in multifamily projects, versus 67% in the US.

¹ As the inventory numbers represent projects in multiple stages, we can't precisely estimate the fraction of construction activity that ZE represents. However, in comparison with annualized housing starts – [1.3 million in the US as of April 2019](#) and [202,337 in Canada as of May 2019](#) – ZE homes are still a tiny fraction.

PATH TO ZERO



TOP 20 ZERO ENERGY CITIES BY NUMBER OF UNITS	
1. London, ON	2001
2. New York, NY	1811
3. Vancouver, BC	749
4. Davis, CA	670
5. Honolulu, HI	389
6. Philadelphia, PA	367
7. Portland, OR	366
8. San Diego, CA	352
9. Austin, TX	347
10. Clarkdale, AZ	323
11. Washington, DC	318
12. Chino Valley, AZ	308
13. Bronx, NY	308
14. National City, CA	268
15. Denver, CO	265
16. Bellmont, AZ	253
17. Rialto, CA	248
18. Townsend, MA	238
19. Far Rockaway, NY	22
20. Pleasanton, CA	210

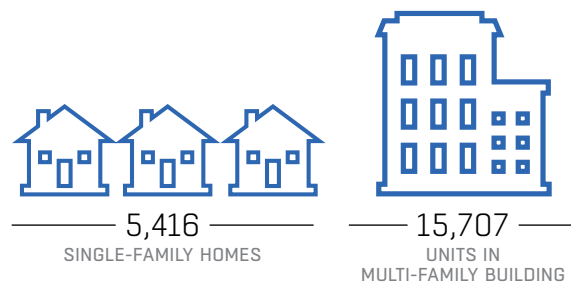
	MULTI-FAMILY UNITS	SINGLE-FAMILY UNITS	TOTAL UNITS
CANADA	3,062	342	3,404
USA	12,645	6,097	17,742
TOTAL	15,707	6,439	22,146

ZERO ENERGY HOMES ARE A SERIOUS BUSINESS

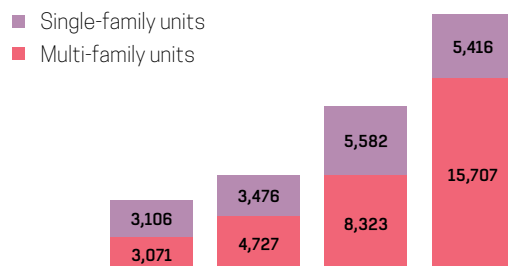
Once again, the 2018 inventory reinforces an important discovery yielded by our prior inventories: projects of two or more units (both single- and multifamily) dominate ZE activity across the US and Canada; they represented 94% of all ZE units in 2015, 95% in 2016, 94% in 2017, and clocked in at 95.4% in 2018.

The unwavering prevalence of commercial ZE residential development is a clear signal that ZE is not a tiny niche for bespoke homes.

PROJECTS COMPRISING OF 2+ UNITS



SINGLE-FAMILY VS MULTI-FAMILY UNITS



Of these multi-unit projects (that is, comprising 2+ units), 74% (15,707) of the 21,123 units are in multifamily buildings, with an average project size of 59 units (up from 47 in 2017); the remaining 26% are in single-family developments, with an average project size of 26 units (down from 36 in 2017).

Sifton Properties' 1,900 multifamily units at West 5 Phase 2, now under construction in London, Ontario (Canada), once completed, will be the largest ZE project on the continent, by a factor of nearly three. The University of California – Davis (662 completed, zero energy ready units) is holding onto second place by a slim margin, with Handel Architects' Sendero Verde in New York City close behind at 650 units.

Arizona is the clear center of gravity for single-family ZE development. Mandalay Homes, with 23 ZE projects totaling 1,159 units, also reported the largest single-family project – Mountain Gate in Clarkdale, AZ (323 homes under construction, zero energy ready). The largest completed project is Flagstaff Meadows subdivision in Bellemont, AZ, by Capstone Homes (24 homes, zero energy ready).

