

# Project Summary and Public Exhibit Materials

## DESCRIPTION OF TEAM HOUSE

Built to demonstrate affordable housing through energy efficiency, this net – positive home showcases industry leading energy efficiency technologies and universal design that performs comfortably throughout the four seasons with minimal to zero energy costs for the life of the home. Through the use of ICF foundation walls, SIP upper walls, efficient windows, air sealing, ample insulation, high efficiency mini-split HVAC, battery backups, and solar power generation, this six-bedroom three-bathroom, 2450sft home is designed to provide the best energy efficiency while maintaining a traditional Craftsman style with appeal for the mass market.

## DESIGN PHILOSOPHY AND HOUSE DESIGN

The home is situated in a diverse neighborhood in Ogden Utah with historic architecture and new home developments. The intent of the design was to present a home that would match the historic aesthetics of the community while providing the modern amenities and energy technologies. The home's design is a traditional Craftsman Bungalow style with two tone exterior trim, columns supporting the covered porch and wood trim details. The two-story home appears fairly small from the outside, yet it provides 2450sft on the inside. This design decision was intentionally made to allow the home to fit in with the adjacent one-story homes and not appear out of place on the smaller corner lot. This design decision was critical in making the home a usable size for the local demographics while maintaining the appropriate neighborhood scale. Ogden, and many surrounding communities are family centered and according to the University of Utah, have the highest household size in the nation. Many high efficiency homes are designed small and are only usable for a couple without children or a new family with only one child. The decision was made to make this a "mass market" home, where it would provide universal appeal and would not become a niche product. The target market is families and the design speaks to the needs of a family. For example, there is a washer and dryer upstairs, but also additional hookups downstairs for ease of doing laundry for a six-bedroom home. There are two gathering places, the living room upstairs and the large family room downstairs. The outside has a private outdoor space where adults and children can spend time protected from the traffic of the street. Three bathrooms provide the utility needed to support the occupants. The home has multiple storage locations throughout the home and even in the detached two car garage. This is important for a livable space and to allow comfort if the home had all rooms occupied.

The design allows for a single family to live in the home through all stages of life because the main floor is designed to allow for aging in place with minor alterations to access. The HVAC system can be completely turned off downstairs or in individual rooms that are not occupied or when occupancy decreases. This is important for the sustainability of the home and will help increase savings the home will provide over the years.

## UNIQUE HOUSE FEATURES

Besides the energy performance materials used to construct the home, the home has no unique features that differentiate it from the surrounding homes. The intent was to make this home similar to other homes constructed in our area in order to make a familiar format to any buyer.

## TECHNOLOGICAL INNOVATIONS

Beyond the aesthetics or convenient design elements, the home was designed to be a net-positive home. This means that the home will over the course of a year produce more energy than it consumes. This is accomplished through the many cutting-edge technologies, some of which will be discussed here. First the framing of the home is different than most homes built today. The foundation walls were made using Insulated Concrete Forms (ICF), a product that provides ridged foam insulation to the inside and outside of the foundation wall and acts as the forms when pouring the cement structural core. Acting as a form it reduces the waste material traditionally found in wooden forms and can be constructed with minimal expertise. The wall is waterproofed on the outside once the cement has set and provides the strength and durability of a traditional home with the added insulating R-value from the foam.

The main level's exterior walls are different from the foundation walls and are framed using Structural Insulated Panels (SIPs), a structural wall component that replaces traditional stud framing and instead uses Oriented Strand Board (OSB) and ridged foam to provide a wall system that has very minimal thermal bridging and very good insulation properties. In a traditionally framed home, studs can make up more than 25% of the wall structure and provide a low R-value compared to the insulation between the studs. The studs transfer more of the heat and act as a bridge, hence the term thermal bridging. This is almost eliminated with SIP framing. Additionally, the wall comes in precision milled panels that can be easily placed according to the floorplan layout in minimal time and they provide a square framed wall and has very few air gaps.

The roof is framed using raised heel trusses which give enough space for additional insulation depth and coverage of the whole attic cavity. Most roof framing creates a tight triangle at the corner of the roof where the wall and roof meet. This space cannot hold much insulation or it would prevent adequate air ventilation and create an ineffective roof. The raised heel is located at the junction of the roof and wall and provides a short wall, about one foot, where additional insulation can be added without inhibiting the airflow.

