

Is Zero Net Energy 2020 Actually Attainable, Perceptions of Various Professionals Effectuated

Michael Aldridge

California Polytechnic Institute
San Luis Obispo, California

California has created a mandate that will require all new residential buildings to become Zero Net Energy by 2020. Some are already doing it others don't know what it means, and some don't think it will be possible. Those that already do it are doing it without any extra cost. All that is required is, on average, a 4KW roof solar panel system. This is something that easy to install and only requires a little more planning during the design phase. There are many other things that a designer and builder can do to successfully reach ZNE including focus on the envelope or natural light, but the minimum would be the 4KW system. ZNE is actually a very easily attainable goal. A lot of the worry surrounding ZNE 2020 is actually due to the lack of information some builders have about it. Not knowing what ZNE means or how to actually implement it creates a lot of worry for small builders who have done it a certain way for so long. Realizing that their needs to be more information, California made a plan to begin educating professionals on what the expectation is. 2020 seems like a long time away, but it really isn't for those in the construction industry. The change has to start now and the programs have to be introduced in order to educate those who don't know. When 2020 comes around California will be ready for the mandate, and if they are not they will begin to adapt to it very quickly.

Key Words: Title 24, Zero Net Energy, ZNE, Residential Construction, Green Building, Sustainable Homes, Zero Energy Building, ZEB.

Introduction

The state of California has always been a leader in innovation, especially in construction. California published the first Uniform Building Code (UBC) in 1927, which set the framework for uniformity in building codes for the years to come. Just the same, in 1978 California enacted Title 24, which became the standards on energy in California. (History 2016). Since, California has pushed energy standards as a priority, "In California, the passage of AB32 consolidated future statewide goals for reducing Greenhouse Gas (GHG) emissions. Subsequently, the California Public Utilities Commission (CPUC) adopted the Big Bold Initiative, which directed that all new residential and commercial construction be Zero Net Energy (ZNE) by 2020 and 2030, respectively." (Collyer, 2012). AB32 in 2006 led to the Title 24 changes; "In 2008 the state set a goal for new residential buildings to reach zero net energy (ZNE) target starting in 2020 with the same extended to new commercial buildings by 2030." (Zero-net-energy homes, 2015). When AB32 and Title 24 initially proposed the idea of ZNE Residential 2020 there were many who did not believe it could be done, they said, "certainly not by 2020, and not even remotely at a cost anyone could afford." (Zero-net-energy homes, 2015) Now, eight years later, the industry is beginning to react. Some companies are already preparing themselves for the mandate while others do not think ZNE 2020 will happen and are waiting until it becomes a requirement before any changes are made. Regardless of how companies are reacting, California has attempted to clarify what Title 24 means by ZNE and has begun devising a plan to reach it by 2020. ZNE is attainable and will be required in the next four years; it's time the whole industry jumps on board.

Methodology

Objectives of this project:

- Introduce Title 24 and Zero Net Energy 2020.
- Define Zero Net Energy.
- Identify different ways California is attempting to transition the industry into ZNE.
- Discuss what it takes to attain ZNE in California.
- Present and Address perceptions of Zero Net Energy 2020 from the Industry.

- Conclude that Zero Net Energy 2020 is attainable

This report will attempt to present more knowledge about Title 24, Zero Net Energy 2020 for residential construction, some of the different systems used to attain ZNE, how likely it will be and to create an awareness of how the residential industry is reacting to the mandates. In order to successfully complete the objectives above this report will use several different resources.

In order to present more knowledge on the subject of Title 24 and ZNE 2020, this report will look directly at the literature within Title 24's Residential Compliance Manual (2016) prepared by the CEC. When looking at the manual this report will show the use of different journal articles to compliment and clarify what the Compliance Manual states, including the definition of ZNE. The Cal Poly Library was used in order to find these useful journal articles.

To identify and discuss what California's plan is to accomplish ZNE 2020 this report uses the CEC's Plan workshop. This workshop was created by California in order to better prepare professionals for the changes coming from Title 24.

For identifying different ZNE systems used this article will reference different journal articles and interviews of professionals in the San Luis Obispo residential industry. These interviews will also discuss different perceptions the industry has on ZNE 2020. The interviews give this report new and localized knowledge on where San Luis Obispo is in the transition of ZNE. Although the interviews allowed for the conversations to develop, there was a series of pre-prepared questions. Those questions were:

- Tell me more about you and your company?
- What is your knowledge of Title 24?
- Have you begun making changes for ZNE 2020?
 - If so, what different systems do you use to reach ZNE 2020?
 - If not, have you worked with sustainable technologies before?
- What cost implications do you experience from T24?
- What is your knowledge on other residential companies in the area adapting to Net Zero 2020?
- How do you think the industry is doing in the transition before 2020?
- Is T24 possible in your industry?

