

Net-Zero Homes, The Homes of Our Future

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Net-Zero homes are the homes of the future (Holmes, 2018). What makes Net-zero homes unique is they rely on solar power, opposed to all standard housing that relies on the power grid. These homes use solar instead of other forms of energy generating technology because it is more affordable and better for the environment. California has blazed the trail for the rest of the United States and the world to follow with their Net-Zero housing proposition. Starting January 2020 California will require all residential buildings to be net-zero homes. Net-Zero homes are important because it is no secret that our atmospheric CO₂ levels have dramatically increased in the last 10 years. Because Net zero homes are a clean energy source that can help us fight back and eliminate a large portion of our CO₂ emission. This case study will highlight the multitude of benefits that net-zero homes have on the world. The cost analysis in this paper will educate the reader on why Net-Zero homes are the better option in the long run. Net-Zero homes are not only cost effective for the buyer/owner but also environmentally friendly for the world.

Key Words: Net-zero, carbon emissions, cost analysis, environment, Solar

Introduction

In the early 2000's net -zero homes got on the map and became an extremely hot topic in all areas of the United States. In 2005, National Renewable Energy Laboratory (NREL) and Habitat for Humanity of Metro Denver got together and decided to build an affordable and sustainable Net-Zero Energy model home that would generate as much energy as it consumes. Three years later, the project took off and exceeded their expectations (NREL, 2008). The U.S. Department of Energy (DOE) Solar America Initiative (SAI) was created in January 2006 as part of the President's Advanced Energy Initiative. The SAI's goal is to make solar energy cost competitive by 2015 (NREL, 2007). The price of solar has dropped upwards of 70% since 1980 making it more affordable than ever (Boston Solar, 2020).

In the beginning of 2020, California took a stand and said all new residential buildings would be required to be net-zero. When California made their statement about changing their building guidelines other states have followed by example. New York has plans to change their new residential building laws to be net-zero by 2040 (NY Pension, 2020). Some of the benefits of Net Zero homes are cost (huge savings), personal health improvements, and positive environmental impact. Because of the environmental crisis of today's reality people are looking for any way to live a healthier lifestyle and use only clean energy. Some studies have found that living in a Net Zero home can help reduce possible diseases from gas emissions that have long term effects on the human body (SMO, 2021).

Zero Energy Building Growth

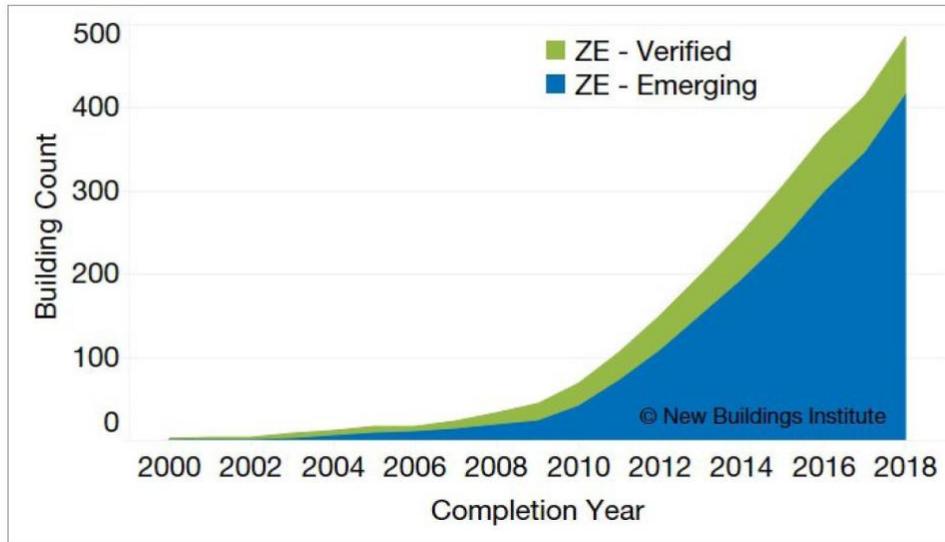


Figure 1 – Net-zero growth, also known as zero energy building.

Source – New building Institute 2018

The building of Net Zero homes has rapidly increased year after year, since 2000 the number of net-zero buildings has gone up over 500% and hasn't stopped there. As you can see the chart above illustrates the acceleration of net-zero building and how it has almost doubled year after year. These numbers will keep climbing with outside factors such as state requirement, buyer education, marketing, and people's choice.

