



U.S. DEPARTMENT OF ENERGY
SOLAR DECATHLON 2020
BUILD COMPETITION

Project --- Summary

**Kaikaiknong Crescent
Development**

Warrior Home Student Design Team
University of Waterloo - Waterloo, ON, Canada
info@warriorhome.ca

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Our Partners



U.S. Department of Energy
Solar Decathlon 2020
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BC_WH_SUMMARY_2020-04-21
Submission Date: 04/21/20

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Project Overview

Over the past two years, the Warrior Home team has worked in constant communication with the Chippewas of Nawash Indigenous community. What fueled the team to complete the design and help build the net-zero energy home were the people in the community, which include, the housing authority, Chief and Band Council, Melissa and her four kids who are the homeowners, and many others met throughout the process. Building a strong connection with Habitat for Humanity Grey Bruce and the Chippewas of Nawash helped Warrior Home understand the needs of the community. This understanding provided valuable insight on how the team can help them in their goal of designing and building energy efficient homes for those who wish to return back to their community on the Neyaashiinigmiing Reserve.





Design

Philosophy

Partnered with Habitat for Humanity Grey Bruce, the University of Waterloo Warrior Home Design Team has been working to construct an affordable, occupant-oriented, and resilient home for a low-income family. The project adds to the existing Kaikaiknong Development and as a result, our target market was the growing families that reside in the Chippewas of Nawash community.

Habitat for Humanity uses many donated materials while gaining help of volunteers for construction. This helped Warrior Home keep material costs low and maintain affordability for the homeowners. To further improve affordability, a better building enclosure, mechanical and energy systems were employed to introduce operational cost savings. The simplistic design ensured the ease of constructability by volunteers and minimal use of expensive equipment and skill. This resulted in a single storey, single family home with a basic gable roof.

The goal of occupant comfort was constantly revisited by the design team to ensure the family would feel comfortable in terms of personal space, communal space and that there was a functionality for each room. The home itself was

designed for a growing family. By providing four rooms and two full bathrooms, the house can accommodate a family with children and seniors. With limited bathroom space, the design team ensured functionality by offering a divided bathroom space allowing use of the sink while another person uses the toilet or shower in privacy. The second bathroom is backed with a storage closet, which can be adapted to an accessible washroom with a bathtub rather than a standing shower.

With a strong value in community and connection to nature, the Chippewas of Nawash were kept in mind when designing the home. A covered front porch enables casual conversation with neighbours while the open concept kitchen and living space encourages gatherings with family and friends. The open concept space is purposely placed to one side of the home, rather than a central location, in hopes to distance the social gathering space from the private bedrooms. By doing so, this helps separate the noise levels of different occupants.

Warrior Home's goal was also to design a house that is adaptable to the needs of the family for generations, as this will be their family home on the Reserve. Over time, each room can be repurposed for different uses. Every room can be repurposed to an office, nursing room, or bedroom for elderly. The rooms can fit bunk beds, two single beds, or a simple king sized bed. The adaptability of the living space and bedrooms allow for the family to grow and also age. This addresses the need of resilience, as overtime, the family can easily change the home to suit their needs.

