

TO ZERO AND BEYOND



Zero Energy Residential Buildings Study

2019-2020 Inventory of residential projects on the path to zero in the U.S. and Canada

INTRODUCTION

TEAM ZERO is proud to present this landmark report documenting six years of findings and observations from inventorying zero energy (ZE) residential design and construction activity in the US and Canada. Herein we offer you—our contributors, allies, and fans—our most recent data along with a few nuggets of insight derived from this six-year—and counting!—research project.

The data we have compiled since our modest start in 2015 have enabled us to track not only the volume and growth of residential ZE development, but also to discern patterns to this growth and identify leading geographic areas, key influences, key technologies, and powerhouse players in this still nascent sector of the building industry.

We at TEAM ZERO offer our heartfelt thanks to all you who have invested your time and energy to assist in compiling this inventory. Your pioneering efforts and willingness to share information are the lifeblood of the ZE movement. You are the ZERO HEROES who are steering the housing industry to the necessary new normal!

All our annual reports can be downloaded at teamzero.org/inventory-of-zero-energy-homes

Along the way, we believe we have succeeded in providing inspiration to aspiring ZE practitioners, proof of the viability of ZE construction as a valid business proposition, and confidence to policymakers that incentivizing ZE home building was a reasonable and right pathway.

Over time, we have also been able to provide more customized lenses on our data for public agencies, non-profits, corporations, and research institutions about ZE development in areas of particular interest to them. (Please email aaron@eeba.org if you would like more information about customized data queries.)

Each year, we want to know more! We struggle to weigh the value of gathering more information, while not wanting to overburden our contributors. This year, curiosity won, and we asked just a bit more about the ZE projects we inventoried.

First, in response to the phenomenal groundswell in the energy community around the concept of decarbonization, and more specifically, all-electric building, it became imperative for us to find out

how ZE homes are being fueled. See what we learned about that on page 11.

We were also curious about what fraction of inventoried homes already include solar energy (as opposed to being ready for solar, having achieved ZE levels of efficiency), as well as other key energy technologies that are increasingly found in ZE projects. Those results are also shown on page 11.

As the combination of onsite solar energy and batteries make it ever more feasible to approach off-grid performance, we decided to extend our reach into that category, too; the few off-grid projects we netted are tallied on page 10.

And lastly—but certainly not least importantly—it's long past time we acknowledged not just the developers and builders of ZE homes, but also the rock star architects without whom these projects wouldn't happen. We salute the most prolific designers on page 7.

Despite asking more of you on our [data intake forms](#), we have improved our data collection process. A number of items have been clarified, and we simplified the data revision process for contributors gracious enough to update projects they have previously reported – e.g., with changes in status, such as from in design to completed. (We also offer more support for contributors who have large project portfolios.)