A number of other geographic patterns can also be observed from the map on page 5:

- California (6,828 units) remains the ZE leader, with New York (3,022) in second place
- California, Arizona (#4), Colorado (#7) and Texas (#10) together hold claim to 9,589 units, making the US Southwest the North American ZE stronghold
- Anchored by New York, the Northeast US along with Ontario, Canada, is the second-strongest region with 6,653 units
- The Pacific Northwest (Cascadia) – British Columbia (#5), Oregon (#9), and Washington (#15) – have a total of 1,710 units
- The US Heartland and Canadian far north remain the areas of least ZE residential activity

As in the past, many of the city and state/province rankings (pages 5 and 8, respectively) can be directly attributed to large ZE projects.

ZERO ENERGY BUILDER BIG HITTERS

BUILDERS/DEVELOPERS WITH 10+ PROJECTS

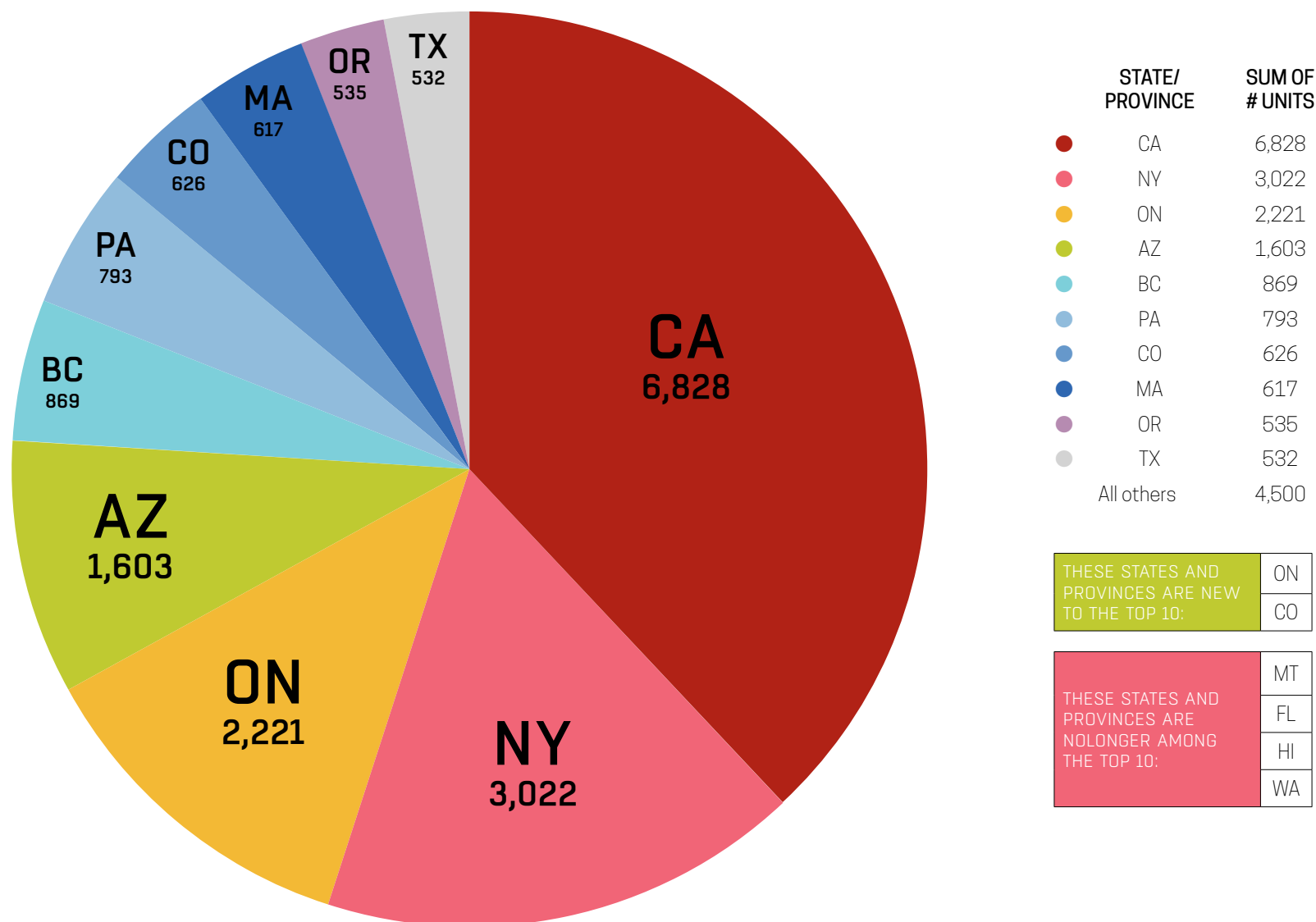
	PROJECTS	STATE/PROVINCE
BrightBuilt Home	78	ME
Greenhill Contracting Inc.	39	NY
BrightLeaf Homes	27	IL
Clifton View Homes	26	WA
Mandalay Homes Inc.	23	AZ
Palo Duro Homes, Inc	20	NM
Decker Homes, Inc	17	OH
Latitude 38 LLC	15	VA
BPC Green Builders, Inc	15	CT
Charles Thomas Homes	14	NE

