DOW SUSTAINABILITY FELLOWS
UNIVERSITY OF MICHIGAN

# 2022 Final Report

## *Making the Case for Sustainable Home Construction*

2022 Dow Fellows Habitat for Humanity International Project Team:
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November 28th, 2022

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# Executive Summary

Habitat for Humanity International (Habitat) is a Christian nonprofit organization in pursuit of "a world where everyone has a decent place to live." Although Habitat is headquartered in the United States, it has a global reach and serves families by building and repairing affordable, decent homes in approximately 70 countries. As one of the largest private residential builders in the United States (Builder 2022), Habitat is in a position to drive significant progress toward reducing the carbon cost of building in the often slow-to-change construction industry.

With support from Dow, Habitat launched the Carbon Mapping and Mitigation Program (CMMP) in 2019. The overarching goal of this program is to assess the carbon cost of current Habitat building methods, test new methods of sustainable building, and create and share guidance on how to put these new methods of sustainable residential building into practice. The goals of the CMMP go beyond the requirements of current residential building code in most countries, thus making a nonprofit and community-focused organization like Habitat an ideological fit for driving this change.

One of Habitat's greatest strengths is its focus on the community. The umbrella of Habitat for Humanity International guides the global mission and core principles while a regional or state Habitat provides support to local Habitat affiliates in accordance with Habitat's four pillars of service (Figure 1). Each local affiliate operates as it sees fit to best serve their partner families and the local community given its unique qualities and circumstances. This means there is no single blueprint for a Habitat home, which presents a challenge for promoting and implementing sustainable building best practices identified through the CMMP.

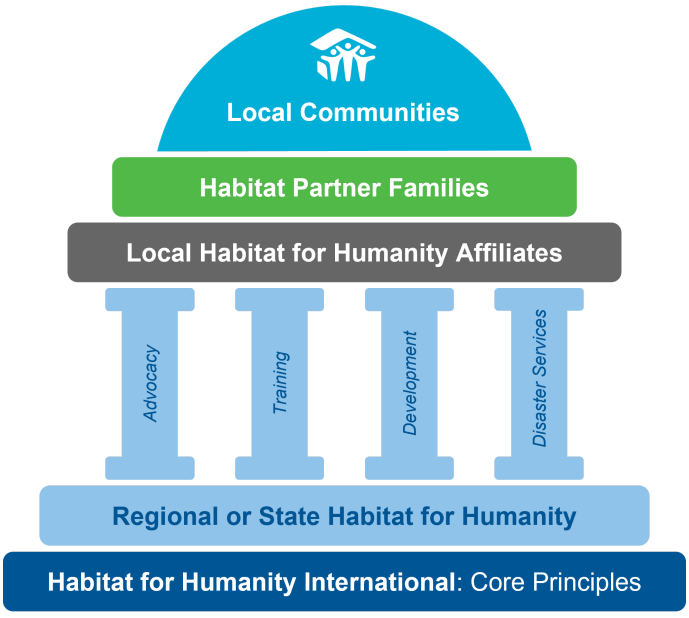


*Figure 1*. The Habitat organization places the greatest importance on serving families and the local community. This figure was adapted from Habitat for Humanity Texas (2020).

Taking inspiration from a growing list of sustainable building examples compiled by Molly Berg, a Habitat Sustainable Building Specialist and our client contact, we set out to address this challenge by creating a series of case studies to share best practices through storytelling. We interviewed a total of nine Habitat affiliates throughout the United States and distilled some of their lessons, challenges, and successes into five case studies:

1. **All-Electric Homes**: This case study describes the strategies that different affiliates have pursued to construct net-zero emissions homes.
2. **Alternative Builds**: This case study highlights alternative approaches to traditional home building including new styles and alternative materials.
3. **Community Impact**: This case study discusses the impact of Habitat's work beyond building homes, including the homeowners well-being, green education, and their greater community impact.
4. **Data Collection**: This case study highlights the techniques affiliates are exploring to collect sustainability-related operational data through post-occupancy homeowner surveys.
5. **Solar**: This case study discusses how solar energy has been used by affiliates to reduce electrical bills, reduce carbon emissions, and generate additional revenue during the build process.

Molly Berg and her team intend to distribute these sustainable building case studies to affiliates taking part in the CMMP and then make them broadly available to all Habitat affiliates to facilitate knowledge sharing and discussion. In fact, during the case study draft review process, featured affiliates expressed interest in getting in contact with one another to learn more about each other's work. The process to create the sustainable building case studies is documented and provided with this report, enabling Habitat to continue adding more case studies to the series. We also anticipate that Habitat or future Dow Fellows can build on this work by: working directly with affiliates to implement widespread post-occupancy surveys, conducting a gap analysis or progress audit of the CMMP, and developing realistic incentives for adopting sustainability best practices.

# Background

According to the International Energy Agency's (IEA) Energy Technology Perspectives 2020 Report, half of the existing building stock will still be in use in 2050. In particular, residential buildings are expected to average 70-100 years of use based on modern construction techniques. However, there is still a dire need for more housing, not only in the U.S, but around the world. Consequently, it is crucial that buildings constructed today incorporate techniques and technologies that improve their long-term sustainability. Additionally, in order to reach the Paris Agreement goals, the embodied carbon of new construction projects must be reduced by at least 40% by 2030 as mentioned in the 2021 Global Status Report from the UN Global Alliance for Buildings and Construction. This highlights the importance of addressing sustainable and low-carbon potential designs for new construction today.

Habitat for Humanity International (Habitat) is a global leader in promoting affordable and quality housing for all. To give a sense of the scale in which they operate, during fiscal year 2021, Habitat helped more than 4.2 million people build or improve the place they call home (Habitat 2021). In terms of total structures built in the US, Habitat also ranks among the largest developers. Although Habitat for Humanity has a single unified "umbrella" organization, most work is done through local units called "affiliates" which are independent non-profit organizations that act in furtherance of Habitat's mission. Due to the size and scale of Habitat's vision, there is great opportunity for positive environmental, economic, and social impacts through the incorporation of sustainable construction techniques in builds across Habitat.

In 2019, Habitat, with support from Dow, launched the Carbon Mapping and Mitigation Program (CMMP) with affiliate organizations in Michigan (Habitat Michigan, Kalamazoo, Kent County, Midland, Greater Jackson, and Grand Traverse). Habitat and the previous Dow Fellows cohort identified numerous barriers to the implementation of the CMMP, such as a lack of standards/guidance and the misalignment of goals between the affiliate and corporate level. In the 2022 continuation of this project partnership, our team aims to help highlight sustainable construction technologies and techniques that affiliates are pursuing across the country. By developing case studies around innovative work that is being done around Habitat, our team hopes to promote information sharing and collaboration among affiliates centered around sustainable construction.

# Methods

Informed by last year's Dow Fellows report on barriers to implementing carbon emission reduction strategies, we aimed to highlight exemplary stories of how Habitat affiliates have incorporated sustainable building principles into their work by distilling their lessons into relatable and actionable case studies. The stages of development of these case studies included: identifying affiliates to participate, developing standardized questions/conversation topics based on multiple themes (Appendix A), engaging in interviews with affiliates, drafting case studies, and soliciting feedback from the affiliates directly.

Our team initially worked with our client, Molly Berg, to identify Habitat affiliates in various parts of the US who are engaging in innovative green building practices, have been refining these practices for some time, and/or have unique perspectives on how to make housing more sustainable while maintaining safety and affordability. Nine Habitat affiliates doing such work were identified to be included in the case studies (Appendix B).

One-hour initial affiliate interviews took place over the course of two months (June-July 2022) and were conducted virtually with at least two Dow Fellows present during each interview, one leading the conversation and the other recording notes. The interviews were recorded for internal note-taking purposes only. The interview questions were designed to explore the following topics, which are further outlined in the Interview Protocol (Appendix A): Mission-fit, Affiliate Motivation, Environmental Outcomes, Finance, Community, Practicality, and Reflection. Instead of asking each affiliate every question from the Interview Protocol, we followed a semi-structured interview format and asked affiliates questions that were most relevant to their work and expertise.

