Demonstration of Decarbonization in Tribal Affordable Housing

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ABSTRACT

Wisconsin is home to 11 federally recognized tribes, the majority located in northern Wisconsin and comprising approximately 1% of the state population. According to the American Community Survey census from 2016–2020, between 20% and 25% of Wisconsin Tribal members live at or below the federal poverty level. The prominent percentage of poverty is due to many factors but manifests in the available Tribal housing stock, which is typically older and in need of retrofits. Upgrading Tribal affordable housing stock is unique in that many Tribal territories are in remote areas with limited access to weatherization and electrification contractors.

This paper reviews a decarbonization project underway at a 10-unit multifamily affordable Tribal housing complex, provides a funding analysis for available federal funding for Tribal affordable housing building decarbonization, and discusses workforce development needs. The decarbonization project couples a 32-kW dual axis solar array with a 132-kWh battery storage system modeled to offset 59% of the building's electricity use and includes ongoing electrification upgrades to replace existing propane-powered space and water heating systems with air-source heat pump technology and energy recovery ventilation. This design serves as a demonstration project that reduces utility bills and greenhouse gas emissions, improves indoor air quality, supports resident health, and provides resilience during power outages for Tribal housing residents.

Introduction

The long history of insufficient federal housing funding assistance and its negative impact to American Indian and Alaska Native (AI/AN) peoples manifests in many ways, and its influence on housing infrastructure in Tribal communities is still prominent today (HUD 2017). Due to challenges including high poverty rates, high energy burden, overcrowding, poor living conditions, and lack of infrastructure, AI/AN people living on Tribal lands have fewer resources to meet housing needs (Garza 2022; National Low Income Housing Coalition 2022). [1] As shown in Figure 1, AI/AN individuals make up the smallest share of the total U.S. population (1.2%). However, they are the most disproportionately overrepresented group in poverty (Shrider 2023, 6).

[1] The percentage of gross household income spent on energy costs.

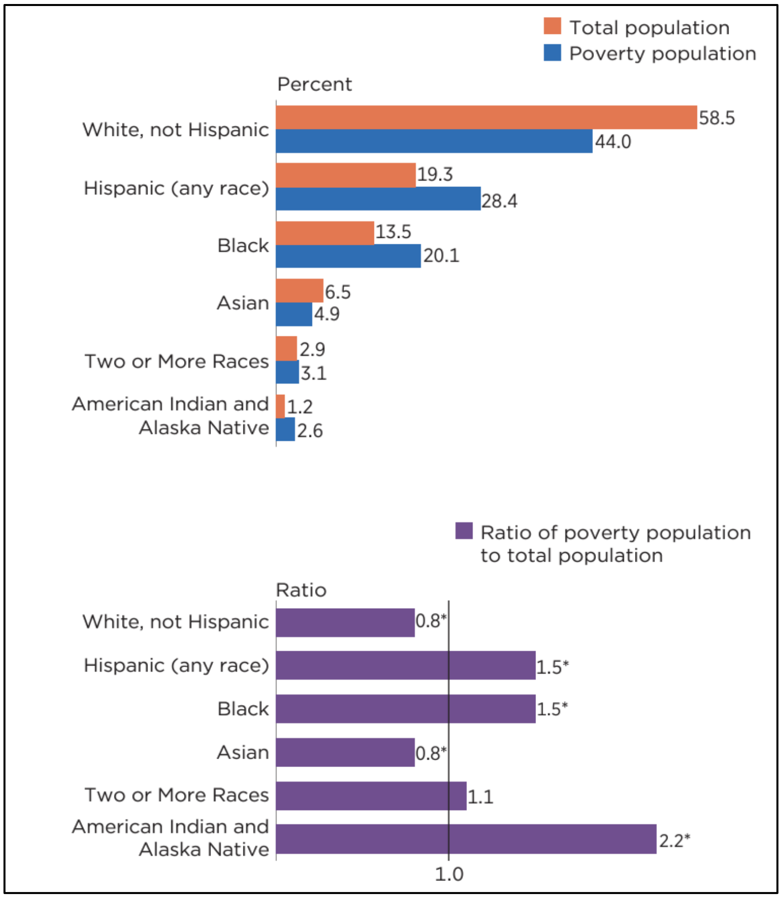

Figure 1. Distribution of total U.S. population and poverty by race using the U.S. Census Bureau, Current Population Survey, 2023 Annual Social and Economic Supplement: 2022. *Source:* Shrider 2023, 5