Using these findings, this report will attempt to provide new knowledge on Title 24, ZNE 2020, and the perceptions within the industry. Giving a better understanding on how the Residential Industry is going about reaching the 2020 deadline.

What is Zero Net Energy?

"California's building efficiency standards are updated on an approximately three-year cycle." (California title 24, 2013). In 2013 and 2016 these updates have attempted to make a clear and concise definition for what the ZNE expectation is. In 2006 ZNE, know as "Zero Energy Building (ZEB) at the time, was originally given four definitions all somewhat different from the other. The four definitions given by the National Renewable Energy Laboratory (NREL) were (Collyer, B):

- **Net Zero Site Energy:** A site ZEB produces at least as much energy as it uses in a year, when accounted for at the site.
- **Net Zero Source Energy:** A source ZEB produces at least as much energy as it uses in a year, when accounted for at the source. Source energy refers to the primary energy used to generate and deliver the energy to the site. To calculate a building's total source energy, imported and exported energy is multiplied by the appropriate site-to-source conversion multipliers.
- **Net Zero Energy Costs:** In a cost ZEB, the amount of money the utility pays the building owner for the energy the building exports to the grid is at least equal to the amount the owner pays the utility for the energy services and energy used over the year.
- **Net Zero Energy Emissions:** A net-zero emissions building produces at least as much emissions-free renewable energy as it uses from emissions-producing energy sources.

It was difficult to understand Title 24's mandates on ZNE 2020 with so many different definitions. It was difficult for the professionals in the industry to understand exactly what is required. It also made it difficult for California to assist in the transition to ZNE without having a more specific definition. The problem with these four definitions above is that they are too vague and do not take into account different locations, seasons and times of day. Because of the lack of clarity and difficulty of each definition, the California Energy Commission (CEC) decided to revise the definition. The revised definition became a working definition that is currently defined as, "The *societal value of energy* consumed by the *building* over the course of a typical year is less than or equal to the societal value of the *on-site renewable energy* generated." (California Energy Commission 2011). The biggest change to the definition is the "Societal value of energy."

Societal value of energy means, "the long-term projected cost of energy including cost of peak demand and other costs including projected costs for carbon emissions, e.g., the time dependent valuation (TDV) of energy." (California Energy Commission 2011). The CEC found that it was important to acknowledge the varying of energy costs during different seasons and hours. (Path to achieving). "While the details of the Title 24 TDV methodology can be complex, at root the concept of TDV is quite simple. It holds the total cost of energy constant at forecasted retail price levels but gives more weight to on-peak hours and less weight to off-peak hours. This means that energy efficiency measures that perform better on-peak will be valued more highly than measures that do not" (Brand, Brook, & Leslie, 2015). This working definition has clarified expectations for those in the industry, making ZNE a more concrete and achievable goal. In order to achieve this goal Title 24 has two different methods.

The two methods for complying with Title 24's ZNE 2020 are prescriptive and performance. Prescriptive is the bare minimum needed to meet the efficiency requirements. (MacCracken, 2016) Performance on the other hand is more complex. "Performance compliance uses computer-modeling software to trade off efficiency measures. For example, to allow more windows, the designer will specify more efficient windows, or to allow more west-facing windows, they will install a more efficient cooling system." (Residential Alternative Calculation, 2016) The Performance method is favored due to its flexibility in design and equipment used, but both methods are acceptable for Title 24 building standards. Despite the method chosen by companies, the change has to happen. In less than four years ZNE 2020 will go into effect.

The Supporters

Amidst the skeptics there are some definite hopefuls. For one, the CEC and CPUC are very certain that the market can shift to ZNE by 2020. As well as California there are some professionals in the industry who are also very optimistic about ZNE 2020. A San Luis Obispo architect and builder are among those who look forward to the 2020 mandate seen in the interviews below as well as a couple already successful ZNE projects.

Jessica Steely – Co owner of Semmes & Co. Builders, Inc.