TOP 10 BUILDERS/DEVELOPERS BY NUMBER OF UNITS

	UNITS	STATE/PROVINCE
Sifton Properties	2001	ON
Mandalay Homes Inc.	1192	AZ
Thrive Home Builders	579	CO
Onion Flats	512	PA
Planet Greenergy	351	FL
Transformations, Inc.	341	MA
Capstone Homes	266	AZ
Walsh Construction Co.	244	OR
Taurus of Texas	237	TX
Landmark Homes	221	AB



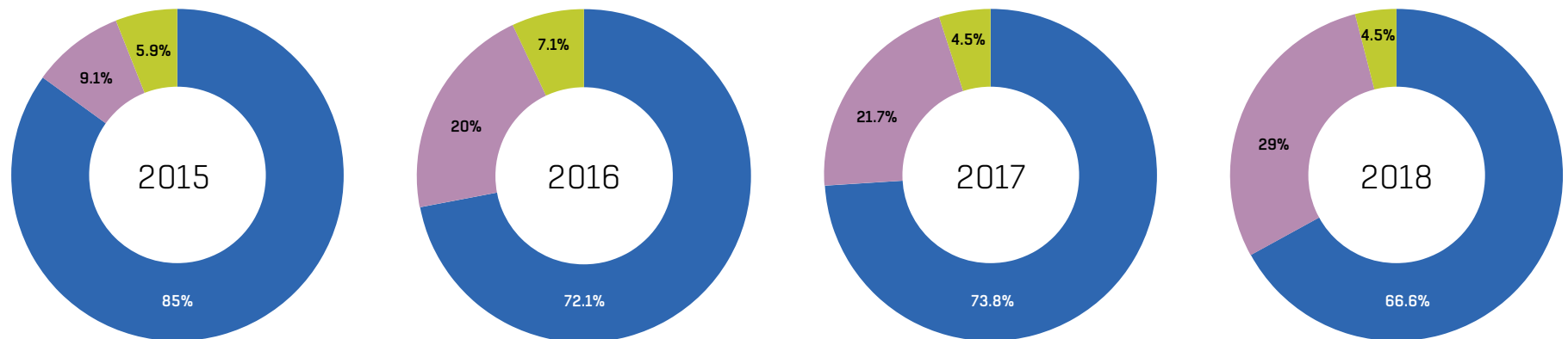
TOP 10 ZERO ENERGY STATES/ PROVINCES BY NUMBER OF UNITS



ENERGY PERFORMANCE

Percentage of Units by Energy Performance

■ ZERO ENERGY READY ■ ZERO ENERGY ■ NET POSITIVE



IN THE PIPELINE

As noted on page 3, most of the numbers cited throughout this report represent only projects that are in the first three of the following categories:

1. Completed
2. In Construction
3. In Design
4. In Planning

There are more nearly 31,000 additional residential units in the planning stage. While somewhat lower than the number reported in 2017 (33,324), it's still an impressive pipeline. The graphics at right show the movement of projects in the pipeline that took place in the past year. Given the overall movement of projects towards completion, the reduced number of units in planning may be the result of that forward progress. It also may be a byproduct of the overall heightened level of activity in this increasingly popular housing niche.