This poverty is exacerbated by high energy burden. In the Midwest, the average energy burden for Tribal communities is higher when compared to the corresponding overall average statewide energy burden percentage, (Garza 2022, 6). Given these statistics (shown in Table 1), and as the federal government signals its objective of improving equity across different marginalized groups, now is an opportune time for Tribes and Tribally Designated Housing Entities (TDHEs) to address these challenges in Tribal housing through improved building efficiency (DOC 2024). Funding for improving building efficiency is accessible through federal and state incentives as a part of the recent Inflation Reduction Act (IRA) and the Bipartisan Infrastructure Law (BIL).

Table 1. Average energy burden by state and tribal lands within state boundaries

State	State average energy burden (% income)	Tribal lands in state boundary weighted average energy burden (% income)	Percentage increase between energy burden on tribal lands and state average
Iowa	3%	5%	67%
Kansas	3%	5%	66%
Michigan	3%	4%	38%
Minnesota	2%	6%	195%
Nebraska	3%	4%	37%
North Dakota	3%	5%	60%
South Dakota	3%	6%	84%
Wisconsin	3%	3%	4%

Source: Garza 2022, 6

Tribal affordable housing is a critical, but often underfunded, part of Tribal building infrastructure. Tribal affordable housing is managed by a Tribally Designated Housing Entity (TDHE), an organized unit designated to receive and administer funding from HUD. TDHEs are responsible for the operation and maintenance of TDHE-owned housing (HUD 2024). On January 3, 1996, the Native American Housing Assistance and Self Determination Act of 1996 (NAHASDA) PL104-330 became law. The Office of Native American Programs within HUD must comply with the requirements of NAHASDA. According to HUD, the passing of NAHASDA provides federal housing assistance to Tribes in a way that recognizes Tribal sovereignty and the right of self-governance. NAHASDA allows for the consolidation of several federal housing programs that provide funding primarily to low-income Native Americans into a single, formula-driven recurring block grant program, the Indian Housing Block Grant, and authorized the Title VI Loan Guarantee Program to assist TDHEs, which cannot otherwise secure financing without a federal guarantee. The block grant funds are used for eligible purposes including design, construction, and maintenance of affordable housing on Indian reservations and Native communities (HUD 2024). Even with the passage and implementation of NAHASDA, Tribal housing funding remains far behind the rising cost of construction, particularly with respect to energy efficiency and clean technology such as solar.

Decarbonization of Tribal affordable housing involves the removal of the majority of on-site fossil fuel combustion equipment within the home, replacing this equipment with electric options, and offsetting grid-tied source greenhouse gas emissions with renewable energy. Before implementation of major upgrades such as heating and cooling improvements or the incorporation of renewable energy, Tribes/TDHEs must consider the following critical steps including health, safety, and weatherization measures to properly size equipment and minimize adverse health impacts. Although removal of on-site fossil fuel combustion equipment is a key step to achieving full decarbonization, there are instances where the cost of electricity is higher than the cost of natural gas, resulting in an increase in overall energy utility costs. In these instances, dual fuel systems pairing natural gas furnaces with an air-source heat pump system (ASHP) can hedge against the higher cost of electricity. Typical residential fossil fuel combustion equipment found in Tribal affordable housing includes furnaces, boilers, water heaters, stoves, and dryers fueled by natural gas or propane. Replacing this equipment with cleaner, energy efficient options that use electric resistance and/or air-source heat pumps can result in improved indoor air quality, and energy usage reduction (Garza 2022). In addition, offsetting grid-supplied electricity consumption with renewable energy technology, such as photovoltaic (PV) solar arrays paired with battery storage, can result in reduced energy costs and improved resilience during power outages.