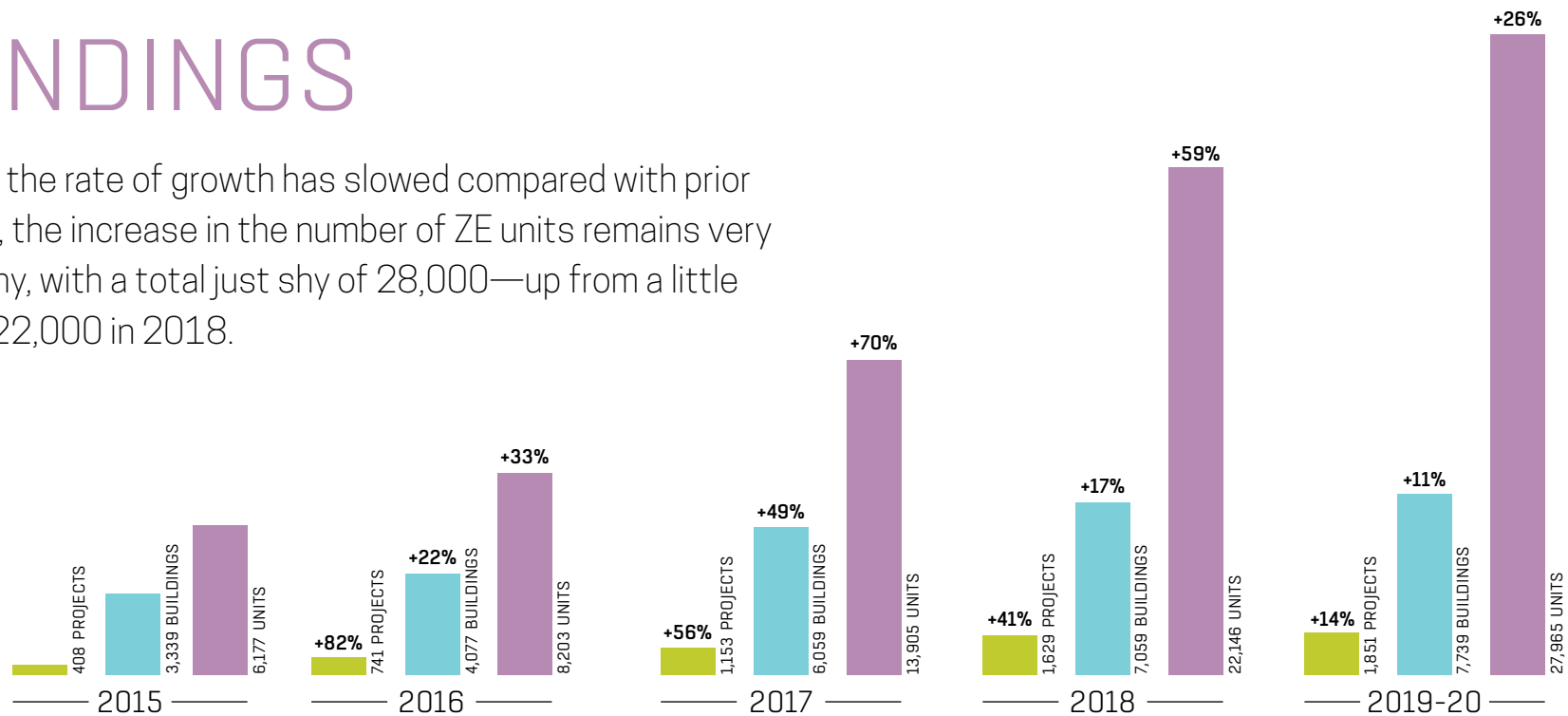
A FEW NOTES ABOUT OUR FINDINGS:

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 13); 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. A snapshot of projects in the planning stage is given on page 12.
6. Numeric discrepancies may appear from year to year, because the inventory is dynamic. Projections change, errors are found and corrected, and our stakeholders update their project information.
7. Because of the impacts of COVID-19 this past year, we have extended our data collection effort for this current report from 2019-Q2 to 2020-Q3, and named this report accordingly.



FINDINGS

While the rate of growth has slowed compared with prior years, the increase in the number of ZE units remains very healthy, with a total just shy of 28,000—up from a little over 22,000 in 2018.



THIS YEAR'S NUMBERS YIELD SEVERAL NOTEWORTHY FINDINGS:

We've seen a significant upward bump in energy performance (page 10)—the zero-energy category gained nearly 10% over last year, climbing up from 29% of units to 38.6%, with most of that increase reflecting a climb out of the ZE-ready category. Net positive units dropped a bit, however, from 4.5% to 2.2%.

Project size is relatively stable (page 6)—the average single-family development (excluding one-home projects) comprises 24 homes, vs. 26 last year. The average multi-family project has 62 units, compared with 59 last year.

The multifamily share in Canada is holding strong at 90% of all ZE units, compared with 73% in the US (page 5)—notable inasmuch as Canada is much less populous than the US, this may reflect a heavier concentration of ZE activity in urban areas.

In the two countries combined, multifamily projects now represent 75% of the total ZE residential stock—this is a modest gain over last year (71%) but bears out the year-over-year trend of increasing multifamily dominance in the ZE marketplace.

There are some new contenders and some position leaps among the top 20 cities (page 5)—California cities Richmond (#6), Los Angeles (#13), San Jose (#14), and Escondido (#18) appear in the top 20 for the first time (406, 338, 326, and 292 units, respectively); Denver jumped to #5 (709 units, vs. 265 last year)—giving Colorado a nice boost to fifth largest ZE state; and Sacramento has reclaimed a position in the ranks (#19, with 290 units).