RESIDENTIAL ZERO ENERGY PIPELINE, 2017-2018

Units	2017	2018	Change
Units Completed	8,547	13,096	53%
Units Under Construction	2,940	5,027	41%
Units In Design	2,419	4,023	66%
Units Planned	33,324	30,597	-9%

Projects by Phase	2017	2018	Change
Projects Completed	956	1,377	44%
Projects Under Construction	126	147	17%
Projects In Design	72	105	46%
Projects Planned	44	33	-25%

RESIDENTIAL ZERO ENERGY PIPELINE



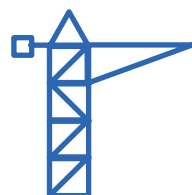
COMPLETED

13,096 UNITS
1,377 PROJECTS



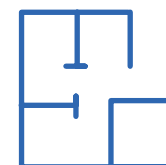
IN DESIGN

4,023 UNITS
105 PROJECTS



UNDER CONSTRUCTION

5,027 UNITS
147 PROJECTS



PLANNED

30,947 UNITS
33 PROJECTS

BACKGROUND

Zero Energy Basics

In simplest terms, a zero net energy building is one that produces as much renewable energy as it consumes each year — the “net” referring to the annual balance between energy production and energy consumption. In non-technical contexts, many practitioners are migrating to the more conversational term, “zero energy.”

The most common renewable energy source for a zero-energy home is a photovoltaic (PV) array, typically roof-mounted but occasionally freestanding on the building site.

However, zero net energy is achieved by working on energy reduction, as well as on energy production. Thus a high degree of energy efficiency is at the core of zero-energy projects; without that foundation, few projects would have space for a PV array large enough to meet their annual energy needs.

Project Categories

“Zero,” in theory, is an absolute, yet the reality is that many homes, although they may not achieve that absolute goal, are designed as part of the larger movement towards zero energy, and we can learn from all of them. So we included all of them. The table at right describes our inventory categories and how they relate to a number of

	DESCRIPTION: DOCUMENTATION MUST SHOW THAT THE RENEWABLE ENERGY SYSTEM...	QUALIFYING PROGRAMS
Net Producer	Supplies 110% or more of the annual energy demand	N/A
ZE	Supplies 100% or more of the annual energy demand	<ul style="list-style-type: none"> ILFI Zero Energy Building Certification Thousand Home Challenge (THC must designate project as ZE)
ZE-ready	Can supply 90% or more of the annual energy demand (or could, if/when renewable energy is added or system capacity is increased); AND/ OR energy use data are not available	<ul style="list-style-type: none"> DOE ZERH Earth Advantage Net Zero & Net Zero Ready PHI ‘Classic’, ‘Plus’ & ‘Premium’ PHIUS+ Thousand Home Challenge

ZE programs. In all cases, we have relied on self-reported data from our online inventory form to categorize projects.

There are many more “solar homes” than zero-energy homes — where PV systems were added to relatively inefficient homes, and don’t come close to meeting the homes’ annual energy demands.

There are also projects touted as zero net energy that are actually only zero net electricity — that is, other energy sources (e.g., natural gas, propane, or solid fuels) used in the buildings are not accounted for in the energy balance.

LEED and virtually all other North American green building programs address energy efficiency and/ or renewable energy in some fashion, but just a few explicitly identify or reward zero energy projects. Those that do collaborated with NZEC in developing the project categories used in our inventory and database project.

Note: Although “zero energy” suggests precision, the inventory sought to identify all residential ZE projects designed to achieve energy performance in the realm of zero. All projects designed with this aim importantly contribute to creating a clean energy future, and to our understanding of the market for ZE development in the US and Canada.

INVENTORY HISTORY

Our inventory project was born out of a desire to answer some key questions about the burgeoning zero energy movement:

- Is the movement really making headway? How fast?
- Where are the hotbeds of ZE construction activity?
- Who's leading the charge? Who are the laggards?
- What kind of performance are ZE projects achieving?

Truly informative answers to these questions can only be given by those creating the ZE projects. This inventory is therefore the result of extensive, repetitive (and perhaps, occasionally, annoying) outreach to builders, developers, architects, consultants, advocates, local agencies, utilities, non-profits, and others who are directly engaged with ZE projects. We thank you for your time and dedication to this initiative! Without you, we would have nothing to report.

When we began the inventory in 2015, our stakeholders believed that the information we collected would not only yield answers to the basic questions above, but could also provide insight into the effectiveness of ZE-oriented policies, programs, and incentives – for example, would we observe a correlation between ZE building activity and local initiatives? This in turn might teach us how to encourage greater ZE adoption and thus accelerate our transition to a clean energy future.