With net-zero growing year after year our solar consumption has increased dramatically. Because of technological innovation the price has dropped over \$1000 since 1980. Experts say these numbers will continue to decline as we discover more and more ways to utilize clean energy. For years other forms of energy have remained around the same price, clean energy has drastically dropped every year. This makes Net Zero homes more attractive and desired by home buyers therefore creating more opportunity for companies to build Net Zero homes.

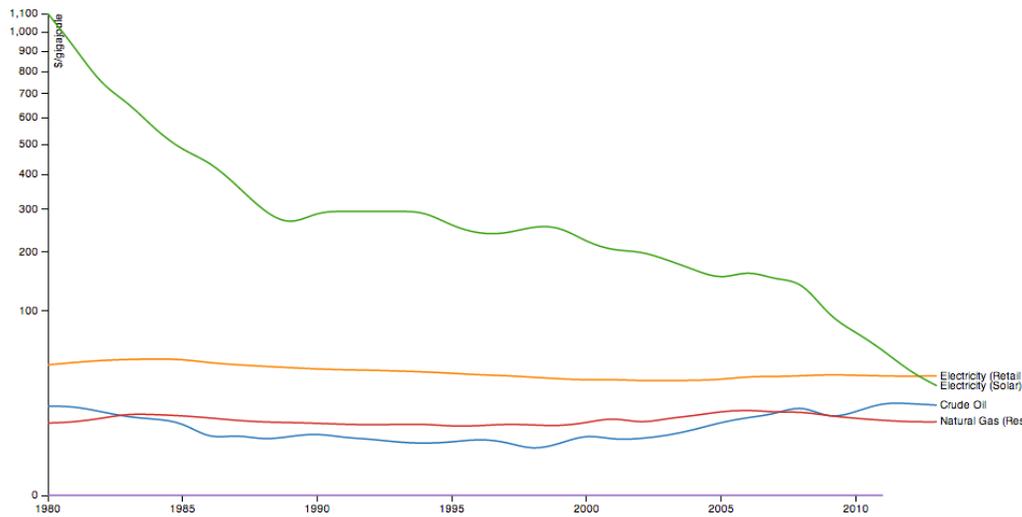


Figure 2 – Cost of Solar decreasing since 1980 and continuing the downward trend while other energy sectors are remaining steady
Source – Medium 2013

Innovations

Solar panels on the roof of homes have come a long way since the first panels were installed in 1995. Solar panel efficiency has doubled in the last 20 years due to technology advances. In 1995 the Photovoltaic system was around 5% efficient, fast-forward to 2020 and it is almost at 15% efficiency (Han, 2020). There are 3 main types of solar for net-zero homes, these include monocrystalline, polycrystalline, and thin film. Each have their own pros and cons, and some can even absorb more energy than others.

The most common solar panels for Net Zero homes are Monocrystalline for a couple of reasons. First, they are the most efficient panel on the market offering up to 22.5% efficiency depending on the maker. Second, is the overall sleek aesthetic they provide for homes is more attractive than the bulky industrial look that comes with other panels. Third, you will not need as many panels on your roof to power your home. Monocrystalline solar panels also come with the longest life span out of all 3 solar panel types lasting up to 25 years.



Figure 3- Monocrystalline panels only taking up 50% of roof space while providing a sleek look

Source- Archi expo

One of the most significant changes in recent years is adding a battery storage to your home so you don't have to pull energy from the grid during the night. This also allows you to save your power in case of a blackout. Tesla makes home batteries that can hold up to 13.5 KWH, which is equivalent to powering your home for 12 hours (buildwithrise,2017). These batteries are easy to install and can be put inside or outside of your home. Another great feature is these batteries can connect to your smart devices so you can monitor your usage.

Below in figure 4, is an example of what Tesla home batteries look like and how they can easily fit anywhere inside or outside your home. You can also see from the photo that they do not take up a ton of space and can be put virtually anywhere.