After all initial interviews were complete and information was compiled and analyzed, we proceeded to identify common themes in the affiliates' work. Each affiliate interview was discussed in detail and techniques and programs that stood out as contributing to sustainable building became our themes. For example, multiple affiliates were integrating solar technology into their builds which was made possible by unique community and/or corporate partnerships, donations, and expertise, which allowed for plenty of material for a single case study on that topic. However, for other topics, such as our theme focusing on alternative building techniques, we pursued an approach that was more of a survey of multiple techniques. We ultimately identified five themes that then became the topics for our case studies: All-Electric Homes, Alternative Builds, Community Impact, Data Collection, and Solar Energy. Each case study showcased work from at least one affiliate, and some included multiple affiliates. Additional information for questions that were unanswered during the interviews was provided by affiliates via email correspondence. Final case study drafts were distributed to the nine affiliates for them to provide feedback on content, structure, and overall presentation. After final affiliate feedback, Molly Berg gave final approval on each case study.

Throughout this process, we aimed to communicate and showcase affiliate successes, challenges, and specific translatable lessons on how sustainable building practices align with the core mission and values at Habitat. These case studies may then be used as actionable examples of how the home building process can achieve short- and long-term sustainability goals alongside Habitat's broader mission.

# Results

As detailed in the methods section above, our team developed five case studies that serve as exemplary stories of how Habitat affiliates have or are currently practicing sustainable building and how these practices fit into the greater mission of Habitat. By promoting these stories of

success we hope to encourage local affiliates to incorporate these practices into their day-to-day operations or find inspiration for new practices altogether.

The main deliverable developed throughout this project was a series of case studies on sustainable building stories from Habitat affiliates. Five case studies were developed based on Habitat's past work on incorporating climate change mitigation and adaptation principles into construction projects. These communication deliverables are aimed at Habitat affiliates to serve as examples of success stories of sustainable building practices that have been implemented from across the organization. These case studies highlight the impacts that the more intentional and sustainable building practices able to be done by Habitat affiliates can both reduce the environmental impact that construction has, as well as positively impact the family and community being served.

A brief description of the case study topics is provided below. The topics were chosen based on the information and themes that emerged from our affiliate interviews. Each case study addressed how affiliates successfully implemented the following components while pursuing sustainable construction practices:

1. **All-Electric Homes**: This case study describes the strategies that different affiliates have pursued to construct reduced- and net-zero emission homes, and highlights the specific elements, materials, and construction practices that have allowed affiliates to build fully electric homes.
2. **Alternative Builds**: This case study highlights alternative approaches to traditional home building including new styles of foundations/paneling, straw bale homes, small homes, and mixed-income dense development. It also discussed the environmental benefits of these approaches and how to gain support for innovative strategies.
3. **Community Impact**: This case study contains insight into strategies used by affiliates to ensure the long-term ability to stay in one's home, how to incorporate green education for both homeowners and affiliates, as well as what it could look like for Habitat's reach to extend beyond individual households into the greater community.
4. **Data Collection**: This case study highlights the techniques affiliates are exploring to collect sustainability-related operational data through post-occupancy homeowner surveys.
5. **Solar**: This case study discusses how solar energy has been used by affiliates to reduce electrical bills, reduce carbon emissions, and generate additional revenue during the build process. It also addresses the importance of strategic partnerships and potential challenges in the use of solar, and how to overcome them.

These case studies will be distributed internally within the Habitat organization to affiliates across the country to help facilitate conversations around implementing similar carbon reduction measures in their communities. The goal is to provide inspiration, direction, and spark conversation among affiliates who are interested in moving towards more sustainable building practices.

# Impacts

This series of case studies was created to share success stories and resources from affiliates who have developed strategies for sustainable building. Habitat can distribute these case studies to affiliates who are interested in implementing more environmental sustainability into their work. We see these case studies as an opportunity to elevate the sustainable building work being done by Habitat affiliates across the country. The goal of these case studies is to share resources with other affiliates to inspire and transfer knowledge to further advance Habitat's mission of affordable housing with sustainably built homes.

The knowledge sharing through these five case studies will lead to an anticipated development of future case studies on similar sustainability topics, as well as provide insight on how affiliates can more widely adopt sustainable building practices. The interview process and case study templates can be replicated by local or regional affiliates to develop additional case studies on sustainable building projects. Appendix A serves as a guide for the interview process and could be utilized by affiliates interested in developing their own case studies.

The project was presented by our team and Molly Berg at Michigan's annual Habitat conference in late October 2022. This presentation added to the discussion on strategies affiliates could consider when incorporating sustainable building practices into their building practices. Two of the affiliates interviewed were in attendance at this conference, so this presentation served as an opportunity to highlight the work they are doing in sustainable building initiatives.

Our team has witnessed some success in the power of sharing stories among affiliates. When reviewing the final products to get feedback from the affiliates we interviewed, Gunnison Valley Habitat reached out to ask for contact information for the Greater Jackson area affiliate. Gunnison was interested in learning more about the Concrete Free Foundation they have championed to see if this was a project that could be implemented in their builds in Colorado. Our team up the two in contact, and this new building technique might be taken up by

In addition to the short-term goals of sharing knowledge on sustainable building practices through these case studies, we anticipate this project will influence long-term goals of Habitat as well. The anticipated long-term impacts include both carbon reduction impacts, as well as health and social impacts. As stories like the ones outlined in the five case studies are shared, we anticipate it will continue to move forward the conversation of sustainable building practices within the Habitat organization.

# Recommendations

We are excited to see the direction Habitat and future Dow Fellows take. Suggestions for work that builds on what we have learned are summarized below.

**Work Directly with Affiliates to Expand Wisconsin River's Post-Occupancy Survey**
The next Dow Fellows team could work with Habitat affiliates to generalize the Wisconsin River Area affiliate's post-occupancy survey that is being conducted in late-2022/early-2023. This survey focuses on identifying how Habitat homes have (or have not) suited Habitat families' short- and long-term needs. Support from Dow Fellows could include anything from modifying and distributing surveys through data analysis tasks and final synthesis. This project would additionally enable Molly Berg and her team to directly gather insights on how homeowners view sustainability and how it impacts them directly or indirectly.

**Conduct a Gap Analysis/Progress Audit of the Carbon Mapping and Mitigation Program**
A future Dow Fellows team can work alongside Habitat to document what has been accomplished, what is in progress, and what still needs to be done in accordance with the CMMP. Alternatively, if something like this has already been done, the Dow Fellows team can help Habitat plan for what remains to be done and propose metrics or key-performance-indicators for long-term tracking.

**Develop and Propose Realistic Incentives for Adopting Sustainability Best Practices**
One of the recommendations from the 2021 Dow Fellows Habitat team was to implement sustainability incentives that would encourage affiliates to try more sustainable building techniques and methods. This is an important step that is more easily said than done. The next Dow Fellows team could research and propose incentives to make the switch easier and/or more appealing for affiliates that fit within Habitat's resource constraints.

# Acknowledgements


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*Habitat for Humanity of Cape Cod:* Bob Ryley and Beth Wade
*Habitat for Humanity of Kent County:* Abby Langenberg and Mark Ogland-Hand
*Habitat for Humanity of Orange County, NC:* Richard Turlington
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## Dow Sustainability Fellowship Program Acknowledgement Statement

This work was supported by the Dow Company Foundation through the Dow Sustainability Fellows Program at the University of Michigan.

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# Appendix A: Interview Protocol

The following interview protocol is a blend of the protocol we used during our 2022 affiliate interviews and lessons we learned during and after those interviews. This can be used as a template for further interviews, but altering any wording, questions, or topics is encouraged based on knowledge of the interviewee and the affiliate.

We defined the question bank based on the following general topic areas that we deemed essential to Habitat's mission and sustainable building practices:

- **Mission-Fit:** How did the affiliate's sustainability project uphold Habitat's mission and align with the values of the case-study affiliate
- **Affiliate Motivation:** What was the affiliate's motivation for pursuing their sustainability project? How has this impacted the overall culture of their branch?
- **Carbon Emission Reduction:** energy efficiency of the project, alternative materials used, and waste reduction practices
- **Finance:** How sustainable construction impacts affiliate finances and the grant-seeking process. What are the potential cost-savings?
- **Community:** Values and characteristics of the community of volunteers, homeowners, and builders who made this project possible. How did this project address equity?
- **Practicality:** How did the affiliate practically achieve their sustainable construction goals (materials used, timeline, unique challenges).
- **Reflection:** Things that went well, things that did not, lessons that could be brought to new projects.

**Overarching Question**

What experiences, attitudes, partnerships, and techniques has the affiliate harnessed to incorporate sustainability into their operations?

**Introduction**

Hi, I'm [*name*] and I'm here on behalf of [*organization or project partner*] to learn about how you're incorporating sustainability into your builds and daily operations at [*affiliate name*]. This interview should take about 45-60 minutes and will cover a variety of topics. I'm here to learn from you, so you can treat me as someone with little to no background in any of the tools, techniques, or concepts we might discuss. Ultimately, what we learn will be incorporated into a sustainable building case study to encourage knowledge sharing across Habitat.