Jessica Steely is a co-owner of Semmes & Co. Builders, Inc., a high-end custom homebuilder in San Luis Obispo County. Semmes & Co. has been around since 1978. From the beginning their goal has been innovation and sustainability. One way to accomplish this is the use of the Design-Build project delivery method. This allows for a lot of collaboration with the Architect from the beginning. Jessica has been with the company since graduating Cal Poly in 2004 and became an owner in 2011. She is now General Manager and Head of Sales. In the conversation with Jessica, when asked about Title 24 and Semmes & Co., she said, "For us it has been relatively easy, because we've been exceeding Title 24 by 60 to 80 percent over the years and so as the requirements get more respective, it's not frequent, for us, to be in a position where it is a challenge." Semmes & Co. has been doing it for years so it is not difficult because there is nothing to change. That being said she expressed that, although she can't speak for other companies, the 2020 mandate is not a difficult thing to reach. Jessica went into some detail on the different systems they used in order to be well over the requirements for ZNE 2020. Some of those systems and techniques are: Passive solar, solar water heating, efficient windows, orientation, sealed envelope, 2x6 or 2x8 walls, blown fiberglass insulation, LED lighting, Heat pump technology, and induction stoves, etc. Jessica explained how the list could go on and on, but as for implementing these techniques into the home, it is pretty easy and inexpensive. It just requires planning. Jessica also stressed the use of the performance standard over the prescriptive standard, because it is easier to be more cost efficient using many different systems. Jessica closed with, "Technology is out there now days to be able to enable us to do net Zero very easily" As for her and Semmes & Co., ZNE 2020 is nothing to be afraid about. (Steely, 2016)

Stacey White – CCGBC Founding Board Member

Stacey White seems to agree completely with Jessica; there is nothing to be afraid of. Stacey is multi-faceted woman. Stacey graduated Cal Poly in 1999 with a Bachelor of Architecture. She has since worked as an architect at RRM Design until opening up her own company, Mode Associates. Stacey is also a lecturer at Cal Pol where she teaches an Architecture Studio class and technical courses on Sustainability. She is also a Founding Board Member of Central Coast Green Building Council and LEED AP BD+C. Stacey is very familiar with Title 24. It is part of the curriculum to one of her courses as well as a big part of her designing as an architect. She shared about her experience with Title 24 and the way it typically works. “Title 24 updates every three years and it gets incrementally more rigorous, that we go through this super predictable cycle, we’ve been doing it since Title 24 came into play, is where it gets more rigorous, there’s this reaction like it can’t be done, then we figure out how to do it and we do it.” Apparently that is how the market has been reacting since the beginning of Title 24 and she doesn’t see it changing anytime soon. She went on to talk about her personal house, which has been Zero Net Energy for ten years now, and she has two electric cars. Her explanation was that it wasn’t that hard. It only required about a 4KW system for solar energy and some simple techniques within the house. “If all you have to put in is a 4KW system all you really need is roof area and as long as you’re not putting in anything weird, as a package it’s not a problem.”

All of which did not cost her a dime more. This brought up a story about UC Merced. About ten years ago the school created a plan with Zero Net Framework. This meant Zero Electric, Zero Water, and Zero waste. At first she said they were nervous and didn’t think it would be done or that they could afford it, but the campus decided to implement it anyways and it was successful and without any extra cost. It took a little more planning, but she said the biggest thing was that the architect and contractor were made aware of the project parameters from the beginning, which allowed for a smooth and successful project. She is certain that, “Cost is because of lack of clarity.” Her thoughts are that ZNE 2020 is very simple, especially in the climate of San Luis Obispo, and will only require some education and planning. She exclaimed, “People like to freak out about everything... There’s nothing to be freaked out about!” (White, 2016)

Jacob Atalla of KB Homes

In the PG&E ZNE Cost Study it looked at several different examples of successful ZNE stories. One of those stories was Jacob Atalla’s story with his company KB Homes. “For instance, Jacob Atalla of KB Homes indicated that his company took the state’s 2020 ZNE goal to heart and has started to explore ZNE design strategies, implementation issues, expected costs, and customer satisfaction in advance of the 2020 target. To date, KB Homes has built eight ZeroHouse2.0 ZNE homes throughout the U.S., including one in southern California. According to Mr. Atalla, all eight of these homes show a positive homeowner cash flow (monthly utility bill savings greater than added mortgage costs). These early projects allow KB to gain experience with ZNE implementation and also assess supplier capabilities, marketing issues, and cost implications.” (Collyer, 2012). Jacob wanted to let the market know that yes it is possible and it saves the owner in the long term.