Lac du Flambeau Chippewa Housing Authority Case Study

This case study was developed to demonstrate the opportunity to both decarbonize Tribal affordable housing and highlight challenges TDHEs face to access the full benefits of the IRA and BIL. This project takes place on a 10-unit multifamily building on the Lac du Flambeau Band of Lake Superior Chippewa Indians (LDF) reservation located in northern Wisconsin. LDF has inhabited this area since 1745 (Lac du Flambeau Tribe 2024 (1)). The LDF reservation is home to 2,517 persons identifying as AI/AN, according to the 2023 HUD Indian Housing Block Grant (IHBG) summary (HUD 2023). Housing programs in the community are led by the Chippewa Housing Authority (CHA), established in 1963 under a Tribal ordinance. In 1997, the CHA became eligible to receive block grants for low-income housing and for implementation of NAHASDA-sourced housing assistance. This funding goes towards providing safe, sanitary housing and housing services throughout the community. The services provided by the CHA include housing rehabilitation, maintenance, and inspections (Lac du Flambeau Tribe 2024 (2)).

Project Background

Elk Point West is a 10-unit 9,350 ft^2 apartment complex located on the LDF reservation, pictured in Figure 2. The apartment complex was built in 1980 and offers 1 and 2-bedroom units. All utilities are master-metered and paid for by the building owner, the CHA.

Figure 2. Photo of Elk Point West Apartments located on the Lac du Flambeau Reservation in Wisconsin. *Source:* Elevate

The decarbonization project involves two phases: (1) electrification and (2) solar with battery storage installation. The electrification portion of this project was funded by philanthropic grants targeting decarbonization of an existing building in a marginalized community, one that could benefit from both clean energy and environmental resilience[1] (Elevate 2024). The solar and battery storage portion of this project is funded by a grant awarded to CHA

[1] Resilience refers to the building's ability to remain operating and comfortable for occupants during utility service disruptions.

by the Wisconsin Public Service Commission, Energy Innovation Grant Program (PSC WI 2022).

The CHA partnered with Elevate and Evergreen, nonprofit organizations focused on clean energy and building efficiency projects in low-income communities, to manage the project implementation. Elevate evaluated certain CHA buildings through energy assessments and found that CHA's 10-unit Elk Point West could benefit from electrification upgrades, as its heating was supplied by propane, which resulted in high utility bills (Elevate 2024). Elevate's role in the project was to provide project management and engineering and construction capacity.

No natural gas lines extend to Tribal housing on the LDF reservation, and every building located on the LDF reservation is heated by either wood or propane. The addition of air-source heat pumps coupled with solar PV and storage provide a model for future housing upgrades on the reservation. This project involved multiple aspects of the building decarbonization process from funding, building assessment, scoping, mobilization of labor, and implementation.

Decarbonization Measures at Elk Point West Apartments

Several improvements were made to the 10-unit Elk Point West apartments including adding mechanical ventilation with energy recovery, replacing water heaters with electric resistance water heaters, sealing air leaks, adding insulation to the attic, installing air-source heat pumps for space heating, and upgrading lighting. Air sealing and attic insulation were completed by the CHA maintenance staff; outside contractors completed all other measures.

Figure 3: Photo of air-source heat pump air handlers installed at the Elk Point West apartments in Lac du Flambeau, WI. *Source*: Elevate

Cold climate ductless air-source heat pumps were installed, as shown in Figure 3. Indoor heat pump heads were installed in each living room and bedroom. Each residential unit had one outdoor heat pump unit installed, which serves the indoor heads. Ducted heat pump systems were installed for common areas like hallways, laundry, and storage. The existing propane boilers and baseboard hydronic system remained in place for supplemental heat. Based on the costs for propane and electricity, the controls were set to operate the air-source heat pump whenever the outside temperature was warmer than -5°F. This setpoint can be adjusted in the future as utility costs change. Some units used window air conditioners for cooling which were removed as the heat pumps provided cooling. A fan coil split system that cooled the storage area was also removed.