Before we start, I would like you to know that:

- Your comments are confidential and you will not be quoted or attributed in the final case study without your permission.
- You can also ask that anything you say be removed from our notes or the case study generated from this conversation for any reason.
- Your participation is entirely voluntary and if you would like to stop at any time for any reason, you can just let us know. Doing so will have no adverse effect.

I also have [*name(s)*] with me to help with note taking and follow-up questions. Do you have any questions before we get started?

**Warm-Up Questions**

- Tell us about yourself and your work.
- What motivated you to work with Habitat?
- *Is it okay if we record this conversation for our own note-taking purposes? The recording will not be shared with anyone beyond this group.*

**Topic-Based Questions**

Questions from each of the topics below can be selected based on any prior knowledge available about the affiliate. Not all questions below may be applicable and some new questions may come up based on the natural flow of the conversation and the interviewee's interest and experience.

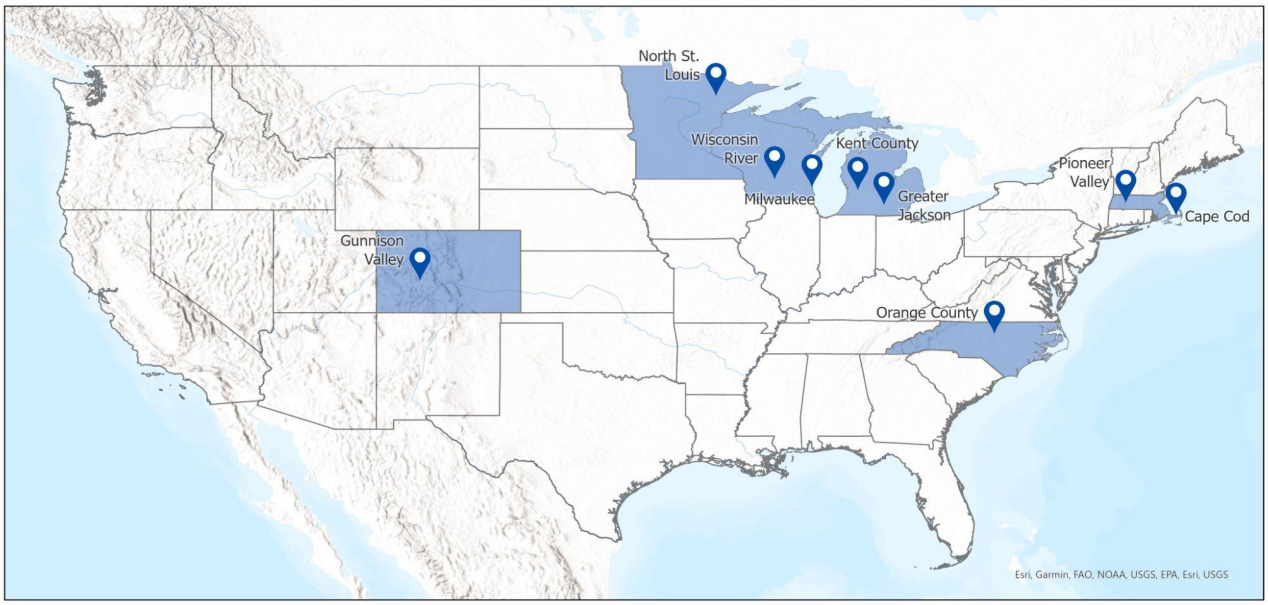
| General Topic Area | Question |
|---|---|
| Mission-fit | At a high level, describe how sustainability is part of your work. |
| Mission-fit | What do you do differently now compared to 5-10 years ago? |
| Mission-fit | Can you tell us about your team's experience making these changes? What were the challenges and successes along the way? |
| Practicality | What personnel were crucial to the execution of this project? (Partners, contacts, resources, etc.) |
| Practicality | What challenges did you face in executing this project? |
| Practicality | What was your timeline for completing this project? Did you meet your goals within the set time frame? |
| Practicality | Were there any unique processes that you had to navigate that were not standard to the building process prior to taking on this project? (i.e. different materials needed, unique skill sets, weather challenges, etc) |
| Community | What were some of the values and characteristics of the community of volunteers, homeowners, churches, businesses, and builders who made this project possible? |
| Community | *What are the social impacts of this project? – we can ask more nuanced questions once we know the community* |
| Affiliate Motivation | Why did your branch decide to pursue this particular initiative? |
| Affiliate Motivation | What was your motivation to pursue this project? |
| Affiliate Motivation | Why was this the right timing for the project? |
| Affiliate Motivation | How has this initiative impacted the overall culture of your organization? |
| Affiliate Motivation | Have other sustainability initiatives grown from this? If so, please describe. |
| Affiliate Motivation | Has this project inspired any changes in your work |

| General Topic Area | Question |
|---|---|
| Affiliate Motivation | How has it impacted how you interact with colleagues, volunteers, the community? |
| Affiliate Motivation | Was this initiative proposed/driven by homeowners/prospective homeowners? How about builders? Is turnout higher? |
| Environmental Outcomes | Were there any environmental outcomes/benefits that were tracked through this project? |
| Environmental Outcomes | What outcomes has this produced for you or the homeowner? |
| Environmental Outcomes | Can you describe any waste-reduction practices that were implemented? |
| Environmental Outcomes | Were alternative or more sustainable materials used in this project? If so, what were they? |
| Environmental Outcomes | Was there any analysis done of carbon emission reductions for this project? |
| Environmental Outcomes | Does the affiliate bundle costs of utilities into the housing affordability ratio? |
| Finance | How was this project financed? Please describe any grants that were obtained |
| Finance | Were there any challenges in financing this project? |
| Finance | Did this project provide any cost-savings to the affiliate? |
| Finance | To the homeowner? |
| Finance | How do you feel that sustainability initiatives fit into the financial landscape of your branch? |
| Finance | To what extent do finances impact the decision to pursue similar projects? |
| Reflection | What were things that went well, things that did not, lessons/advice that could be brought to new projects? |

# Appendix B: Habitat for Humanity Affiliate Partners Map

Below is a map of the Habitat for Humanity Affiliates who were interviewed and featured in this series of sustainable building case studies. The affiliates interviewed include:

- Gunnison Valley Habitat for Humanity
- Greater Jackson Habitat for Humanity
- Habitat for Humanity of Cape Cod
- Habitat for Humanity of Kent County
- Habitat for Humanity of Orange County, NC
- Milwaukee Habitat for Humanity
- North St. Louis County Habitat for Humanity
- Pioneer Valley Habitat for Humanity
- Wisconsin River Area Habitat for Humanity



# Appendix C: Sustainable Building Case Studies

*Below are the series of case studies that were developed as a result of the 2022 Dow Fellows Sustainable Building Case Study project.*

1. **Addressing Sustainability Through All Electric Homes**
2. **Addressing Sustainability Through Alternative Builds**
3. **Community Impacts of Sustainable Building**
4. **Data Collection: Gathering Homeowner Experiences with Surveys**
5. **Sustainable Building Case Study: Solar Energy**

Sustainable Building Case Study

# Addressing Sustainability Through All Electric Homes


**ALL ELECTRIC HOMES CASE STUDY**

**FEATURED AFFILIATES:**

- Cape Cod, MA
- Greater Jackson, MI
- Gunnison Valley, CO
- Kent County, MI
- North St. Louis, MN

**CASE STUDY CONTENTS:**



**ADDITIONAL CASE STUDY TOPICS:**



## Background

Electrifying homes is an endeavor that many Habitat for Humanity affiliates have embarked on to increase the energy that can be sourced from renewables, save costs for homeowners, and uphold sustainable building practices alongside their values of building decent, affordable homes. Some affiliates have been building electric homes for a number of years, while others have only recently started. In this case study, we hope to share a few lessons from affiliates who have had successes, as well as challenges, in eliminating fossil fuels by electrifying their habitat homes.