Figure 4- Tesla home batteries

Source- Build the Rise

Methodology

Objectives of this case study:

- To find out if switching to Net-Zero saves people money
- Comparing Net-Zero to homes to homes without net-zero
- To find out the many advantages if Net Zero homes
- To take a deeper dive into the benefits of Net-Zero homes
- To discover the buildings and homes of the future and what we can expect

The qualitative method was used for this research study. I recently interviewed with Jacob Atalla who is the VP of sustainability initiatives at KB home. The interview was regarding City Square, a multifamily net-zero community in Southern California built by Meritage Homes. The interview analyzed the main differences in net-zero and non-net-zero homes. We discussed the main advantages and disadvantages of building net zero homes. Lastly, we analyzed if it is smarter to build a new home or to renovate and make your current home net-zero. The information is critical for any new home buyers or home renovators.

Case Study

The City Square multifamily community is the first net-zero community in Southern California. This project is the staple of home building for our future. This development showcases the advancements in sustainable building innovations by showcasing solar, smart technology, electricity, and clean indoor air quality. This is also one of the many new buildings that is helping to eliminate the carbon emissions. City Square a full Net-Zero community with up-to-date appliances, EV ready, and solar to power each home. New innovations are going to help make future buildings more efficient, easier to build, cheaper to build, and more attractive to customers. This is not only attractive for the community but also to potential buyers.

Project Specifications

Jacob gave me recent data on the City Square build as well as an analysis of the benefits of net-zero homes. City Square is located in Irvine California, these new town homes were selling for upwards of \$845,000-\$900,000. The cost is a little more expensive because there is an additional up-front cost around \$40,000 extra per home for net-zero. The extra \$40,000 per unit in cost comes from energy efficient windows, solar, Energy Star HVAC, doors, and other home features. In the study we went over a cross analysis of fully electric appliances and mixed fuel appliances to highlight the long-term benefits of electric opposed to mixed fuel. These homes are partnered with Southern California Edison (SCE) to demonstrate the technical and economic feasibility for all electric multifamily homes (Consol, 2020).

Key energy features:

- Home Energy Rating System (HERS) of 11 to 17
- 100% LED Overhead Lighting
- Smart Wi-Fi Light Switches
- Smart appliances

- EV ready garage
- SunPower 4KW Solar panel system on the roof
- Efficient windows: Low-E, Air-filled, double glazing
- R-13 Open cell Spray Foam Wall Insulation
- Hybrid heat pump and water heater

Below I have a detailed breakdown of the cost analysis of all electric appliances compared to gas and electric (mixed fuel). These main appliances use the most amount of energy in the household. Most people are led to believe that electric appliances are more expensive up front and cost more than mixed use appliances. These claims are proven to be false. Below in a cost analysis you can see the total amount saved by switching to all electric appliances.

		Mixed Fuel Appliances	Electric Appliances	Cost Saving
Multifamily	Cooktop	\$ 2,071.00	\$ 1,788.00	
	Hot water Heater	\$ 4,240.00	\$ 3,372.00	
	HVAC	\$ 10,961.00	\$ 8,907.00	
	Clothes Dryer	\$ 2,059.00	\$ 2,614.00	
	Total cost	\$ 19,331.00	\$ 16,681.00	
	Cost Saving			\$ 2,650.00