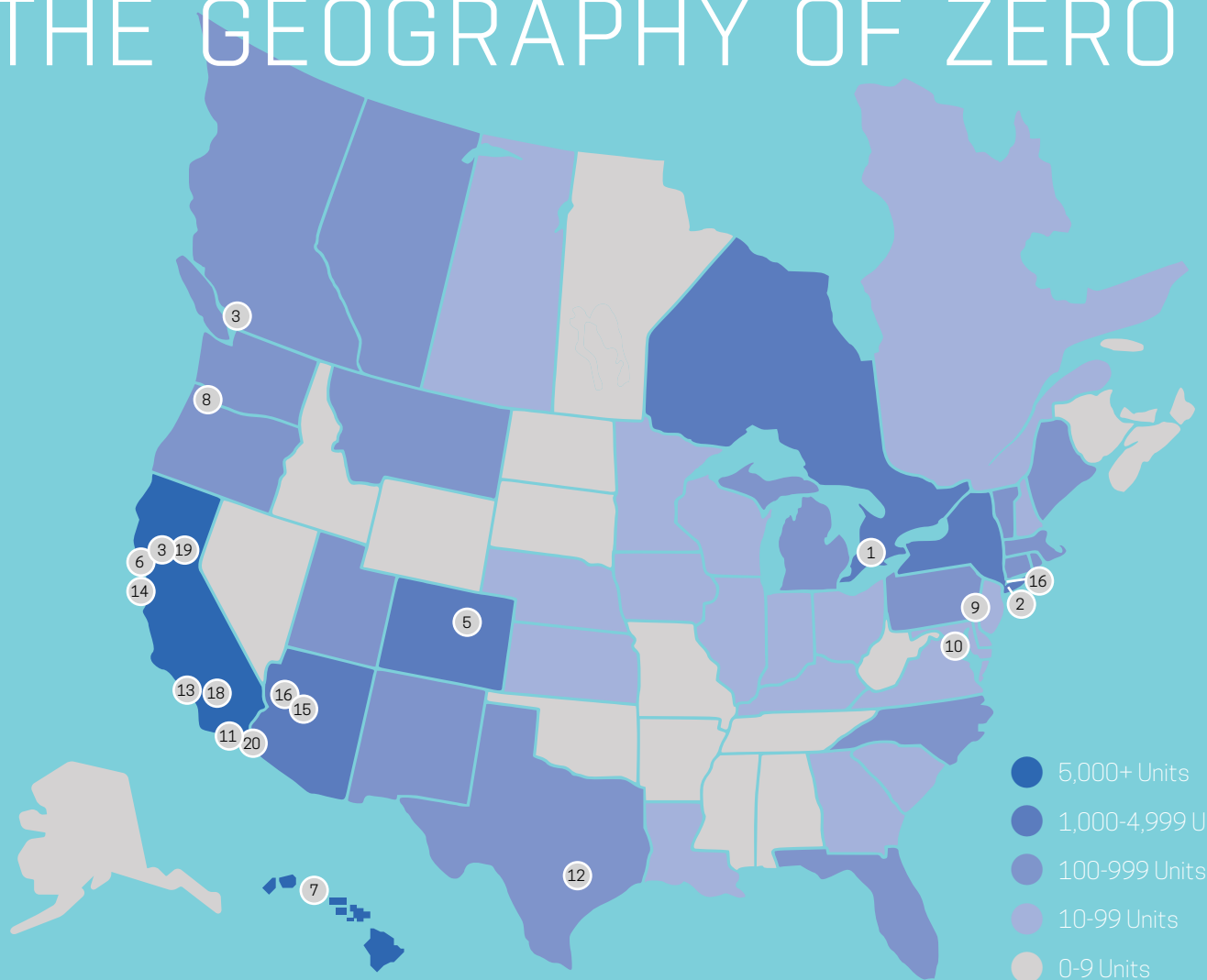
THE GEOGRAPHY OF ZERO

TOP 20 ZERO ENERGY CITIES BY NUMBER OF UNITS

| | |
|-----------------------|------|
| 1. London, ON | 2001 |
| 2. New York, NY | 1811 |
| 3. Davis, CA | 759 |
| 3. Vancouver, BC | 759 |
| 5. Denver, CO | 709 |
| 6. Richmond, CA | 406 |
| 7. Honolulu, HI | 389 |
| 8. Portland, OR | 378 |
| 9. Philadelphia, PA | 367 |
| 10. Washington, DC | 356 |
| 11. San Diego, CA | 352 |
| 12. Austin, TX | 347 |
| 13. Los Angeles, CA | 338 |
| 14. San Jose, CA | 326 |
| 15. Clarksdale, AZ | 323 |
| 16. Bronx, NY | 308 |
| 16. Chino Valley, AZ | 308 |
| 18. Escondido, CA | 292 |
| 19. Sacramento, CA | 290 |
| 20. National City, CA | 268 |

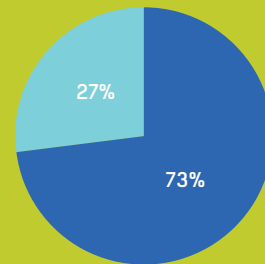
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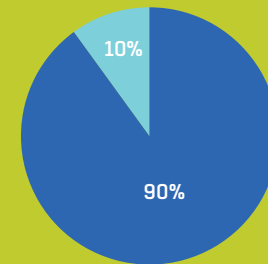