## Why Electrify Homes?

Increased efficiency: Heat pump technology used for heating/cooling uses less energy than traditional gas furnaces. Cost-saving: Analyses have shown electric appliances for space and water heating reduce costs over the lifetime of the appliances when compared to fossil fuel-run counterparts. Indoor air quality: a growing body of research suggests that gas appliances can increase risk for the development of asthma and other respiratory issues. Electrifying homes can mitigate exacerbations of respiratory diseases. Safety: Electric appliances eliminate the risk of gas leaks and carbon monoxide poisoning. Equity: Air pollution, among other environmental hazards, disproportionately impacts low-income populations and communities of color. Electrification lowers this burden while providing safe, healthy, affordable housing, especially for the families and children that many Habitat homes serve. Climate: Electric homes have significant climate benefits by reducing and/or eliminating greenhouse gas emissions from the home. By shifting to all-electric, affiliates are preparing for a future with a clean energy grid, as mentioned by **Kent County**, and a climate-friendly home environment where homes no longer have fossil-fuel based appliances and can truly be considered zero-emissions homes.

## Building a Tightly Controlled Envelope

*"A tight envelope and all-electric building systems are not synonymous but they are symbiotic." - Gunnison Valley affiliate*

Building a **tightly controlled envelope** was emphasized by all affiliates as one of the keys to a successful electric home. Often, to perfect this process, it takes iteration to find the best combination of personnel and materials to construct the envelope of a home. The envelope becomes especially important for homes in colder climates. When homes are well-sealed and insulated, heat-pumps, or really any utility system, are more efficient and the costs of heating and cooling the home decrease.

Some examples of the technical elements that create these tight envelopes include the following:

- **Kent County:** Their Carbon Footprint Build on London Ave. was their first electric home, built in 2020. The team started with an insulated concrete form foundation, pouring the concrete themselves. For insulation, they used 2.5 inches of rigid foam and a dense-packed cellulose, obtained at a discounted price. They utilized closed-cell insulation for all penetrations in the attic and around the rim joists. They also commented on having more experienced leadership teams versus volunteers doing air sealing, which may affect results. Volunteers also apply a bead of sealant where two pieces of framing come together. Through this work, their home's ACH scores come in around 1.2.

- **North St. Louis:** They use "acoustical sealant" under the exterior plate, which is preferred because it remains tacky through its life and does not harden and crack. In terms of insulation, they use at least 1 inch of closed cell foam on the exterior and interior wall plates, plumbing, HVAC and electrical penetrations into the attic to seal the space. The remainder of the attic is filled with 18" of blown in cellulose.
- **Gunnison Valley:** Their homes are completely foam-free, using straw-bale and cellulose insulation instead. They mitigate environmental impact by eliminating foam, minimizing concrete, glass and steel as much as possible. A hybrid of lumber, straw bales, and cellulose insulation finished with clay and lime plaster make up their envelope. Instead of spray foam around the seams, they use sheep's wool. They emphasize a control layer for air, vapor, radon, water and thermal transfer, often combined in the same product.
- **Greater Jackson:** Since 2015, they have been building electric homes and advising never to skimp on sealing a home as it has the greatest impact on future energy savings. They use 1 inch spray foam insulation in all the walls, caulking on all bottom plates when installed with butyl rubber, and then caulking again after fastened to the floor system. They caulk all holes in wall studs and all holes drilled by electricians. Windows are weather-taped when installed, then foam sprayed at the time of air sealing the walls. When installing foam on the exterior, they tape all joints with weather tape as well.
- **Cape Cod:** Knowing that the tighter the house, the more need there is for fresh air to be brought into the house via energy recovery ventilators, this affiliate recently added spray-on air barriers, which have reduced their air changes per hour from 3 air-changes per hour to less than 1.5. Their homes are plastered, but before they are painted, the air barrier is sprayed on.

## Electric Home Elements

**Heat pumps** are one of the most common pieces of equipment that make up a home because of their energy efficiency and ability to heat, as well as cool, homes. Heat pump water heaters are also an alternative to traditional gas water heaters. Contrary to some beliefs, heat pump air heating/cooling

technology does hold up in colder climates such as Michigan, Minnesota, Colorado, and Massachusetts, as evidenced by the utilization of this technology by these affiliates. While mini splits can be a consideration in electric homes, some affiliates describe them as more expensive and a potential cost burden to the homeowners if something goes wrong or if the system needs to be replaced.

To better utilize incentives for different types of heat pumps, **Cape Cod** involves a HERS rater who gives insight into specific appliances and incentives from the state (i.e. Mitsubishi heat pump model). **Greater Jackson** has used both heat pumps and mini splits in past builds. They emphasize homeowner education, providing them with standardized information, but also explaining any lifestyle changes that come with their new home's heating/cooling system. They use hybrid hot water heat pumps, A. O. Smith or equivalent, as well as air handler cold-weather heat pumps. **Kent County** uses Air-Source Heat Pumps and notes that, when installed properly, they can reach 300% efficiency. **Gunnison Valley's** all-electric home built in 2019 utilized a Minotair HRV system powered by solar panels, which was made possible through a community partnership, as well as an air-water hot water heater which uses a CO2 refrigerant with a global-warming potential (GWP) of 1 (compared to 1000+ GWP for most heat pumps!).

## Cost-Saving Opportunities

Affiliates have shared details regarding a commonly asked question: do electric homes produce cost-savings? According to **Gunnison Valley**, their homeowners save around $1500-$2500 in fees by not connecting to natural gas, which can then be redirected to pay for better insulation, airtightness, window/doors or heat pumps. Heat pumps can be more efficient in general and often heat pumps can cool as well as heat, which is advantageous. **Gunnison Valley** installs a system which conditions the air in 5 ways: heating, cooling, ventilation, humidification & dehumidification. One limitation of heat pumps is they do not have the immediate heating energy of combustion, meaning they produce heat more gradually, which results in their increased energy efficiency. To account for this limitation, they utilize electric resistant duct heaters on their ventilation/conditioning systems that provide instant heat when needed. While the difference in heating bills is often negligible with modern building energy codes, there are larger benefits that regenerative housing can provide such as: better indoor air quality, resilience, energy independence, comfort, carbon sequestration, and local economic sustainability **Cape Cod** has been building homes with heat pumps (for HVAC and water heating), along with solar to produce the electricity to run homes, since 2016. Their solar installations provide a significant percentage of the homes' electric/energy needs, which eliminates a large portion of electricity from the coal-fired grid. Anecdotally, many of their homeowners report zero-cost energy from late spring to fall (and some even into winter!) with net metering credits to their electric bills (see *Addressing Sustainability Through Solar Energy* case study for more information). **Greater Jackson** shares that one of their tips is using hybrid hot water heat pumps, air-handler cold weather heat pumps, and keeping all water lines short for water management.

## Indoor Air Quality

Home air quality's direct impact on the health of homeowners, especially those with pre-existing conditions, is of high importance. **North St. Louis** has had homeowners with respiratory issues report improvements in symptoms after moving into their Habitat homes, demonstrating how successful improvements in air quality contribute to homeowner health and happiness. This affiliate provides detailed instructions to homeowners on how to operate the air exchangers. They explain how the air-control of the home relates to efficiency and the need for using their air exchanger. They also provide physical demonstrations in a classroom setting and walk-throughs of their homes to teach homeowners how to clean and operate the controls. In their colder Minnesota climate, they emphasize when to turn the unit up or down to control the humidity, and that the unit itself is very energy efficient, so it doesn't require the homeowner to shut it off to save money. They perform regular check-ins with the homeowner to ensure they're comfortable and using the system properly.

**Gunnison Valley** has had reports from homeowners that children, especially those with respiratory issues, experience higher quality sleep and less symptoms. They also know from monitoring that the indoor air quality in their homes generally exceeds the outdoor climate, especially during fire season. At **Cape Cod**, indoor air quality was the reason they started using heat pumps. This affiliate has been informed that homeowners have benefited - for example, they have had children moved from damp basements into their clean-air homes, with improvements in health status reported. **Kent County** participates in Indoor airPLUS, which is a partnership and labeling program that helps new home builders improve indoor air quality by requiring construction practices and product specifications that minimize exposure to airborne pollutants.

## Unique Reasons for Success

**Cape Cod** owes some of their success to the landscape and attitudes of their surrounding community. The unique combination of residents in their community, proximity to a strong scientific community, and positive attitudes toward alternative energy where it is supported and incentivized often allows them to offset costs related to more sustainable building choices. **Greater Jackson** leadership attends Green Summits every year and brings back information to challenge their team to push forward green building initiatives. This allows them and the volunteers to be able to implement new techniques in electrifying homes. In addition, they owe their creativity and success to strong relationships cultivated over time with corporations and businesses, which often have shared goals of reducing carbon emissions. **Gunnison Valley** is fortunate to have access to an abundance of natural resources and biophilic materials (lumber, clay, straw) with carbon sequestration ability and low health risks. They also have a community ecosystem that allows them to increase their education and community interest in electric home initiatives, such as a partnership with a local regenerative building institute that teaches courses on how to think about construction regeneratively, and a local high school that teaches students how to design and build homes.