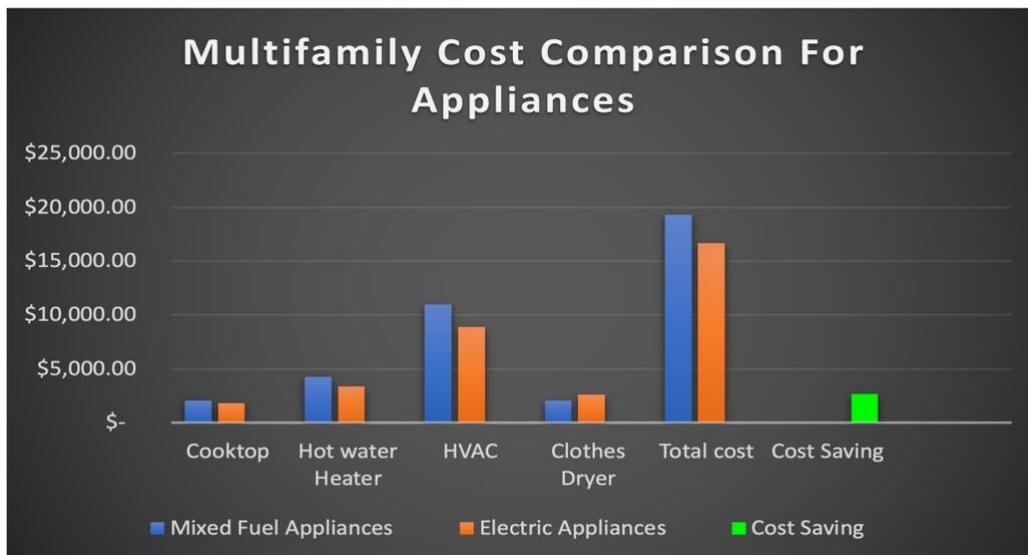


Figure 5 - Appliance Cost Comparison

Source – IMO 2020

Below you can see the average cost saved per month in different areas around the house when you have a Net-Zero home. These numbers have the ability to increase your savings when you consume less energy than you produce. Power companies will pay for your excess energy produced. Energy consumption can be greater than your solar can support which causes monthly savings to decline.

Climate Zone	Building Type	Utility Bill Savings
Pasadena , Pomona, LA Civic Center	Multi-Family	\$ 56.31
Redlands, Riverside, San Bernardino, El Cajon	Multi-Family	\$ 57.66
Brawley,Bylthe, El Centro, Needles	Multi-Family	\$ 72.82

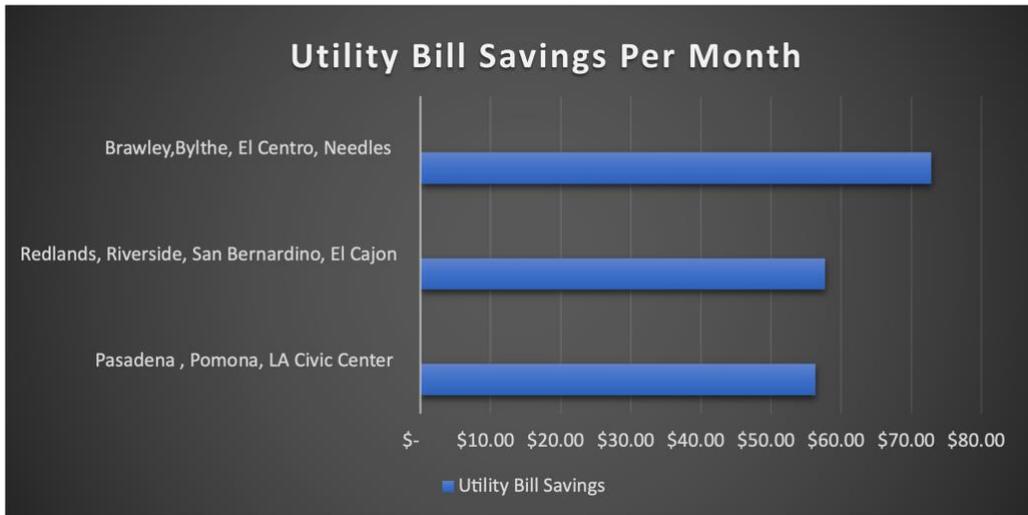


Figure 6 – Utility Bill Saving Per Month

Source – IMO 2020

CO2 reduction in our atmosphere is needed more than ever in today's world. Net-Zero homes save on avg 9 trees per home. The trees are saved due to less CO2 emissions from homes generating their own electricity. Helping to save trees and eliminate CO2, these buildings will help save the environment one building at a time. The chart shows that different climate zones use more materials than others. Some areas consume more energy than others which means net-zero in different areas will have a more substantial impact on CO2 emissions.

Climate Zone	Building Type	Emissions Savings (Tons)	Equivalent Number of Trees
Pasadena , Pomona, LA Civic Center	Multi-Family	0.52	9
Redlands, Riverside, San Bernardino, El Cajon	Multi-Family	0.52	9
Brawley,Bylthe, El Centro, Needles	Multi-Family	0.44	7