SPECIAL KUDOS TO HONOLULU AND WASHINGTON, DC—THE ONLY TWO LEADING CITIES NOT IN THE TOP TEN STATES

| | MULTI-FAMILY UNITS | SINGLE-FAMILY UNITS | TOTAL UNITS |
|--------------|--------------------|---------------------|---------------|
| CANADA | 3,070 | 348 | 3,418 |
| USA | 17,876 | 6,671 | 24,547 |
| TOTAL | 20,946 | 7,019 | 27,965 |



United States



Canada



MULTI-UNIT PROJECTS ARE ZE MAINSTAY

The most stable trend over the last several years is the dominance of both single-family and multifamily projects of two or more units.

These multi-unit projects represented 94% of the total ZE stock in 2017, 95% in 2018, and once again comprise 95% of all the units in this year's inventory. The remaining projects are those that consist of just one home.

The clear takeaway is that nearly all of residential ZE construction activity is driven by the business of home building, and not by private individuals.

ZE is not a custom niche!

MULTI-UNIT VS. SINGLE-UNIT PROJECTS, 2017-2019

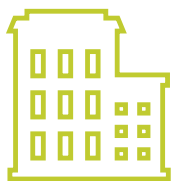
LEGEND



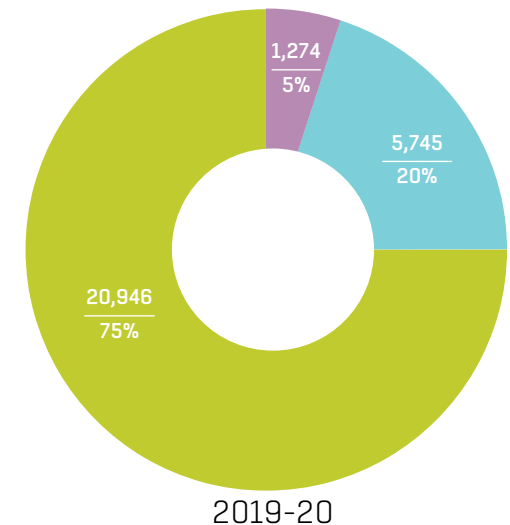
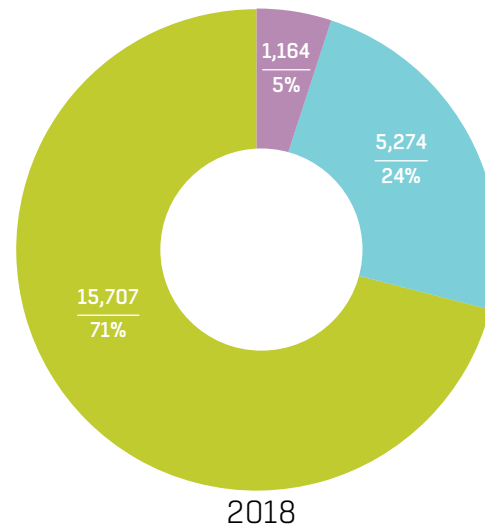
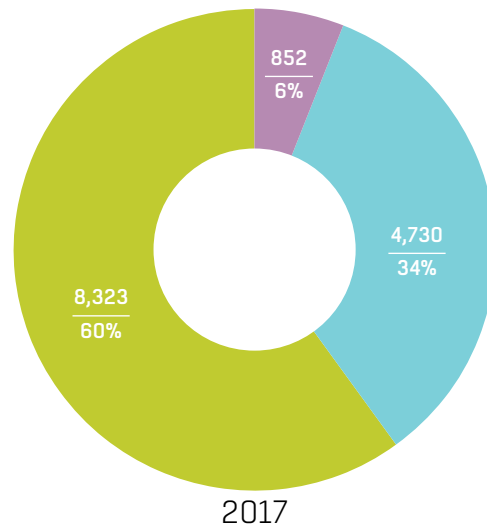
SINGLE-FAMILY HOMES



UNITS IN SINGLE-FAMILY MULTI-UNIT PROJECTS



UNITS IN MULTI-FAMILY PROJECTS



ZE STAR PROJECTS

Multi-unit projects this year account for 26,688 of the inventory total of 27,965 units:

- 20,943 in multifamily projects, with an average of 62 units
- 5,745 in single-family projects, with an average of 24 units

The large projects featured at right are emblematic of the consistent year-over-year leadership of three geographic regions, as the map on page 5 reveals:

- US Southwest anchored by California (#1), Arizona (#4), Colorado (#5), and Texas (#10)
- New York (#2) plus Ontario, Canada (#3), Pennsylvania (#7), and Massachusetts (#8), anchoring the Northeast US/Southern Canada
- British Columbia (#6), Oregon (#9), and Washington (#15), making up the Pacific Northwest



Sifton Properties still holds claim to the largest project in the inventory, reporting 1,900 multifamily units at [West 5 Phase 2](#), now under construction in London, Ontario (Canada).