## Conclusions

One thread that ties together this work of electrifying homes by these different affiliates is their commitment to their mission and the heart present in the work that they do. Emphasis has been on unique and equally impactful visions to move forward with sustainable building, such as: training the next generation of leaders and building homes that are good for the community, economy and environment in **Gunnison Valley**; building strong, trusting relationships with other affiliates and the community in **Greater Jackson**; realizing the impact of their work on the health of younger generations of inhabitants in **Cape Cod**; creating mindset shifts within their organization to commit to going all-electric in the next few years in **Kent County**; and centering practicality and justice when sticking to the mission of building simple, decent, affordable homes in **North St. Louis**. This case study demonstrates how Habitat for Humanity affiliates are leading the way in creating sustainable homes that bring stability and comfort to more lives.

Sustainable Building Case Study

# Addressing Sustainability through Alternative Builds

## Background

The construction industry is historically slow-moving when it comes to implementing new efficient and sustainable practices. However, several Habitat affiliates are shifting this standard through alternative models of building and bringing innovative solutions to the industry. By thinking outside of traditional building standards and using features such as local climate and materials to their advantage, these Habitat affiliates created unique solutions to improve the efficiency and sustainability of their builds.

**"We need to empower ourselves and the next generation to have the most impact. We have to fundamentally shift the paradigm of how construction works in this country..."**
**– Gunnison Valley affiliate**

**ALTERNATIVE BUILDS CASE STUDY**

**FEATURED AFFILIATES:**

- Greater Jackson, MI
- Gunnison Valley, CO
- Orange County, NC
- Pioneer Valley, MA

**CASE STUDY CONTENTS:**



**ADDITIONAL CASE STUDY TOPICS:**

All Electric Homes
Community Impact
Data Collection
Solar Energy

## Straw Bale Homes

One focus of Habitat for Humanity **Gunnison Valley** in Colorado is using a framework called "Resource Conscious Construction". It enables them to quantify their impact in a holistic manner. They seek to avoid foam materials, reduce concrete or use emerging concrete technology, and employ less glass and steel, which can greatly reduce the environmental footprint of a build. They complete carbon impact analysis for their builds using the Building Emissions Accounting for Materials (BEAM) tool, designed by Builders for Climate Action. Since they are a smaller affiliate and have a unique model, they have been able to experiment with sustainability, leveraging their community to achieve their goals through innovative approaches rather than traditional green building practices alone.

**Gunnison Valley** is using local natural resources to their advantage in their builds. They incorporate Colorado's abundant resources—like lumber, clay, straw, and other biophilic materials—in place of non-sustainable choices. They have found that this resource conscious approach offers many benefits, as plant-based materials sequester carbon and local materials reduce emissions due to less transportation.

In 2019, two Habitat homeowners were interested in a straw bale home, and **Gunnison Valley** worked with them to create an ecologically sound home. They used materials including straw and cellulose for insulation,

around 90% local lumber, and other natural materials like wool, cork, and clay throughout the house. The straw bale hybrid used increased insulation values ranging from R-45 to R-70 for walls. One winter, while unheated, the home remained above 50 degrees inside for over a week, while outside temperatures were an average of -10 degrees, indicating the effectiveness of the combination of insulation and solar used for the build. According to the BEAM tool, this home will sequester more carbon than it emits by the time of occupancy, and it is expected that in 30 years of use it will still be carbon neutral. Beyond environmental benefits, the use of local materials was estimated to keep an additional $30,000 in the community.

Part of **Gunnison Valley's** success with implementing innovative materials in their builds relies on their local community. They leverage support from local universities and non-profits, including key partnerships with Western Colorado University, the Coldharbour Institute, and Equitable Solar Solutions. Their local building inspector is also very supportive and willing to work with Habitat on out of the box solutions. In addition, the organization itself is changing. With this new direction, the organization has attracted new blood onto the board, energized the volunteer community and opened new opportunities for funding and support.

For more information see: **https://www.hfhgunnisonvalley.org/projects/205-south-6th-street**


## Concrete-Free Foundations

In 2011, **Greater Jackson** Habitat began to explore how they could build more efficient-and lower cost- homes for their buyers. Their journey started with energy efficiency. The first change they made was a switch to building all-electric homes, which they have successfully been doing since 2015. Although they were building very energy efficient homes, they had a high carbon footprint most commonly due to the large volume of concrete used in builds. Other decisions made in the build process, such as using air sealing compared to caulking, demonstrate the tradeoffs between lower cost, higher efficiency, and more sustainable homes. However, they have been making progress toward their goal, stepping up their builds every year to make them better.

**Greater Jackson** highlighted the importance of attending green building summits to generate ideas about new techniques and innovations they can use in their builds. They believe attending and bringing information back to the affiliate is a key way to challenge their team to implement new strategies. In 2015, they went to their board to gain buy-in for some of these new types of builds. Although some cost a bit more, they were better for the environment and homeowners. In addition, they found that local corporations and businesses have interest in being involved in green projects and are willing to provide funding and resources to Habitat builds that include such programs. They are continually working to draw these groups in as bigger partners.

Around 2018, **Greater Jackson** learned a new method of building foundations using all wood instead of concrete. This technique was in discussion for a while, and 2022 was the first year they tested this process for building two houses on Franklin Street. These foundations use materials including wood, gravel, and cut stone instead of traditional poured concrete, which offers many benefits including lower cost and reduced carbon footprint. To evaluate benefits, **Greater Jackson** compared two builds of the same size (a 21' x 35' footprint) each using a different foundation style. The traditional concrete foundation cost $21,000 including labor and resulted in a carbon footprint of 27 tons of $CO_2$. The all-wood foundation was installed by Habitat volunteers (only cost $15,000 to install) and had a carbon footprint of only 4.1 tons of $CO_2$. The affiliate embraced this foundation style as a great step toward meeting their cost-saving and environmental goals.

There are a few challenges with using an all-wood foundation. This approach can't be used in every state due to climate concerns, although it is suitable for most. Areas with a north, north-central type climate or those with a non-coastal environment could likely employ this strategy. The process is also more time consuming and labor-intensive as it requires the right equipment and volunteers for installation. The prep

time took one to two weeks to complete two foundations. One benefit is that once completed, it can be built upon immediately without having to wait for it to settle as with a concrete foundation. For success, it is important to have a volunteer base who is excited about the project and willing to put in extra work for it.

**"It is much more gratifying than just showing up and having a concrete slab to build on, because right away you are looking at that and if you are looking at it from an environmental standpoint, you just showed up to a huge carbon footprint that is going to be there for 100 years."**
**– Greater Jackson affiliate**

## Small Homes

**Pioneer Valley** Habitat's focus is on building small, simple, and energy efficient homes, where sustainability overlaps with affordability. There is give and take with this approach, as some materials are very affordable but do not have a great environmental impact. However, by focusing on practical implementation and building smaller homes, they can use less of these types of materials and make improvements in other areas. They believe dual benefits is a key aspect of their simple building focus. For example, building a more durable home is both more sustainable and better for Habitat homeowners because they do not need to replace things as often. They also have found that the industry as a whole has changed in recent years, especially in Massachusetts where building and energy codes have become stricter. Initiatives like energy efficiency and HERS ratings have become commonplace as the industry shifts towards embracing some of these ideas.

One of their simple building initiatives is the Big Enough Homes project. This project started being developed in 2017-2018, and the first pilot homes were built in 2019. Their goal was to explore how building small can be a tool for affordability, by implementing simple build designs and processes and reducing the number of materials needed. They use standard construction techniques to keep builds simple, such as traditional wood-framed houses, which may not have as great an environmental savings but are easy for volunteers to assist with without requiring the expertise of highly specialized builds. Instead, they earn their environmental and cost savings from building a smaller footprint.

Traditionally, **Pioneer Valley** built 2- to 3-bedroom homes, but they realized this missed an entire population of homeowners. Their first 1-bedroom home at 1 Garfield Avenue in Northampton totals 650 sq. ft. and was built on a small lot. Focus was on a simple box-shape design that minimized materials. One challenge was the permits required to build on a small lot. They had to apply for cluster development zoning in addition to a permit for smaller driveway and house setbacks. Using smaller setbacks allows more efficient use of land in existing neighborhoods and also had sustainability benefits. After construction of these houses, Northampton changed zoning laws to allow for smaller developments. This zoning is unfortunately not always allowed in other parts of Massachusetts or in other states but does present an interesting opportunity for Habitat affiliates to get involved with driving change toward smaller development.