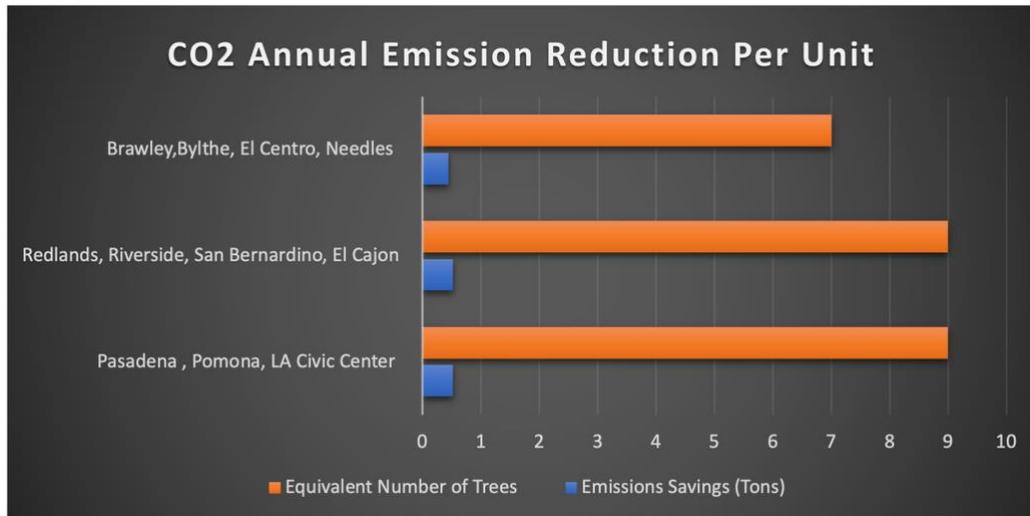


Figure 7 – CO2 Reduction Per Unit
Source – IMO 2020

Positives of Net-Zero

Net-zero homes have high insulation materials to ensure an airtight building envelope. A building envelope is the physical separator between the conditioned and unconditioned environment of a building including the resistance to air, water, heat, light, and noise transfer. This is where the Low-E, Air-filled, and double-glazing windows help with the R-value. R-13 open cell hybrid insulation helps keep the home very well insulated. R-13 blocks air leaks and drafts better than any other insulation (Matthews, 2021). This allows for less energy to be used in the hot summer days and cold winter nights. This is why having a great building envelope can reduce energy consumption.

Using energy star certified appliances help to use less energy which reduces the amount of energy needed to run. These appliances also help to reduce the amount of toxins that are circulating inside your home. Gas stove tops emit up to NO₂ at 15 % and Formaldehyde at 11% of indoor air while in use (Consol, 2020). Electric stove tops eliminate these harmful gasses by 100%. People who have kids with asthma often look for any means to reduce their symptoms and these homes can help.

People will no longer have to carry the burden of paying for electricity. On average they will save over 800 dollars a year by living in a Net- Zero home. They will also save on their electric bill by about \$2,650 yearly.

Negative of Net-Zero

The average Net-Zero home costs \$40,000 more than homes without net-zero capabilities. In the long run Net-Zero will save you money but people are struggling to afford the down payments. “For every \$1,000 more dollars spent to build a home there are over 100,000 households that cannot afford that house in the United States” (Atalla, 2021).

These buildings have a more complex building regime due to new technology being implemented and new designs. Net-Zero does not work as well for big communities as it does for single family homes, this is due to the available roof space for solar panels. A single-family home could fit double the solar panels a townhome could. If there is not enough energy being generated by the number of solar panels on the roof, then the homeowner has to pull power from the grid using not clean energy and making their bills higher.

Utility companies are getting hurt by Net- Zero homes due to customers buying little to no energy from them. The companies are going to start charging each home a fee to stay connected to the grid in case they do need to draw energy in an emergency situation.

Conclusion and Future Research

Net-zero building has been and will continue to evolve year after year. There is going to be better technology for less emissions and better efficiency. Electricity might not even be the main source for Net-Zero homes, it very well could switch to another form of green energy. The companies that can evolve and adapt with the advancements are going to thrive the most in the future. These companies are also going to affect the lives of millions of people and new families.

It was made clear by City Square that there is a reason we need to have net-zero buildings throughout the entire United States and not just California. As the first net zero community it sets the standard for what people can expect when looking for a net-zero home. They will expect safer indoor air quality, cheaper bills, and a cleaner world. The challenges I see in the future include getting that extra cost to build Net-Zero homes reduced so more people can afford to buy these homes. They will also need to educate people on why these homes are so much better to buy for their families and our planet. Once people are educated on the benefits of Net-Zero homes people will demand to live in them. California is forcing all new construction to be Net-Zero which is causing a monumental shift across the United States and the world.

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