The largest completed project is [West Village at the University of California – Davis](#), with 662 zero energy ready, multifamily units of student housing.

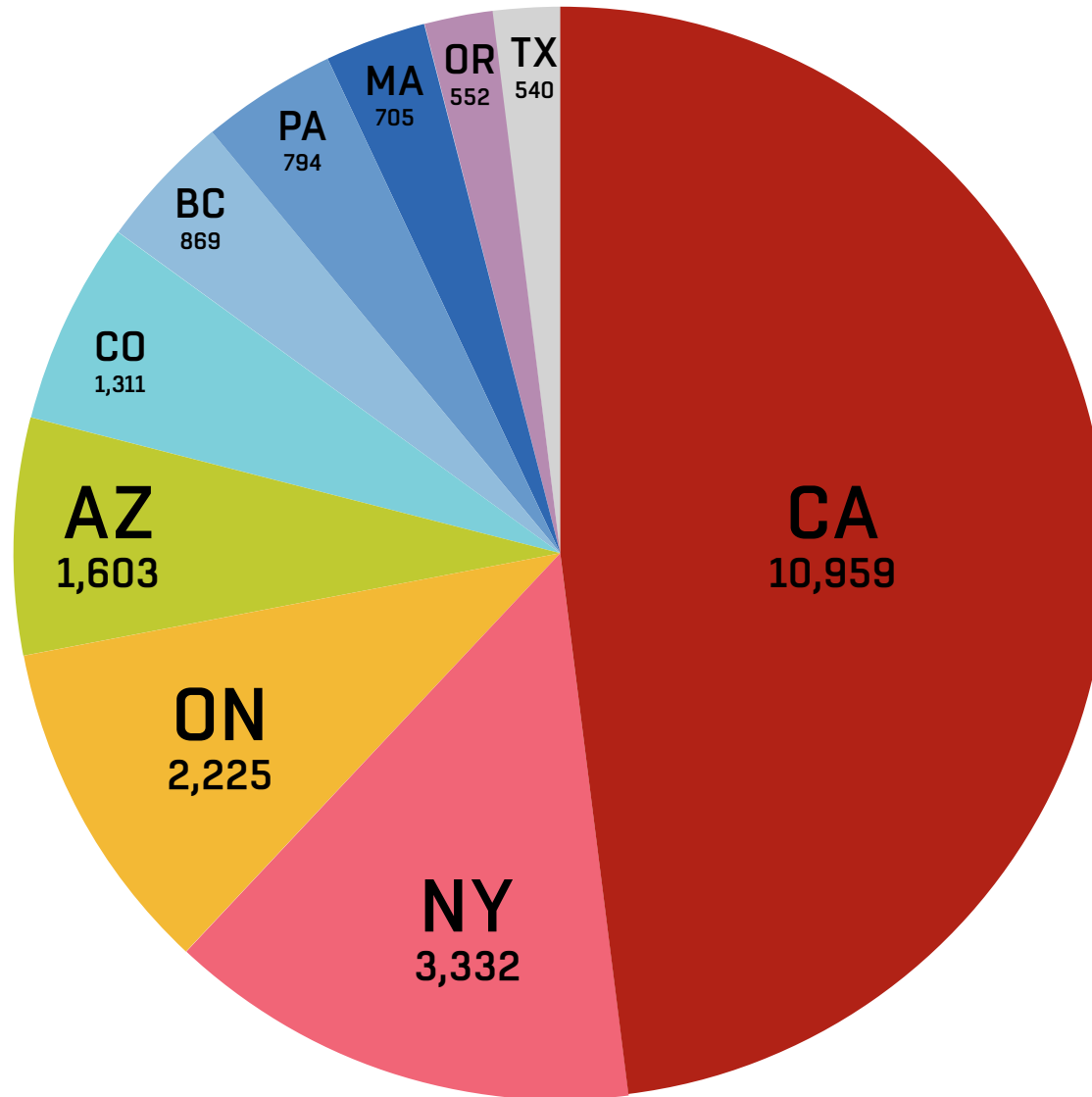


Mandalay Homes is holding onto the title for the largest single-family project: 323 ZE ready homes under construction at Mountain Gate, Clarkdale, AZ. Mandalay's leadership continues to crown Arizona sovereign in single-family ZE development, with 17 projects totaling 1,153 units, or 79% of Arizona's 1,458 single-family ZE homes. The largest completed single-family project is also in Arizona: Capstone Homes' 240-home Flagstaff Meadows subdivision in Belmont (zero energy ready).