Unique House

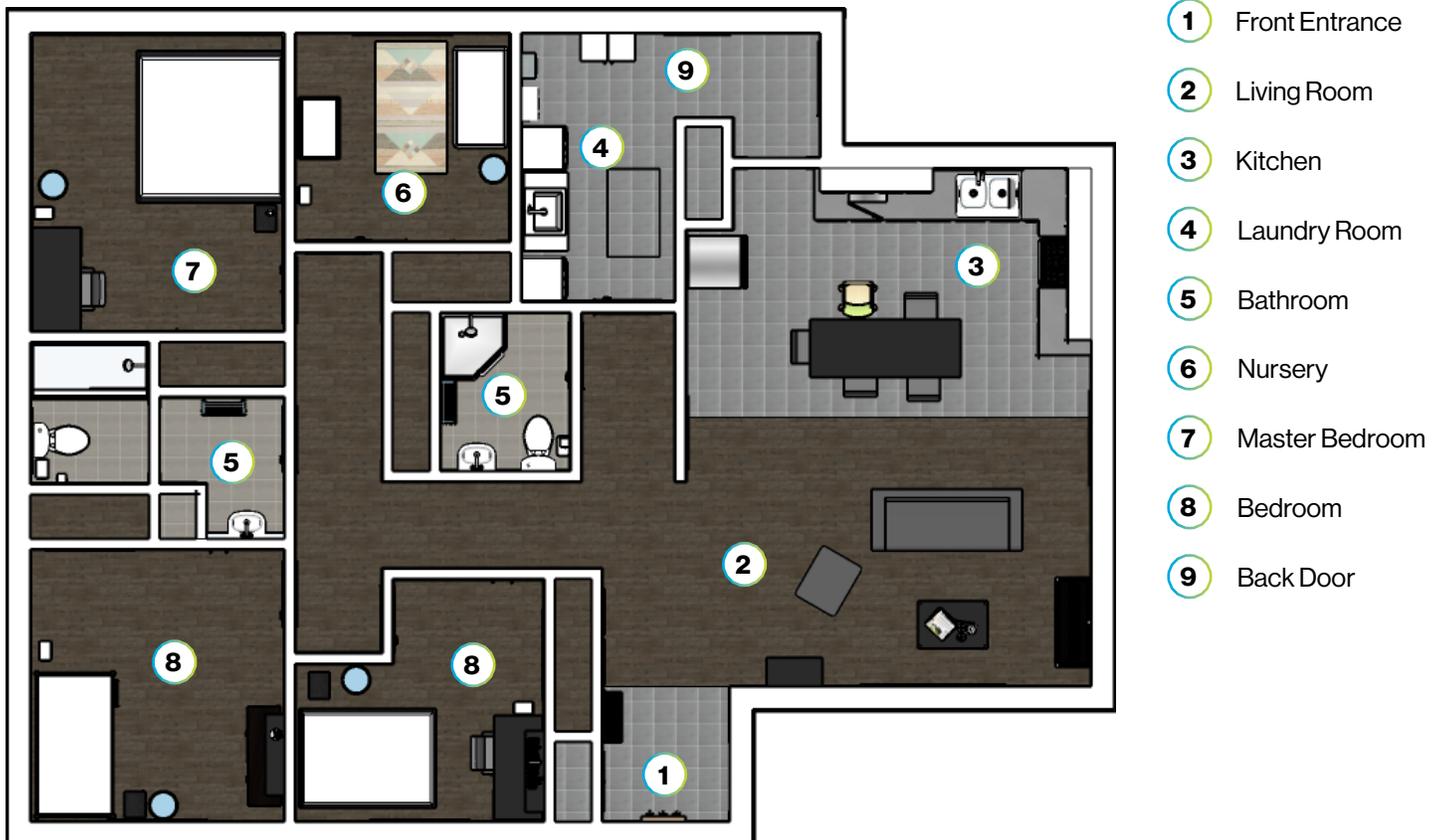
Features

The Chippewas of Nawash community and the family the home was designed for make this project unique, from a social and technical perspective. The team thoughtfully considered the family's needs and lifestyle throughout the design process, while incorporating the insight of other residents and encouraging innovative and efficient design features. This design demonstrates that net-zero homes can be built in any location and at an affordable price.

Neyaashiinigiing Reserve No. 27 falls is located within ASHRAE climate zone 6. During the winters residents can see temperatures below -35°C (-22°F), with significant snow loading, and upwards of 30°C (86°F) during summer months. As such, thermal control elements of the enclosure were prioritized, in addition to achieving a high degree of airtightness to minimize unwanted thermal gains and losses. This was of critical importance as minimizing energy usage was a priority for the community and design team. The remote location of the home is additionally unique to the design as the energy saving generated from this project result in greater emission savings than a typical net-zero

home would. This is because the community does not have access to the natural gas infrastructure within the province. Instead most homes use a diesel or propane furnace as the cost of electricity is much higher in comparison to fuel. Therefore constructing a net-zero home within the community alleviated the need for fuel-combustion heating sources and thus the emission associated with them. This was an outcome the community saw to be extremely favourable as they take great pride in the beautiful natural environment they have maintained.