The 2015, 2016, and 2017 inventories did indeed yield some illuminating facts:

- The 2015 data showed a 50-50 split between single-family and multifamily ZE projects; 2016, however, showed multifamily pulling into the lead by a substantial margin (61%).
- In 2016, 94% of all projects (both single- and multifamily) comprised two or more units; i.e., the majority were not custom projects but instead commercial developments, either for-sale or rental. As we've noted, this trend has been remarkably stable throughout the inventory's four years.
- 2017 confirmed another trend we observed earlier, that the rate of growth in projects tends to be slower than the rate of growth in units; i.e., over time, smaller projects are giving way to larger ones.
- Geographic concentrations do in fact occur in areas with strong ZE policies and programs (notably, California and the Northeast).
- Conversely, individuals are also making their mark – there are several areas with relatively high ZE penetration that clearly reflect the efforts of one builder, developer, or consulting organization.

This year, Sifton Properties, with its impressive 1,900 units coming out of the ground in London, Ontario, and Mandalay Homes, with a total of 1,159 homes completed and under construction, are the standout examples of individual companies making major contributions to the field. While considerable variation in how ZE is measured remains from place to place and program to program, by any measure we are seeing strong growth and increasing commitment to high performance goals in ZE home building.

All of our inventory reports are available at www.teamzero.org/inventory.

ABOUT TEAM ZERO

Since publication of the last Inventory, the Net Zero Energy Coalition has joined forces with several other not-for-profits, industry players, and related associations to form an umbrella organization, known as TEAM ZERO.

TEAM ZERO Vision

The built environment is a positive asset on the carbon balance sheet of the planet by 2050

- New buildings to zero net operating carbon by 2030
- Existing buildings to zero net operating carbon by 2050
- Integrate buildings into an optimized energy grid
- Eliminate embodied carbon in buildings
- Encourage positive energy buildings that can power electric vehicles

TEAM ZERO Mission

To unify stakeholders involved in promoting different 'paths to zero' with a common agenda and collaborative efforts that accelerate market adoption of zero energy and zero carbon homes, commercial buildings, developments, communities, and retrofits across North America.

To build awareness, the knowledge base, and the desire for 'zero-harm' buildings among all players in the value chain so that zero becomes the first choice and the new norm.

To ensure that zero-harm homes and buildings are accessible and affordable to homebuyers, renters, and businesses in all communities, regardless of income level, race, ethnicity, gender, or sexual orientation.

Join us!

If you or your organization is in agreement with the TEAM ZERO mission, please join us (www.teamzero.org/take-action/jointeamzero). And if you are in a position to become a TEAM ZERO sponsor, please sign up (www.teamzero.org/take-action/become-a-sponsor).

ACKNOWLEDGEMENTS

We thank Rockefeller Brothers Fund for their past financial support, without which neither the 2016 nor the 2017 inventory would have been possible.

We also thank our members and sponsors (shown below) for their important financial support for this project and for our larger mission.

Our thanks, as well, to each individual who took the time to provide project data or help spread the word about the inventory.

Author: Ann Edminster, Design AVEnues LLC

Outreach, research, & data analysis: Núria Casquero-Modrego



Collaborating Organizations

Architecture 2030 ▪ Build It Green ▪ Earth Advantage Institute ▪ International Living Future Institute ▪ New Buildings Institute ▪ North American Passive House Network ▪ Northeast Sustainable Energy Association (NESEA) ▪ Passive House California ▪ Passive House Institute of the US (PHIUS) ▪ RESNET ▪ Structural Insulated Panel Association ▪ Thousand Home Challenge ▪ US Department of Energy

Sponsors



JOIN THE MOVEMENT

TEAM ZERO's vision is that the built environment will be a positive asset on the planet's carbon balance sheet by 2050.

Our mission is to unify stakeholders involved in promoting different 'paths to zero' with a common agenda and collaborative efforts that accelerate market adoption of zero energy and zero carbon homes, commercial buildings, developments, communities, and retrofits across North America.

Here's how you can get involved:

Join TEAM ZERO for exclusive access to member resources and benefits:

<https://teamzero.org/take-action/join-the-coalition>

For recognition as a TEAM ZERO Leader. Drive the market and create change:

<https://teamzero.org/take-action/become-a-sponsor>

Sign up for TEAM ZERO News:

<https://teamzero.org/newsletter-signup>

Report your project or refer other projects and builders for the next inventory:

<https://teamzero.org/resources/zero-energy-inventory>

For more information, email info@teamzero.org