Sendero Verde, a development under construction in East Harlem, New York, by L+M Development Partners, Jonathan Rose Companies, and Acacia Network, is close behind UC Davis's West Village, with 650 units. Phase 1, designed by Handel Architects, just topped out in late November 2020 ([details here](#)).

TOP 10 ZERO ENERGY STATES/ PROVINCES BY NUMBER OF UNITS



The top ten states and provinces all held their own this year, with one minor change – Colorado made a jump up from seventh place to #5.

| STATE/ PROVINCE | SUM OF # UNITS |
|--------------------|-------------------|
| CA | 10,959 |
| NY | 3,332 |
| ON | 2,225 |
| AZ | 1,603 |
| CO | 1,311 |
| BC | 869 |
| PA | 794 |
| MA | 705 |
| OR | 552 |
| TX | 540 |
| All others | 5,075 |

ZERO ENERGY ROCK STARS



TOP 10 ARCHITECTS BY NUMBER OF PROJECTS

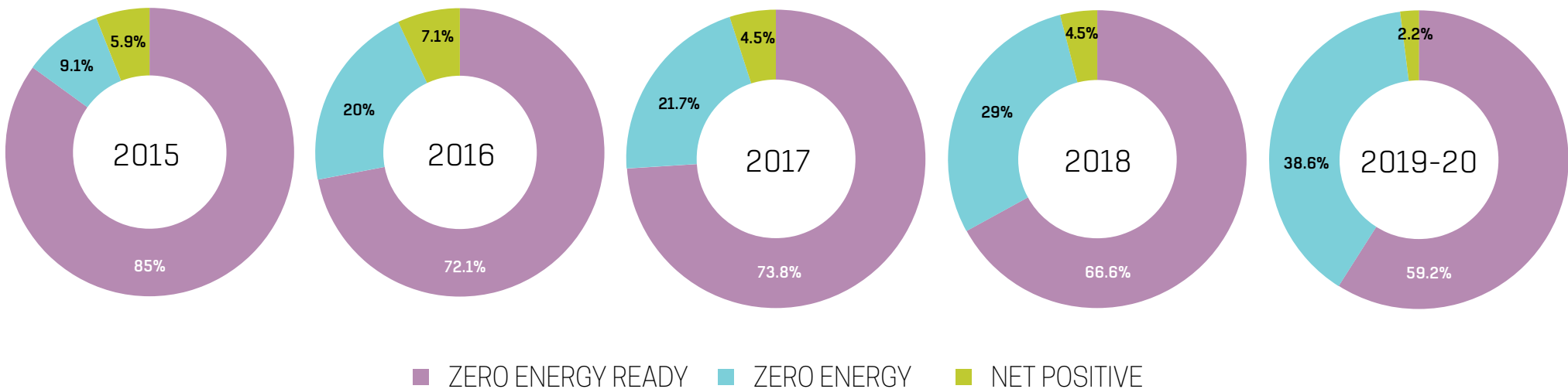
| | WITH ZE PROJECTS IN: | NO. OF PROJECTS |
|-----------------------------|------------------------|-----------------|
| ZeroEnergy Design | MA, NJ, CT, VT, RH, RI | 22 |
| Deltec Homes | NC, MN, AK, SC | 11 |
| Marken Design + Consulting | BC, NB | 8 |
| Green Hammer Design Build | OR, WA | 7 |
| Baxt Ingui Architects | NY | 6 |
| GVI International | TX | 6 |
| Lanefab Design/Build | BC | 6 |
| CK Architects | CT | 5 |
| Daniel Smith and Associates | CA | 5 |
| Pill-Maharam Architects | VT | 5 |

TOP 20 BUILDERS/DEVELOPERS BY NUMBER OF UNITS

| | UNITS | STATE/PROVINCE |
|--------------------------------|-------|----------------|
| Sifton Properties | 2,001 | ON |
| Corporation For Better Housing | 1,281 | CA |
| Mandalay Homes Inc. | 1,192 | AZ |
| Handel Architects | 1,002 | NY |
| Thrive Home Builders | 841 | CO |
| Affirmed Housing | 797 | CA |
| Danco Communities | 762 | CA |
| Carmel Partners - UC Davis | 662 | CA |
| Community Housing Works | 649 | CA |
| MRK Partners | 614 | CA |
| ONION FLATS | 487 | PA |
| Bridge Housing Corporation | 422 | CA |
| Bruns Realty Group | 408 | NY |
| Tesha Malama | 389 | HI |
| Palm Communities | 362 | CA |
| Recollective | 358 | BC |
| Planet Greenery | 351 | FL |
| Thrive Collaborative | 346 | CO |
| Transformations, Inc. | 344 | MA |
| FX Collaborative | 340 | NY |