To improve the indoor air quality, a mechanical whole-building energy recovery ventilation system (ERV) was added. This is an especially important consideration given the high volume of smoking within the building and the Tribe's location in northern Wisconsin, which results in colder winters and longer times indoors. Outside air is drawn into the building through an abandoned chimney and ducted to an energy recovery ventilator that transfers heat and moisture between the fresh air supply and stale air exhaust airstreams. During the heating season, an electric heater warms the supply air to near room temperature. No additional cooling or dehumidification is done to the supply air stream. Outside air is supplied to each living room and bedroom at a rate of 25 cfm per room. Additional outside air is supplied to the corridor to provide makeup air for exhaust from restrooms off the corridor and to pressurize the building so that most air leaks are out instead of in. The bathroom exhaust fans were removed and replaced with exhaust grilles. The exhaust air was ducted to the energy recovery ventilator and exhausted out the back wall, far from the air intake on the roof. This ventilation system increased energy consumption due to the heater and fan operation, but energy savings from other upgrades more than offset this increased usage, resulting in a net reduction in energy consumption.

The existing propane water heaters were replaced with electric resistance water heaters. Heat pump water heaters were considered but were not installed due to current challenges with controlling multiple heat pump water heaters as one system.

The fluorescent light fixtures in common areas were upgraded to LEDs. Exterior light fixtures that were not already LED were also upgraded.

The electrification and lighting portions of the project were completed in May of 2024. The next phase of this project is to install a ground-mounted solar PV and storage system during the summer of 2024 that will keep the building operable during a power outage, contributing to the building's climate resilience (Elevate 2024).

Impacts of Measure Implementation

Electrification is expected to reduce annual building propane cost by approximately $3,800 (72% reduction). The annual electrical cost increase of about $1,900 from electrifying space heating and water heating and installing an ERV makes the net annual savings about $1,900. As of May 2024, actual energy savings have not been measured and are not yet available.

The air-source heat pumps provide cooling for Elk Point West residents, which is considered an imperative health and safety measure because of increasingly hot summers due to a changing climate (CDC 2019). In addition, improving indoor air quality through efficiency measures and installation of an ERV will not only provide health benefits but can also result in economic savings for CHA. U.S. Department of Energy (DOE) studies show that households could save $514 per year in medical bills resulting from healthy building measures as well as experience reductions in time needed off work for health-related issues (DOE 2019).

To understand the impacts on indoor air quality, Elevate commissioned EcoBalance Technologies to measure several characteristics of indoor air quality for five days in four of the ten residential units prior to the retrofit and before any new equipment was installed. Those characteristics included indoor temperature, humidity, carbon dioxide, volatile organic compounds (VOCs), particulate matter (PM2.5), and radon. Two sensor packages were installed in each of the four units—one in the living room and the other in the master bedroom. The same measurements will be made after implementation for comparison.

Acceptable ranges for temperature and humidity are defined by ASHRAE Standard 55, which are shown by the polygons in Figure 4.

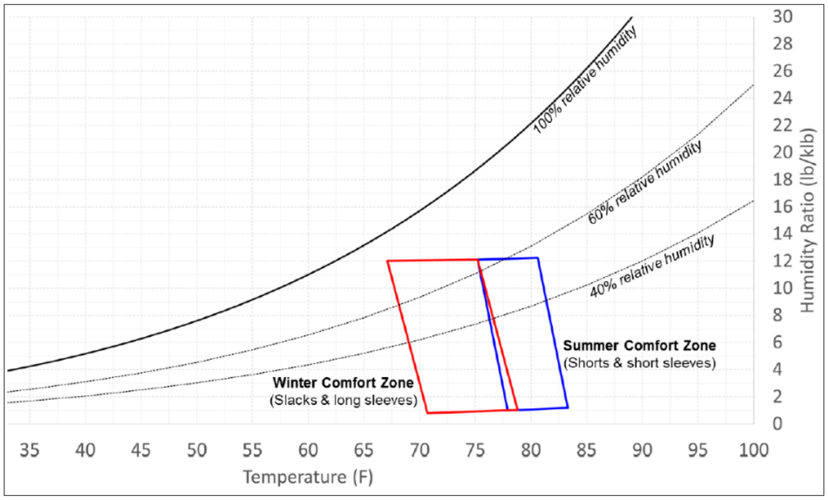

Figure 4. Acceptable ranges of temperature and humidity. *Source*: EcoBalance Technologies, 2023

Thresholds for other indoor air quality metrics are from Healthy Indoor Air Quality Guidelines by ERV manufacturer Build Equinox and are found in Table 2.