**"If more people built small, they would see that a small home is all the space they need."**
**– current owner of 1 Garfield Avenue**

One important consideration in these builds is how construction intersects with social aspects, such as homeowner culture, financials, and zoning requirements. When designing homes like this, **Pioneer Valley** had to balance the size of the build with the wants of the homeowner, for whom the switch from renting to home ownership has important cultural considerations. Homeowners expressed wanting features like a bedroom door and a washer and dryer in-house, which dictated a minimum size that the affiliate could build. However, beyond these features, homeowners were very willing to engage with smaller build options.

Similar to other strategies discussed in this case study, the community is an important aspect of the success of these builds. **Pioneer Valley** stressed the importance of considering the house as a whole system. Rather than just implementing a green initiative, it is important to understand how that feature impacts other areas of the build, including design and livability of the home. Because of this, it is important to have a diverse range of stakeholders involved in green building projects—from architects that help with design of buildings, to home energy raters that provide a critical third-party review of a home, to volunteers who are passionate and willing to help reach your vision. There are also many established green building principles that affiliates can use as a starting point to enter the green building space, and then work toward adding more innovative building approaches to their repertoire through the support of their community.

For more information see: **https://www.pvhabitat.org/big-enough/**

## Mixed- Income Development

Habitat for Humanity of **Orange County** has been working on their green building program for the past two decades. One of the challenges they face is balancing products that are good to make with those that are good to maintain. Some environmental products are not easy for volunteers to work with, which is a challenge they are facing especially for siding. Luckily though, the local community supports implementation of green building strategies. They have a large volunteer base, being close to universities, and many volunteers ask about sustainable practices, even something simple like where the recycling bin is. Volunteers can get turned off from returning if they do not see these initiatives in practice. In addition, asking about green building strategies is included when they apply for permits or developments in the area.

Another challenge faced in North Carolina is that people want to live in highly desirable areas, like Hillsboro and Chapel Hill, but there is limited land available for new development. Donors and town governments have been pushing builders toward denser developments. **Orange County** has decided to enter this space with their newest development, Weaver's Grove, which will be the largest development contract for this affiliate.

Construction on 32-acres will hopefully begin Spring of 2023 and continue over the next five years. It will feature 101 Habitat homes, in townhouse or duplex styles, for a total of 237 units. Additionally, they are selling 40 single family lots and three condo buildings totaling 96 units to two local builders to help raise funds for this project and create a mixed-income development.

**Orange County** has sometimes considered different types of construction too expensive or not in line with a traditional Habitat build. However, you can usually find a way to do sustainable approaches affordably, and they are beneficial and fit well with the Habitat mission. One recent project example was implementing permeable pavers to reduce stormwater runoff from impervious surfaces. There are often grants available for innovative solutions like these, with interest in funding pilot programs that feature sustainable practices.

For more information see: **https://weaversgrove.org/**

## Conclusions

Overall, as all of these affiliates showed, there are many ways to be involved with green building and to implement innovative approaches, which vary with the challenges and resources of the particular region. No matter which state you are in, or what type of a build you are hoping to do, it is important to leverage the assets of your local community to help you reach your goals and push past traditional models of building. Achieving a more sustainable home can be a delicate balance with other factors, such as cost and social impacts, but being creative and using alternative builds can help overcome these challenges.

Sustainable Building Case Study

# Community Impacts of Sustainable Building

## Background

Habitat for Humanity at the core works to bring people together to build homes and provide safe, secure, supportive homes for families to live in. This process begins by bringing together a community of people to build the home and does not end here. The role of community is important far beyond the build. It is important for the homeowner to feel ingrained in and supported by their community. Affiliates are expanding into increasingly more innovative sustainable building practices. One benefit of doing this is a deepened sense of connection between homeowners' home and community. This case study serves to share work being done that considers the impact of HFH on the community and the community's impact on homeowner experience.

Sustainable building includes considering the long-term sustainability of a home, both for the building and resident. HFH affiliates are going beyond simply building affordable new homes for homeowners and choosing to work to improve the current building stock to reduce energy use of these homes within their community. Aging in place and home repair programs are seeking to make homes livable for the long-term.

Homeowner education and engagement is another area that is an essential piece of sustainable building. With new technologies being implemented in Habitat homes, it is essential to provide educational opportunities to help homeowners understand how they can optimize their home's savings potential and incorporate more sustainable and healthy living practices into their daily habits.

**Community Impact Case Study**

**Featured Affiliates:**

- Wisconsin River Area, WI
- Orange County, NC
- Gunnison Valley, CO
- North St. Louis County, MN

**Case Study Contents:**



**Additional Case Study Topics:**

All Electric Homes
Alternative Builds
Data Collection
Solar Energy

As a non-profit organization who cares to advance affordable housing opportunities, investing into the whole community and building relationships is essential to the success of the mission. This expanded reach into the community can look like advocacy work for more sustainable and affordable homes. Another question being asked is how affiliates can connect residents with resources. Another avenue of building community involves a shift from the traditional way of building, from single-family to a high-density development model.

## Build Homes for Life

Habitat for Humanity's main mission is to make homeownership more accessible, and to ensure families are able to stay in their homes long-term. Affiliates are going beyond the traditional model of building new homes and are looking for ways to sustain home ownership for all who face housing insecurities within their community.

The Housing Plus Model is being championed by the **Wisconsin River Affiliate**. This program both works to provide safety upgrades for residents to age well and weatherization for homes to reduce energy bills. The aging in place work in **Wisconsin River** began a few years ago and was born out of the affiliate identifying the greatest needs in their community related to housing. According to a public health report,

one of the leading causes of death and injury to the elderly population in the state was due to falls, with their risk being 2.5 times greater than other states. When a homeowner requests to participate in the Housing Plus program, the affiliate partners with an occupational therapist to assess any health or safety concerns in the house. Their feedback allows the affiliate to put together a plan to ensure the resident can safely stay in their home.


In addition to improving the safety of a home, Habitat volunteers work to provide weatherization updates to the house as a part of this program. The average age of homes in the **Wisconsin River** community is 80 years old. Many of these homes also have not received modern weatherization updates, which results in high energy bills and drafty homes. These older homes require projects such as replacing windows or doors, energy efficiency projects like improved insulation or sealing leaks, and transitioning to electric appliances. Older homes have high energy bills, and this can be a financial burden for families, so these weatherization efforts work to reduce the monthly utility bills for residents.

**Wisconsin River** volunteers do over 60 home repairs a year, making this program more far-reaching than single family builds in this community. These repairs help increase the comfort of one's home and reduce some of the financial burden people in this community face due to high energy expenses.

Housing Plus programs are beneficial to the long-term ability of one to stay in their homes and increase the comfort and health of residents. Identifying the greatest need in your community as it relates to sustaining home ownership can help retain homeownership of those most vulnerable groups. This has been shown to increase the quality and length of individuals' lives, as it allows for greater independence and continued proximity to supportive communities.

## Homeowner Education

Within a home, there are many opportunities for people to interact with and make decisions on the operating conditions. A home can be soundly built, but it also requires those living there to understand how to interact with the systems in their house to reduce energy. Many homes being built by Habitat have a tight envelope and are equipped with green technology, to operate the home in an energy efficient manner requires some knowledge. Affiliates have developed resources to provide to their homeowners to build capacity on how to make the most of their new home. It is important how the homeowner will interact with their home during the design process and to ensure the homeowner has the tools to make the most out of their Habitat home.

The **Wisconsin River Affiliate** believes homeowner education is critical to reducing the burden of homeownership. As a result, they incorporate education into the process of each build. Their green living program consists of a minimum of 45 hours of workshops or homeowner education opportunities. These classes discuss the various aspects of an efficient home, as well as provide tutorials on how to maximize the efficiency of the appliances within their home to save energy and money. It includes workshops on how to weatherize one's home, including hands-on tutorials practicing how to perform simple home improvements, like caulking. Another opportunity offered is their master rain gardening course. Residents learn about landscaping techniques using native plant species to increase resilience to flooding.

Another example of homeowner's education is **North St. Louis, Minnesota**. This affiliate provides resources for homeowners during and after the building process. Sixty of the two-hundred required sweat equity hours are designated to homeowner educational opportunities. This includes workshops that

review how to care for your home and use energy effectively. As many other affiliates, this group builds extremely airtight and energy efficient homes. This requires ensuring that the homes are properly maintained and ventilated to ensure health and comfort of the building. Energy saving tips are taught, and homeowners get to keep these educational materials to refer to as needed.