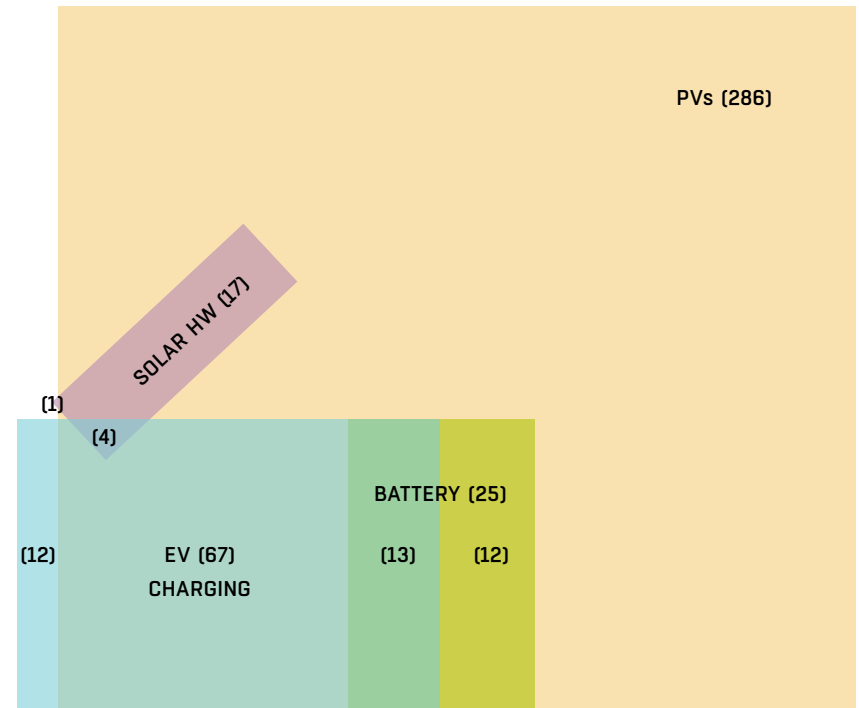
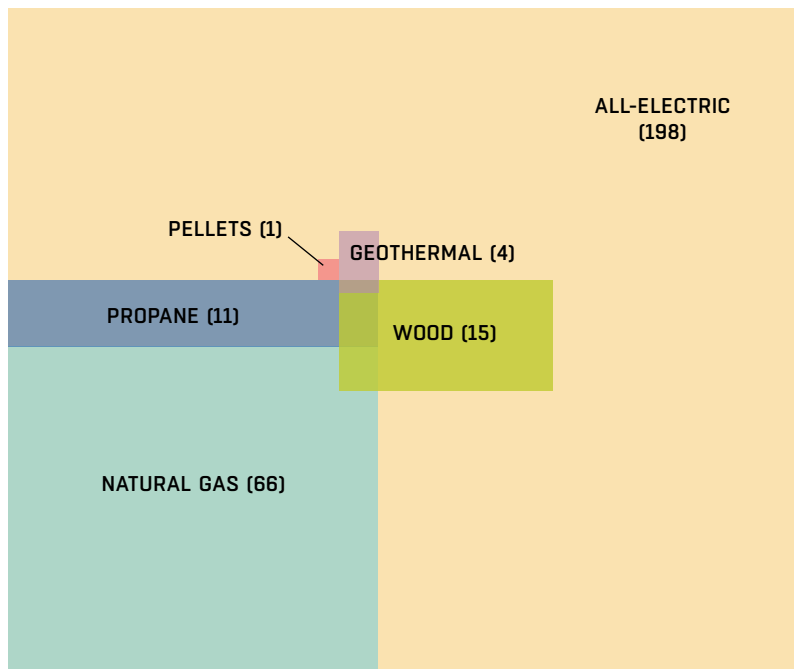
PERCENTAGE OF UNITS BY ENERGY PERFORMANCE

In our newly added category of **off-grid homes**, a total of 3 units was reported, all single-family—too few to show up in the circle graphs below.



NEW DATA

Here we show some more new information from our ZE project reporters—how they’re fueling their projects and what special energy features they’re incorporating. Because fuels and energy system features are new data requests this year, these graphs represent a small subset of all the projects in the inventory, yet nevertheless reveal interesting patterns.