The Skeptics

There are many different views on the probability of the residential industry reaching ZNE by 2020. Some people in the industry feel that ZNE 2020 is an unreachable mandate. California’s Energy Efficiency Strategic Plan conducted a survey on ZNE 2020 to find, “45.3% of respondents indicated that California is not on track to meet its residential ZNE goals, and only 5.3% believe that the State is on track. Most people were unsure. Looking at the top respondents by profession, there is a definite difference in how each group responded with technical experts and utilities being the least optimistic.” (Appendix A, 2013). See the California’s Energy efficient Strategic Plan’s findings in Figure 1.

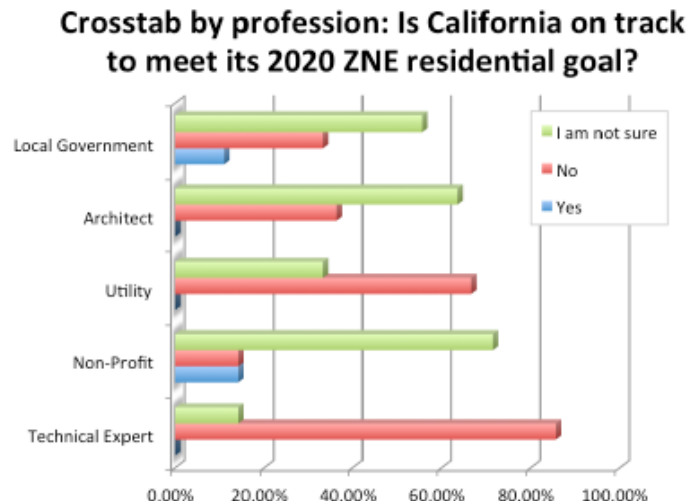


Figure 1

Others think that the expenses will be too high. “Anyway it seems that the global economic crisis of recent years has prompted lawmakers to scale back targets, evidently considering the fact that a NZEB (meaning net zero) is too expensive.” (Adhikari, Aste, Pero, & Manfren 2012). Some aren’t even aware of the mandate. A few local San Luis Obispo builders had a lot to say about ZNE 2020 in their interviews. PG&E also published a cost study on ZNE 2020. Parts of the interviews and report are seen below.

Mark Sullivan - Owner of Mark Sullivan Homes

Mark Sullivan has been building custom homes on the Central Coast since 2005. Before his 11 years in San Luis Obispo he worked for several residential companies in Houston, Dallas, and Fresno. He began as a laborer and has worked his way up through management until now owning his own custom home company, Mark Sullivan Homes. When asked about Title 24, Mark explained how he is very aware of Title 24; he has to be. “Title 24 is the energy standards that builders have to meet when building. We know a great deal about them. That being said, you are asking more specifically about Zero Net 2020. I speak for myself and other contractors I have spoken to when I say we have been given very little about Zero Net 2020 and what is actually required.” Mark began to explain that the mandate was introduced in 2008 or 2009, but himself and his colleagues have only more recently been hearing about it. He went on to say that his company has used very little sustainable systems. “Occasionally we will sub out a solar install, but that is about the extent of it.” He said that his company and others he knows of in the area are sitting tight. No one is making changes and they won’t until they need to. His thoughts were that spending extra money now when it isn’t mandated is pointless. “When people are forced to change, they will.” Mark thinks the changes might be important to the environment, but they are going to hurt smaller businesses trying to stay competitive. He says that Zero Net 2020 will increase the cost of a home greatly without helping its value increase much. (Sullivan, 2016)

Isaac Montgomery – Owner of IMC Building

Isaac Montgomery is a Central Coast Native and has had his own company, IMC Building, since 2008. Isaac has been in and around construction his whole life, working on both commercial and residential projects. IMC focuses on Custom Homes, building new homes and remodeling others. Isaac had similar things to say about ZNE 2020. His thoughts on ZNE 2020 were that is was, “over the top” and “beyond the reach of small businesses like IMC”. He explained that because his company does only one or two new homes a year it is very difficult to push sustainability. He has done work with sustainable systems before, but only if the customer wants to implement them. Isaac explained that he loves the idea of sustainability, but he says that San Luis Obispo County is not the market for it. “Most people here are cheap. Even if they are wealthy they try to get as much as they can for as little as possible.” He added that he thinks that there should be mandates little by little, but not an overall Zero Net Energy requirement. Overall his thoughts were that ZNE 2020 was not good for the market and that he plans to keep doing things the way he always has until someone stops him. (Montgomery, 2016)