## Expanded Reach into the Community

Habitat is a well-known organization, and their mission is far reaching. Other organizations exist within communities who are also participating in work related to equitable and sustainable housing. Opportunities exist for collaboration and resource sharing between affiliates, community members, and community organizations.

One effective way to increase access to resources and connectivity within a community is through building partnerships. One example of this is with advocacy groups who are also working to promote energy efficiency and electrification within homes. The **Wisconsin River Affiliate** has a partnership with a non-profit organization within their community called Power Up Bearaboo, and they are working together to pursue more sustainable building practices within their community.

**Gunnison Valley, Colorado** has been looking for creative ways to partner with their community as well over the years. This affiliate is uniquely positioned near Western Colorado University, the university partners with Habitat to volunteer and research their sustainable building practices. Additionally, the local high school hosts a program that builds a home from start to finish integrating sustainable design principles into their process. These kinds of projects teach the next generation of builders how to be thinking to integrate sustainability into the design process. Additionally, local partnerships with other organizations who are doing work related to affordable housing and sustainability have been fostered over the years with **Gunnison Valley**. This includes an equitable solar company, who retrofits old solar panels to be used on Habitat homes and organizations who are working to improve building codes to include sustainability. Developing relationships with similar organizations within your community could create greater opportunities to serve families.

Traditionally, Habitat for Humanity has focused on building single family homes on a plot of land to help families realize their goal of home ownership. **Orange County, North Carolina** is looking to expand the definition of ownership in an upcoming mixed-use development called Weavers Grove.

This large plot of land was purchased by the **Orange County Affiliate** in the Chapel Hill area, and the idea for developing a community rather than single family homes came out of the understanding of the scarcity of land and a lack of affordable housing. Many who work in the city cannot afford the high cost of land and are forced to live far outside of the city. There will be over 100 homes and units built here, in addition to a community center, community gardens, parks and walking trails, among other assets, which will allow residents to live nearer to their workplaces and better schools. The result will be a richer community. Research suggests mixed income communities lead to improved outcomes for those living

there due to spending more time outside, being exposed to a cleaner environment, better educational opportunities, and having a greater sense of place. This model of dense development of communities being championed in **Orange County** leans into the design of integrating people into a community.

## Conclusion

Habitat for Humanity is deeply committed to the mission of bringing people together to build homes, communities, and hope. In this statement, there is a commitment to the long-term success of the homeowner and the community surrounding them. The housing plus program is innovative as it understands the importance of one's home on their quality of life. For older community members, an accessible home allows for them to stay in their homes longer and to feel safer there. The weatherization program helps to reduce the burden of energy bills for families and creates a more comfortable home.

Sustainably built homes with tighter envelopes and green technology require some level of knowledge to ensure that residents are using the home to optimize their health and energy savings. Habitat builds green education into their home buying process. They are also committed to supporting partner organizations who are doing this kind of work. As a non-profit, there are opportunities to partner with organizations with a similar mission of building sustainable and affordable homes. Habitat's voice is one of expertise and compassion, and affiliates have the knowledge to impact those working in the for-profit construction space to consider beyond just a building, but also the impact they could have on the families living there and the sense of community generated by the build.

Sustainable Building Case Study

# Gathering Homeowner Experiences with Surveys

***"You have a tradition of a 30 plus year relationship with these folks... and you get incredible feedback you wouldn't when there's a constant turnover of clients."***

– Morgan Pfaff, Executive Director, Wisconsin River Area Affiliate

**DATA COLLECTION CASE STUDY**

**FEATURED AFFILIATES:**

- Wisconsin River Area, WI

**CASE STUDY CONTENTS:**



**ADDITIONAL CASE STUDY TOPICS:**

All Electric Homes
Alternative Builds
Community Impact
Solar Energy

## Background

Whether consciously or not, Habitat affiliates collect data every day on the job. Costs and material quantities might immediately come to mind, but data goes beyond numbers. Some of the most important data affiliates can gather, but might not explicitly record, are about people and processes:

- What did we do during this build to stay on schedule despite having fewer volunteers?
- Does the home continue to suit the homeowner's needs 5+ years after move-in? Why is that?
- What can we learn from the homeowner about how they run their home?

When collecting this kind of *qualitative data* (data that cannot be easily distilled down to numbers), some of the major challenges are asking the right questions and finding the resources to record and analyze results to find patterns and insights. The Wisconsin River Area Affiliate is taking on these challenges to better understand homeowner needs. "What's really critical to us is that we are consistently shifting in a way that we can most effectively do what we do," says Morgan Pfaff, Executive Director of the Wisconsin River Area Affiliate. Through a series of surveys and roundtable discussions, the Wisconsin River Area Affiliate is gathering homeowner experiences, stories, and feedback with the goal of improving the long-term sustainability and suitability of their homes. This case study highlights some of these ongoing qualitative data collection initiatives and the thought that went into developing them.

## There Is No Single Best Way to Collect Qualitative Data

Although this case study focuses on surveys, it is important to recognize that there is no one-size-fits-all approach to collecting qualitative data. Depending on factors like financial and staff resources or the number of homeowners an affiliate has in their network, some methods may be more practical than others.

Generally, qualitative data collection methods can be split into two broad categories:

- **More Formal Methods**: Formal methods are more standardized, structured, and repeatable. They are typically best when the results will be used to come to conclusions used for decision-making, but they often require more planning, time, and money. Examples of more formal methods of qualitative data collection include interviews (particularly with a scripted or semi-scripted set of questions) and surveys.

- **More Informal Methods**: Informal methods are more open-ended, casual, and unstructured. They can help form hunches and intuition that could be explored with more formal methods. An example of an informal qualitative data collection opportunity is a one-off conversation with a homeowner where they share their personal thoughts and experiences.

Broadly, informal methods provide anecdotes while formal methods provide insights into major trends. Some of the data collection methods used by the Wisconsin River Area Affiliate are arranged from more informal to more formal in the graphic below.


## Wisconsin River Area Surveys

The Wisconsin River Area Affiliate is actively gathering homeowner and potential home buyer feedback through several ongoing surveys:

| Survey | Purpose | Delivery Method | Participants |
|---|---|---|---|
| **Home Repair Pre- and Post-Assessment** | Understand home repair needs and outcomes | Online survey delivered via email? | Homeowners receiving repairs as part of the Home Repair Program |
| **Home Buyer's Club Workshop Survey** | Understand needs and challenges of interested home buyers | Paper survey completed before/during/after workshop? | Potential home buyers participating in free coaching workshop |
| **Homeowner Experience Survey** | Understand how homes have suited the needs of homeowners since the first build in 1984 | Paper survey delivered via mail? | Sent to all 85 Wisconsin River Area Habitat homeowners with follow-up roundtable discussions |

Support for these surveys has taken many forms. The home repair pre- and post- assessment survey began in 2021 and is being conducted as part of a grant. The homeowner experience survey was developed in partnership with an organizational psychology master's student from Adler University that Morgan is connected with through AmeriCorps. After collecting and analyzing feedback from homeowners in the experience survey, the Wisconsin River Affiliate will hold a series of roundtable discussions with select survey respondents to get a deeper understanding of their experiences.

## Conclusion

For organizations like Habitat that are heavily focused on people, collecting qualitative data to better understand their needs, concerns, and ideas can be vital. Particularly through the lens of sustainability, closing the gap on what affiliates know about how homes suit the needs of homeowners years after the keys are exchanged is crucial to better serving. “A lot of it is getting feedback from the people that become those owners and live in that home day after day. And, nicely enough, a lot of them are willing to, for example, show us their utility bills and let us know what they’re learning about how they make their homes most efficient or what hasn’t been efficient for them,” says Morgan, “And so that’s been really effective.” Data collection and analysis is ongoing, but please reach out to Morgan if you are interested in seeing the surveys themselves to repurpose them for your own work.

Sustainable Building Case Study

# Solar Energy

*(Cape Cod, MA)*

**SOLAR ENERGY CASE STUDY**

**FEATURED AFFILIATES:**

- Cape Cod, MA
- Gunnison Valley, CO
- Milwaukee, WI
- Orange County, NC

**CASE STUDY CONTENTS:**



**ADDITIONAL CASE STUDY TOPICS:**

All Electric Homes
Community Focus
Data Collection
Alternative Builds

## Background

The steadily decreasing cost of solar photovoltaic systems (solar energy) has popularized its use for powering residential homes. These systems can heavily reduce, if not eliminate, electrical bills and carbon emissions, as well as generate additional revenue for homeowners. Affiliates from across the country have been procuring and using solar energy in innovative ways to maximize its benefits for both Habitat and the homeowner.