The interior design and layout of the home was also unique as the team gathered input from the family when selecting interior finishes such as flooring, counter-tops and paint colours. Warrior Home was able to create sufficient private, semi-private and shared spaces, with input from the community throughout the design process. As well, as one of the children in the home has potential for physical and visual impairment, additional features were added to create an accessible space. Some of these features include hand rails along walls, and additional lighting. Finally, the team was able to see how the family interacted within the space and heard feedback on how living in the home had positively impacted their lives and brought them closer to their immediate and extended family. This level of engagement from early design, construction and ultimately move in, built a strong partnership between Warrior Home, the Chippewas of Nawash community and Habitat for Humanity, which drove the success of this project.



Technical Innovations

Mechanical

The HVAC system consists of a central heat pump coupled with a heat recovery ventilator (HRV). Heat pumps are highly energy efficient. By transferring heat from the outdoors instead of producing it from combustion or electricity, they can provide more energy output than the electric power used for operation. Heat pumps can also switch between operating in heating mode and cooling mode, essentially providing two units in one package. Heat pump technology has been around for a while as it's the same type of system typically used in a refrigerator or air conditioner.

The HRV ventilates the home by supplying the proper amount of fresh air into the space and exhausting stale air from areas with high heat and humidity, like bathrooms. This improves the overall indoor air quality of the home, making the air more pleasant to breathe. Additionally, the HRV uses the otherwise wasted outgoing air to pre-heat or pre-cool the incoming fresh air. This means that less work is required from the heat pump to condition that air, improving energy efficiency.

A ductless range hood was selected for kitchen cooktop exhaust. In addition to the normal aluminum mesh filter a ducted hood would use, it also uses a charcoal filter which cleans the exhaust air and allows it to be recirculated back into the kitchen. Since no exterior vents need to be installed, energy losses resulting from exhausting interior air or other losses through the exterior penetration are eliminated. This also means that ductless hoods are much easier to install.

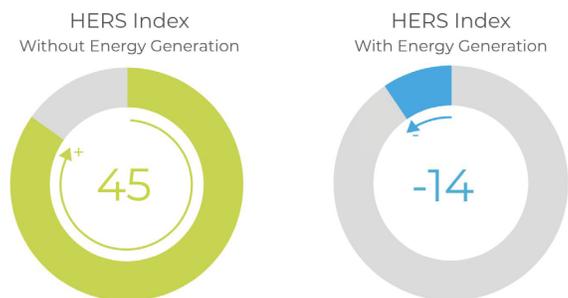
Plumbing

A hybrid-electric water heater tank was selected for the design, which offers the convenience and reliability of a water tank with superb efficiency, as it is paired with a heat pump. In addition to heating the water with electrical resistance, the heat pump draws heat from the surrounding air and uses a compressor and refrigerant to heat the water with the ambient heat. The heat pump water heater is estimated to save up to \$404 annually on the electricity bill, compared to a standard electric heater.

In addition to the hybrid water heater, several low-flow fixtures were selected to minimize water usage. This includes sink faucets, toilets, and showerheads. Using a low-flow fixture can save up to half the amount of water compared to regular fixtures.

Electrical

The home was designed with sustainable energy usage in mind, which resulted in a home designed to use 55% less energy than traditional homes of the same size. The homeowner can utilize different techniques to minimize and keep track of their energy usage, this can be done through smart plugs and smart thermostats, which allow for control of energy usage even when away from the home. Besides technology, this home uses solar panels to generate renewable energy that is used to power the home. The solar panels will generate clean energy for the homeowners, resulting in a net-zero design. As well, the solar panels are projected to produce more energy than will be consumed, the surplus energy that will be produced will contribute to a cleaner grid in Ontario.



Building Enclosure

The building enclosure team gave careful consideration to all aspects of the home's design. Everything from the roof to the concrete foundation was evaluated to maximize the comfort and energy efficiency of the house. Raised heel trusses were selected in order to make room for more insulation, all joints in exterior insulation were sealed to minimize air flow through the walls, triple glazed windows with low-emissivity coatings were utilized to reduce solar heat gains, and insulated concrete form foundation was used to provide additional thermal performance. These are examples of just a few building enclosure innovations that were implemented in the design.





to promote continuous implementation of energy efficient homes in the community, the design needed to have ease of replicability. This philosophy was proven as the home was built almost exclusively by volunteers for Habitat for Humanity Grey Bruce and the Warrior Home Design Team.