Next, the home is designed to be very air tight. Air infiltration is a major cause of energy loss so reducing it as much as possible is vital to an energy efficient home. Using spray foam and caulk, any penetrations are sealed from the inside. The rim joist, located between the foundation and main floor is notorious with energy loss and was extensively sealed and filled with insulation. The windows and doors are high-efficient units with the majority of the non-egress windows being fixed pane. The fixed panel reduces air loss from between the sliding mechanism. The biggest improvement to the air tightness of the home is that the whole home was sealed using a product called Aero Barrier, which is applied using negative air pressure and a fine mist of sealant sprayed into the air inside the home to fill any wholes less than ½ inch. As the air pressure forces the air out of any gaps, the sealant mist is forced into the gap until the gap is filled. This essentially makes the home air tight in all areas of the home, especially those areas that are impossible to get to with traditional sealant methods.

Lastly the mechanical systems are all electric and include ductless mini-split heat pump units that both heat and cool the space using ambient air around the home. Heat pump systems use essentially free heating that is found in the air to condition the space. They are very efficient and in combination with the mini-split head units located inside each room, they can provide customized multi-zoned conditioned air to individual rooms or the whole house. They don't however, provide any air filtration

to the home or essential air changes. To provide air to the very tight home, an Energy Recovery Unit (ERV) is used to exchange the indoor air with fresh outside air without losing conditioned air temperature. It does this through a heat exchanger that passes the outgoing air by the incoming air without mixing but allowing the heat or cool to be exchanged. Most homes rely on the lack of air tightness of the home to provide fresh air, but with a tight home the air is controlled and can provide consistent air quality and comfort throughout the year. The water heater is a 50-gallon heat pump unit that can provide all the water needed for the three bathrooms efficiently. It works on the same principle as the HVAC heat pumps but to heat water. Appliances such as the washer, dryer, range, dishwasher, and microwave are Energy Star rated or better. An electric car charger is located in the garage to provide overnight charging for one car. All of the home is powered by a large solar array on the home's roof and excess energy is stored in a battery bank in the garage. The solar power is essential to meeting the net-positive goal and the battery storage allows the home to run all night or on low production days without tapping into the local utility power.

The electrical appliances are not the only products that are efficient in the home. All water appliances are low flow including the landscaping. The plumbing is centralized in the home reducing the length of travel for hot water to reach a faucet or appliance.

All of this is done to provide a home that lasts generations with little to no utility costs. The initial cost of the home is not substantially above the average per square foot cost of a typical home, yet the operating costs will be much lower and the home will provide a level of comfort not available in traditional homes.

## TARGET CLIENT

Enjoy basking in the morning sun while eating breakfast? Sitting on the porch during a summer sunset? This 6-bedroom, 2-bathroom, home has all the comforts under one roof, not to mention affordability through energy efficiency! 2807 Quincy Avenue is an all-electric, Net Zero house. All the power you need is produced onsite, pay only the \$9 a month connection fee. How, you ask? The 39-panel solar array generates enough electricity for the house, including your electric car charging station in the detached, 2-car garage. Highly efficient, multi zone HVAC systems, water heater, appliances and windows add to the Net Zero design in addition to a tight building envelope and intentionally placed insulation far surpassing current building code standards. Power outage? No problem with a 72-hour battery backup already connected to the electrical needs of your home. We've thoughtfully crafted the last home you'll ever purchase, come discover why his home fits all of your family's needs.

## TEAM ORGANIZATION

Please see the attached team roster.

## FUTURE PLANS

In addition to showcasing this home over the summer to the community through numerous virtual platforms, news media outlets and small gatherings, Weber State University intends to sell this home at appraised value. The purpose of the sale is to generate funds that will be used towards the next Net Zero partnership build with Ogden City Redevelopment Agency and the Construction and Building Science Department at Weber State. Monitoring of energy usage will continue to remain a priority over the next year, with hopeful collaboration from the new owner. All data gathered and documented from the initial concept, close out, and energy analysis into 2021, will be used to increase understanding of how to minimize cost and increase energy efficiency in the built environment.