PG&E

PG&E’s cost study in 2012 addresses some of the same concerns. The main issue with ZNE 2020 is the cost. See the below except of their study:

The question of funding energy efficiency or renewable energy measures can be challenging, especially for residential buildings. For example, if energy efficiency measures and PV installations for a home cost \$50,000 more than comparable baseline construction, homeowners must identify a financing strategy for these costs. In areas of the country with expensive real estate, including many coastal urban areas, these incremental costs do not significantly affect mortgage costs and homeowners may be willing to undertake initial financial burden to achieve long-term energy savings and improved comfort. In less-expensive areas, however, these additional measures would constitute a much larger percentage price increase and could therefore be adversely impacted by the appraisal process. These effects could deter both homeowners and lending organizations to invest in the property. The relative cost of ZNE measures in relation to the property value is an important consideration. Currently the SAVE Act11 is currently on the floor of the U.S. Congress to help address the appraisal issue. The legislation would require that energy costs be included in the underwriting process for federally financed single-family mortgages. (Collyer, 2012)

There are a lot of skeptical builders in the industry who have a lot of unanswered questions; most just have not been given the proper knowledge or training.

The Plan

California officials are realizing that changes have not taken place so far. “Approximately 1,100 ZNE-type homes mostly near ZNE, but includes 16 ZNE about 0.2-0.4% of market since 2006, but ~1% in 2014.” (Action Plan 2015). The California Energy Commission (CEC) and the California Public Utilities Commission (CPUC) have been creating plans for the 2020 change. Their goal is to make the transition as easy as possible for those in the industry. Their action plan consists of six goals driven by six guiding principles. These six guiding principles are: Market Driven, Flexible, Leverage, Consistency, Measurable, and Multiple paths. Each of these six leads to one of the six action plan goals listed below with their purposes (Action Plan 2015):

1. Demand and Awareness
Create deep awareness of the value and benefits of ZNE with homebuyers and builders to spur demand and drive broader industry involvement.
2. Technical Training and Education
Adopt a residential workforce sector strategy³ to increase participation in and improve the quality of education and training for industries related to planning, designing, constructing and developing ZNE homes.
3. Technical Tools
Ensure availability, effectiveness and efficiency of technical tools for designing, modeling, constructing, and monitoring ZNE buildings.
4. Financing, Affordability and Value of ZNE
Develop specific approaches and standards to quantify the value of ZNE homes, support a robust financing market and ensure that ZNE homes are affordable.
5. Future Infrastructure
Drive future grid infrastructure and technological improvements to support State distributed generation goals and a ZNE Building Future.
6. Alignment
Align the development and implementation of regulations, policies, plans, incentives, and codes related to ZNE buildings.

“For this Action Plan to be successful it is critical that the strategies and tactics identified are responsive to the needs, interests, and ideas of industry leaders, key actors, partner agencies, and utilities. This means that the Plan is focused on achieving milestones and being as feasible as possible in the breadth and depth of the proposed strategies and tactics.” (Action Plan 2015). The CEC and CPUC are trying to create these programs and strategies to be appealing to those involved in the Residential Industry. Getting more people on board will begin to create a larger transition into ZNE. In 2014 the percent of homes that were ZNE was about one percent. With this Action Plan the CEC and CPUC estimate that the amount of ZNE homes will grow tremendously in the next few years. Below is an estimate of the growth up until 2020 taken from the CEC and CPUC’s New Residential Zero Net Energy Action Plan 2015-2020.

Figure 2 shows that for the next couple years the amount of ZNE homes will slightly increase until 2019 when it will shoot up to reach the number of new homes constructed per year. For California, with the help of the CEC and CPUC’s Action plan, ZNE 2020 is a goal that will be reached it is just going to take some work to educate the builders.