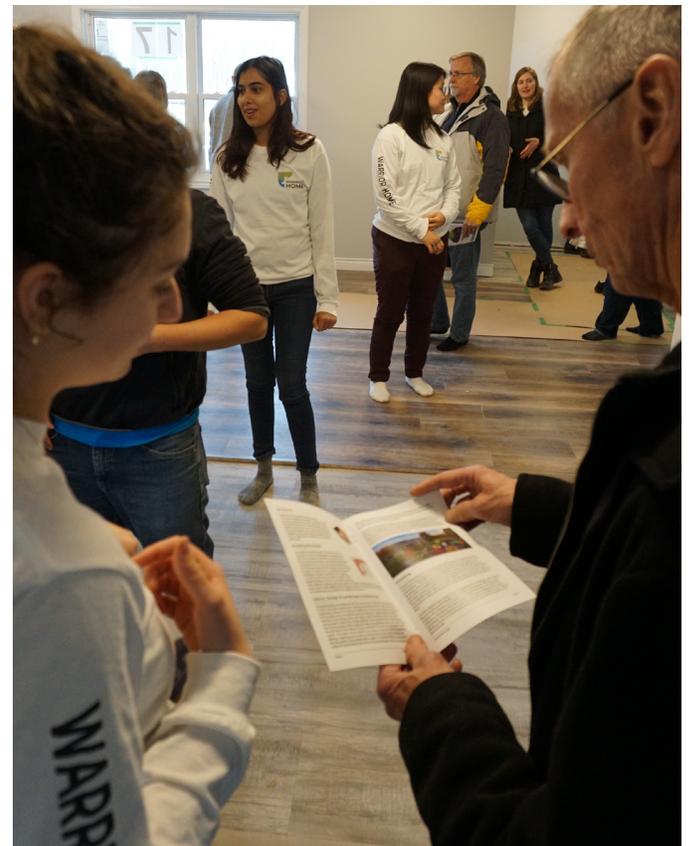


Target Client

The target client for the team house was an Indigenous family consisting of single-mother of four kids. The house is a single-storey to cater to the Indigenous community's collective preference for single-story houses as opposed to duplexes or multi-unit residential buildings.



As the house needed to be suitable for the family's financial needs, there was a strong focus on energy efficiency in the design which would remove the burden of energy bill payments for the mother. Hence, many high performance upgrades were implemented in the home, which were selected to meet the needs of the family and the specific climate on the Neyaashiinigmiing Reserve. An example of this includes the centralized heat pump which was chosen, that also includes a backup heating electric resistor element that would ensure the home had reliable heat during the cold winters experienced. The high performance upgrades were chosen in coordination with the community and local contractors, so that nearby assistance would be available if the upgrades were needing repair. As one of the children had potential for visual and physical impairment, handrails were added in the hallway and bright lighting was used to help them navigate around the home.



Furthermore, there is a significant shortage of decent and available housing in the Chippewas of Nawash community, especially on the Neyaashiinigmiing Reserve where the home was built. Until the Kaikaiknong development was built, there was limited available housing on the reserve. The newly built homes provide the people in the community a means to be closer to their families and their culture. In order

Future Plans for the House

After construction was completed in December of 2019, the house designed by Warrior Home on the Neyaashiinigmiing Reserve was occupied by the family. The house is now the home of Melissa Millette and her 4 children, where they will each have their own space and the opportunity to be