ZE FEATURES

298 responses (projects):

- 96% include photovoltaics (PVs)
- 22% include electric vehicle (EV) charging
- 8% include batteries
- 6% include solar water heating
- 4% include PVs, EV charging, and batteries

FUEL TYPES

287 responses (projects):

- 69% all-electric
- 23% electric + natural gas
- 5% electric + wood
- 4% electric + propane

UNITS AND PROJECTS BY PHASE

As noted earlier, most of the numbers cited throughout this report represent only projects that are in the first three of the following phases of development:

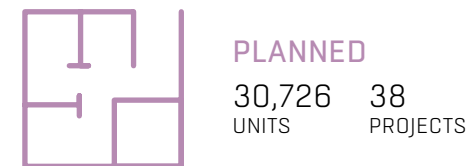
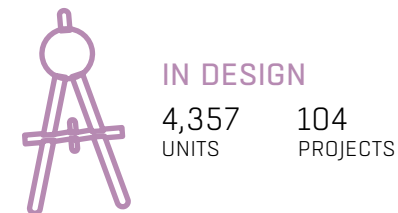
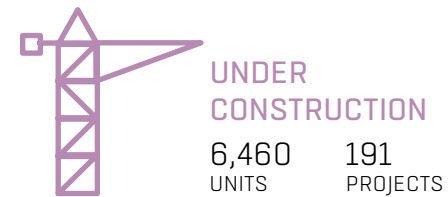
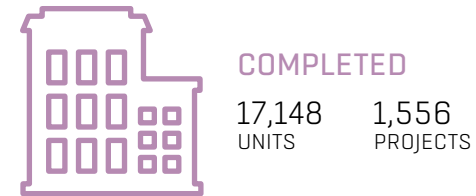
1. Completed
2. Under Construction
3. In Design
4. Planned

An additional 30,726 residential units were reported to be in the planning phase—only 129 more than last year. We're not entirely sure what to make of this, but with ZE continuing to show strong growth overall, it's reasonable to conclude that we're capturing only a fraction of the ZE planning pipeline.



RESIDENTIAL ZERO ENERGY PIPELINE

Here we show the current inventory breakdown by phase, for both units and 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 ZE programs. In all cases, we have relied on

| | DESCRIPTION: DOCUMENTATION MUST SHOW THAT THE RENEWABLE ENERGY SYSTEM... | QUALIFYING PROGRAMS |
|--------------|--|--|
| Net Producer | Supplies 110% or more of the annual energy demand | <ul style="list-style-type: none"> ILFI Net Positive Energy |
| ZE | Supplies 100% or more of the annual energy demand | <ul style="list-style-type: none"> ILFI Zero Energy Building Certification LEED Zero Carbon-Operational LEED Zero Energy-Operational 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 <i>All programs that rely on modeled rather than measured energy performance fall into this category.</i> | <ul style="list-style-type: none"> DOE ZERH Earth Advantage Net Zero & Net Zero Ready LEED Zero Carbon-Design LEED Zero Energy-Design NGBS Green+ Net Zero Energy PHI ‘Classic’, ‘Plus’ & ‘Premium’ PHIUS+ Thousand Home Challenge |

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 did, in 2015, assisted 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.

WHO IS TEAM ZERO?

Since publication of the last Inventory, TEAM ZERO, formerly the Net Zero Energy Coalition, has joined forces with the Energy & Environmental Building Alliance (EEBA) to form a unified organization with the shared goal of sustainable market transformation towards a future with ZERO health impact, ZERO energy, and ZERO carbon homes.

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.

LEARN MORE AND JOIN US!

Learn more about the EEBA TEAM ZERO alliance: teamzero.org/2020/07/21/eeba-team-zero-announcement

If you or your organization is in agreement with the TEAM ZERO mission, please join us: teamzero.org/join

And if you are in a position to become a TEAM ZERO Sponsor, please sign up: teamzero.org/sponsor-team-zero

Report your project or refer other projects and builders for the next inventory: teamzero.org/resources/zero-energy-inventory

ACKNOWLEDGEMENTS

We thank our sponsors and donor members for their past and current financial support, without which neither the 2018 nor the 2019-20 inventory would have been possible. We also thank our current donor members and sponsors (shown at right) 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.

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Nuria Casquero-Modrego - research & data analysis

Frank Baker, President, TEAM ZERO

Aaron C. Smith, CEO, EEBA/TEAM ZERO

COLLABORATING ORGANIZATIONS

- Architecture 2030
- 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



For more information, email info@teamzero.org

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