Estimated Number of ZNE Homes Per Year Compared to New Construction Starts

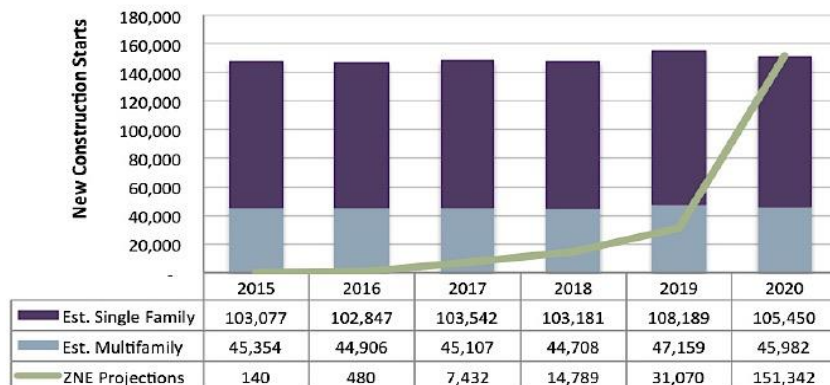


Figure 2

What does it take?

Some are already doing it. Figure 3 below, from the CEC, shows the California regions already succeeding in ZNE. In 2020 this picture will have to look a lot different, but for now it shows that there are places that are focused on these changes to come. Luckily it does not take much to get to ZNE.

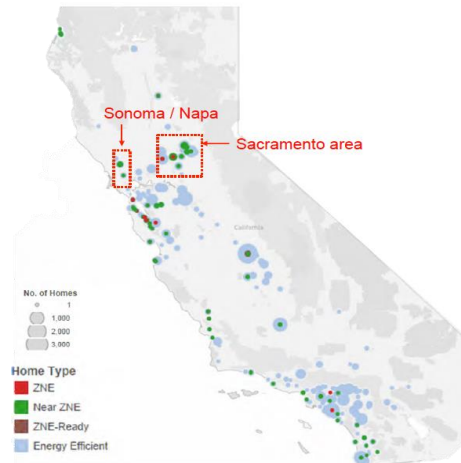


Figure 3

As stated above by Stacey, the average size Photo Voltaic system needed for ZNE is a 4KW. This is seen when looking at the homes in Sierra Crest. “The homes in Sierra Crest will have high efficiency solar photovoltaic (PV), HVAC systems, water heating equipment, heat pumps, and integrated fresh air ventilation. In addition, each will have spray foam insulation, highly insulated windows, energy-efficient lighting, smart chargers, and smart appliances. Together, these features are expected to reduce a typical home’s energy use by as much as 60 percent compared to a house built to the latest California building code. Because the homes are highly efficient, they need a relatively small solar PV capacity to reach the ZNE target. “In a conventional home, the size of PV . . . sufficient to make a home ZNE can be between 7–10 kW. Because of the included advanced energy efficiency, our ZNE homes can achieve (this target) with 3.5–4.5 kW,” (Zero-net-energy homes, 2015) 3.3-4.5 seems like an attainable target and one professionals can accomplish, but California is doing everything they can to make it as simple and as inexpensive as it can.

One thing California is trying to do is provide incentive programs to counteract the cost of PV’s. “The CEC’s New Solar Home Partnership (NSHP) has provided financial incentives for 37,383 systems for 94.0 MW since 2007, for an average installed PV capacity of 2.5kW (State of California 2015a). The average PV capacity for single family residential finished and incentivized projects is 3.0 kW, at a cost of \$20,100 For 2010-2014 reported data, the average size is 3.05 kW, at a cost of \$19,700. NREL shows a decline in average PV installed cost of 6-7% per year on average from 1998-2013 and 12-15% from 2012-2013 (Feldman, 2014). These projections of PV cost reductions, if realized, will have an impact on economic system size going forward.” (Brand, Brook, & Leslie, 2015)

Conclusion:

The incentives are there, the average cost seems to be low and the goal seems to have become more clear, so what is it that is causing such mixed perceptions of ZNE 2020 from those in the industry? Gordon Holness put it eloquently in Ashrae Journal, “We have to develop a culture of sustainability, and it will take consumer awareness and behavioral changes to make any significant progress.” (Holness, 2011). It is going to take more education and awareness before ZNE 2020 will be widely accepted. This education will require both sides working together to help one another. For professionals like Mark Sullivan and Isaac Montgomery it might take some research and going to people to ask the confusing questions. For people like Stacey White and Jessica Steely it will entail reaching out to fellow colleagues and offering their knowledge. Only 5.3 % of professionals believe California can meet the goal for ZNE 2020, but it is not because of the cost of the technology or the difficulty of the systems. It is because many are still in the dark and need to become better informed. As Stacey put it, we think it can’t be done, then we figure out how to do it and then, “We do it!”

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