**"Why not just make our own electricity?"**
**– Cape Cod affiliate**

**Cape Cod** initially focused on improving the air quality within homes to better the health of homeowners and their children. This included ensuring there were no products that were off-gassing volatile organic compounds (VOCs), eliminating sources of combustion like gas-fired stoves and furnaces, and replacing them with heat pumps (See *All Electric Homes Case Study*). During a conversation regarding how their builds do not have sources of combustion, someone mentioned "what about the coal plant that is powering the house?" This caused an employee to think to themself, "Well, we will see about that!"

After that conversation, **Cape Cod** started to focus on integrating solar energy into new builds. Today, they strive to include solar in every home and utilize several strategies to maximize its benefits. Throughout Habitat for Humanity, solar energy is being increasingly used by affiliates on new builds. This case study will highlight some of the successes and challenges that affiliates from around the country have addressed in incorporating this technology into their process.

## Solar & Partnerships

A common thread among affiliates was the importance of partnerships with stakeholders in the community. The scale and length of partnerships varied among affiliates, however, in essentially every case, partnerships were key to establishing and often growing an affiliate's capacity to install solar panels. These partners are extremely diverse and include businesses, government agencies, environmental organizations, academics, community members, or just people simply interested in solar energy. However, at every step of the process, they were essential in providing the impetus, knowledge, and financial or material support to start a solar program.

For example, **Gunnison Valley** originally partnered with Equitable Solar Solutions, a local organization, and received recycled solar panels from solar farms for use in Habitat builds. This spurred the use of solar panels on future builds and now, the homes they make, not only produce more energy than they annually consume but enough to power the average electric vehicle to drive 60 miles a day. Additionally, they completely power the construction of the next home on the adjacent site.

**Milwaukee** leverages its network of donors, contractors, and volunteers to be able to efficiently install solar panels on builds. After a donation from WeEnergies Foundation, they were able to add solar arrays to over 50 houses at no cost. Additionally, the affiliate tapped into their network and found contractors willing to install the panels for free as they wanted to gain experience in solar panel installation.

Volunteers and contractors are also a source of ideas on best practices and experimentation on creating solar-friendly homes. For example, a volunteer brought up the idea of using white shingles instead of black ones to reduce the amount of heat absorbed by the roof. The incorporation of different materials such as these can massively reduce energy needs (see *Alternative Builds Case Study*). Whenever possible, **Milwaukee Habitat** seeks out funding opportunities to maximize benefits to the homeowner while minimizing the cost to the organization.

In another case, **Orange County** started a pilot program with help from the East Chapel Hill Rotary Club which then was used as a proof of concept in a grant application to a local climate action fund. Later they received 260 solar panels in a donation from Strata Solar. This demonstrates that partnerships can be leveraged for not only the initiation of a solar program but the expansion of one as well.

## Finding Solar Partners

Every region, and community, may have a different path to increasing their use of residential solar energy. Among the affiliates interviewed, solar partnerships were formed with:

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|---|
| **Local Businesses** |
| **Utility Companies**<br>**HERS Energy Raters**<br>**Construction Companies + Contractors** |
| **Private Donors** |
| **Interested in Sustainability**<br>**Interested in Reducing Homeowner Utility Costs**<br>**Environmental Organizations** |
| **Local Universities + Community Colleges** |
| **Student Organizations** |
| **Local Nonprofits** |
| **Rotary Clubs** |
| **State and Local Governments** |
| **Retired Employees** |

## Local Ordinances & Solar

Energy policy, specifically regarding solar energy, is highly dependent on state and even local government policies and regulations. One policy that is critical to maximizing the returns from residential solar panels is net metering, which allows users who generate electricity from solar systems to sell the energy they don't use back to the grid. Net metering policies are hyperlocal; they may even vary depending on one's utility company. However, they can be used to help not only reduce the cost of electricity but provide alternate sources of revenue for Habitat and homeowners.

**Cape Cod** realized that their best months for solar were during the construction season; this caused a lot of solar credits to be lost as homeowners typically moved in later. To maximize the benefits of solar panels, the affiliate started to install them as soon as possible and took advantage of "Schedule Z" which is a Massachusetts program that allows one to take net metering credits and apply them to any electric bill. This empowered **Cape Cod** to not only apply these pre-home sale credits towards their office and ReStore electric bills but reinvest the offset into future solar projects so that the cost for solar is not passed onto homeowners. Additionally, **Cape Cod** reported that including solar on builds helps garner public support for new developments, especially when land needs to be cleared, in their environmentally conscious community.

Even if your Habitat is not based in a location with a "solar-friendly" net metering policy, there are still many ways to financially benefit from pursuing solar energy. There are local, state, and federal tax credits, grants, rebates, and other incentives that can help recoup the cost of installation. Additionally, excess energy could be shifted to water heaters and other appliances (see *All Electric Homes Case Study*). If they are installed in Habitat offices or ReStores, one can also maximize solar savings by shifting energy use towards 10 am to 3 pm - when solar panels operate at peak efficiency. Ultimately, solar energy not only makes financial sense, but also helps promote community goodwill, buy-in on future projects, and provides many environmental benefits.

## Challenges

Not every home is a suitable candidate for solar energy as there are physical and technical limitations. Additionally, some houses may experience too much shade, or be situated in a suboptimal direction for solar to make financial sense. For instance, an affiliate wanted to put solar panels on one of their office locations, but after doing some research they decided that the resources could be better spent elsewhere.

After talking with affiliates, one of the largest challenges for solar adoption is ensuring homeowner buy-in. Homeowners are hesitant for various reasons. A few of the most encountered include concerns about increasing the cost of future roof repairs and maintenance, reliability of the panels themselves, not wanting to "stand out" in their neighborhood, and a general lack of knowledge or familiarity with solar energy. Some homeowners were so concerned about rooftop solar that they were ready to turn down entirely free solar arrays. Homeowners have the choice as to whether they have the systems installed or not. However, it is unfortunate if that decision is made without knowing the full picture, which is why homeowner education is key to reducing solar hesitancy.

Several affiliates that were interviewed had a homeowner education process already in place. **Cape Cod,** in partnership with Cape Light Compact (a community-based organization), produced a manual that explains the programs that make low-cost solar possible for homeowners and how rooftop solar will benefit them. Working together with a trusted source to educate homeowners is a very effective way to dispel misconceptions about solar energy.

**Milwaukee Habitat** faced a similar problem; at first, there was not much knowledge and interest in solar energy. However, they packaged it as a financial decision first and foremost. During an interview, it was said that the most important thing is to “get conversations going.” Especially in areas where solar is not as prevalent, simply starting a conversation about its benefits, and how it works, can be a great first step.

Affiliates mentioned that once panels start being installed in neighborhoods, and homeowners can see how much money is being saved, adoption hesitancy diminishes greatly. Another barrier to solar adoption is a lack of solid data on average electrical bills at the local level. **Milwaukee** expressed that it can be challenging to properly size a solar array, as families come from varying living situations, and it can be hard to extrapolate projected energy use from previous occupancy data as apartments differ in energy efficiency.

One of the most common concerns from homeowners is that solar panels will damage their roofs or make roof repair too costly in the future. Having a conversation with the homeowner on how proper installation will not compromise their roof may help alleviate some of their fears. The best time to install solar panels is when the roof is being built; it saves on labor and money, allows for the maximizing of energy generated, and they can last as long, or longer, than a conventional roof. Additionally, when properly installed, they may even extend the lifespan of the roof and improve insulation and cooling. Although solar energy is not perfect, many of the concerns based around it can be alleviated or eliminated altogether through proper planning and installation.

## Conclusion

In the past decade, the residential use of solar energy has been rapidly accelerating and only becoming more prevalent in a variety of use cases. It is easy to see why. As utility bills rise, finding ways to improve energy efficiency and decrease electrical use is becoming increasingly important for low- and middle-income households. That is why the financial benefits alone make solar energy a fantastic investment and a path to ensure housing is more affordable for all. However, the nonfinancial benefits of solar; reduced carbon emissions, reduced reliance on the electrical grid, improved air quality, and greater community buy-in for development, are ways for Habitat for Humanity to support sustainable and transformative development in their communities. Although there are some barriers to entry, one can hope that the use of solar at Habitat builds becomes more commonplace as affiliates share methods and means of procuring and installing this technology.