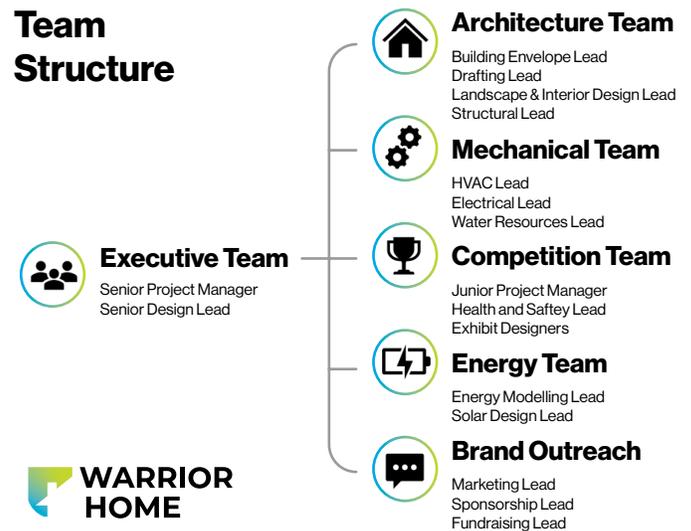
close to their community and family. This project was done in partnership with the Chippewas of Nawash and Habitat from Humanity Grey Bruce. Being the first collaborative project of its kind in Canada, the success of this project and house design will lead to a future of more houses built in Indigenous Communities that are sustainable and affordable. This project has already led to other communities interested in creating similar partnerships. Warrior Home plans on maintaining the relationship that has formed with the Chippewas of Nawash to continue to collaborate and brainstorm potential designs to help serve the community in a more sustainable way.

Team Organization

Name	Title	Email
Shane Chegano	Chippewas of Nawash Housing Manager	housingmanager@gbtel.ca
Scott Walbridge	Technical Advisor	swalbridge@uwaterloo.ca
David Mather	Technical Advisor	david.mather@uwaterloo.ca
Nicole Politis	Senior Project Manager	politis.nicole@gmail.com
Sharon Emmanuel	Senior Project Manager	emmanuelsharon0@gmail.com
Gabrielle Tuck	Senior Design Lead	gjkuck@edu.uwaterloo.ca
Rebecca Wong	Senior Design Lead	rys.wong2@gmail.com
Emily Osborn	Senior Design Lead	emilygosborn@gmail.com
Anisha Thind	Junior Project Manager	anisha.thind@gmail.com
Rochelle Bristol	Sponsorship Lead	rochelletb123@hotmail.com
Dana Usaty	Sponsorship Lead	danausaty@gmail.com
Jessica Dulku	Solar Design Lead	j.dulku16@gmail.com
Ankit Shah	Solar Design Lead	a97shah@uwaterloo.ca
Daniela Rodelo	Energy Modelling Lead	danielars@hotmail.com
Niti Lad	Energy Modelling Lead	nitilad43@gmail.com
Anirudh Dharmarajan	Team Advisor	anirudh.dharmarajan@gmail.com
Amy Markwart	Landscape & Interior Design Lead	amymarkwart@gmail.com
Talina Sen Smet	Landscape & Interior Design Lead	talinasensmet@gmail.com
Jesse Osmond	Building Enclosure Lead	josmond5451@hotmail.com
Kyle Macdonald	Building Enclosure Lead	kylefmacdonald@gmail.com
Kashifah Ahmed	Exhibit Designer	kashifah.ahmed@gmail.com
Tegan Lee	Exhibit Designer	teganlee20@gmail.com
Danica Halum	Exhibit Designer	dmhalum@uwaterloo.ca
Rebecca Persoon	Exhibit Designer	swim_jp_24@hotmail.com
Javier Fierro	Drafting Lead	javier.sebastian.fierro@gmail.com
Tori DeRooy	Water Resources Lead	victoria.derooy@gmail.com
Brooke Macaulay	Fundraising Lead	macaulaybrooke@gmail.com
Joanna Rywak	Health & Safety Lead	rywakjoanna@gmail.com
Darren Sheh	Team Advisor	dsheh@uwaterloo.ca
Nancy Zhou	Team Advisor	nancyzhou517@gmail.com
Saif Hashmi	Structural Lead	saifhashmi98@gmail.com
Abhinava Kidambi	Team Advisor	chintathegreat@gmail.com
Jeff Ren	Marketing Lead	jeffrey.jh.ren@gmail.com
Gongyi Zhang	Mechanical Lead	gongyi.zhang3@gmail.com
Galen Fernandes	Mechanical Lead	galenfernandes@gmail.com



Team Structure



Warrior Home Design Team is a student run design team at the University of Waterloo. Due to the nature of the co-op program offered by the University, the positions are held by different students every alternating term, through the fall, winter and spring. Beyond the executive team, and the leads, Warrior Home has many general members, as well as students who act as advisors to the team. Collectively, over the 2019/2020 school year, the team has over 60 members. However, only the names and positions of the executives and leads in the 2019/2020 school year are listed, along with their contact information.



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