Table 2: Indoor air quality maximum thresholds for various indoor air pollutants

Indoor air pollutant	**Maximum threshold**
Carbon dioxide (CO2)	800 parts per million
Volatile Organic Compounds (VOCs)	125 parts per billion
Particulate Matter (PM2.5)	10 micrograms per cubic meter
Carbon Monoxide (CO)	9 parts per million
Radon	4 picocuries per liter

In Figure 5, temperature and humidity measurements were often within the ASHRAE limits. One exception was a unit where the temperature in the master bedroom fluctuated significantly more than in the living room, possibly due to an open window.

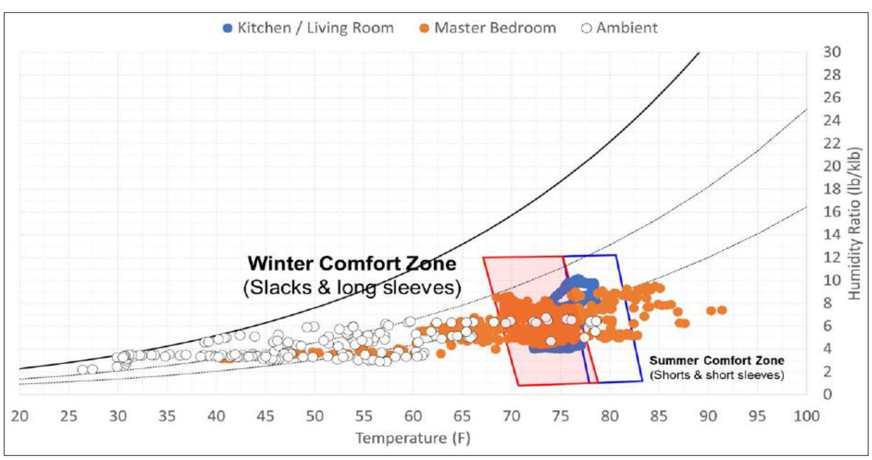

Figure 5: Temperature and humidity measurements. *Source*: EcoBalance Technologies, 2023

Figures 6 through 9 show typical time trends of concentrations from one of the units. Red shading shows values that exceed limits in Table 2. Carbon dioxide often exceeded the recommended concentration, as shown in Figure 6. Similarly, Figure 7 shows measurements of volatile organic compounds and Figure 8 shows PM 2.5 concentrations measured above healthy levels. Finally, radon measurements are within the limits as shown in Figure 9.

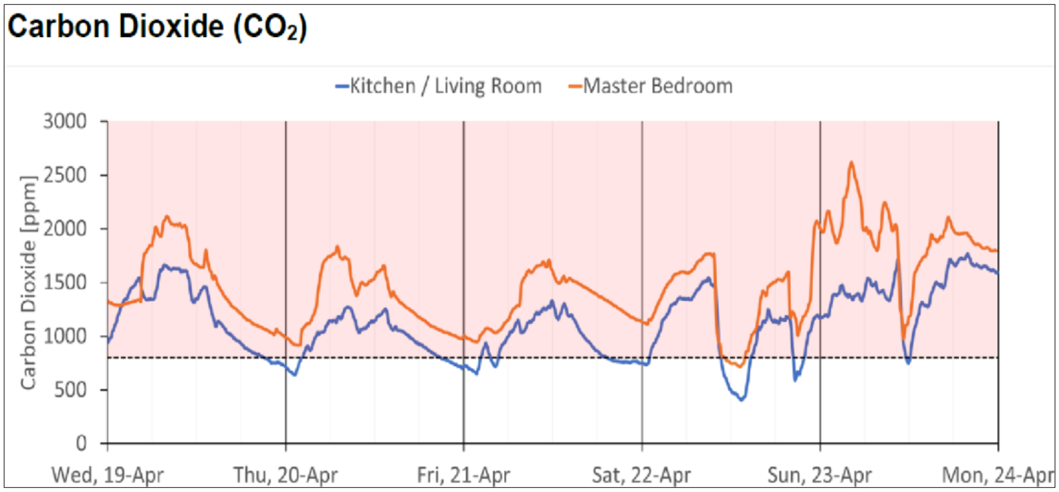

Figure 6. Indoor carbon dioxide measurements at Elk Point West. *Source:* EcoBalance Technologies, 2023

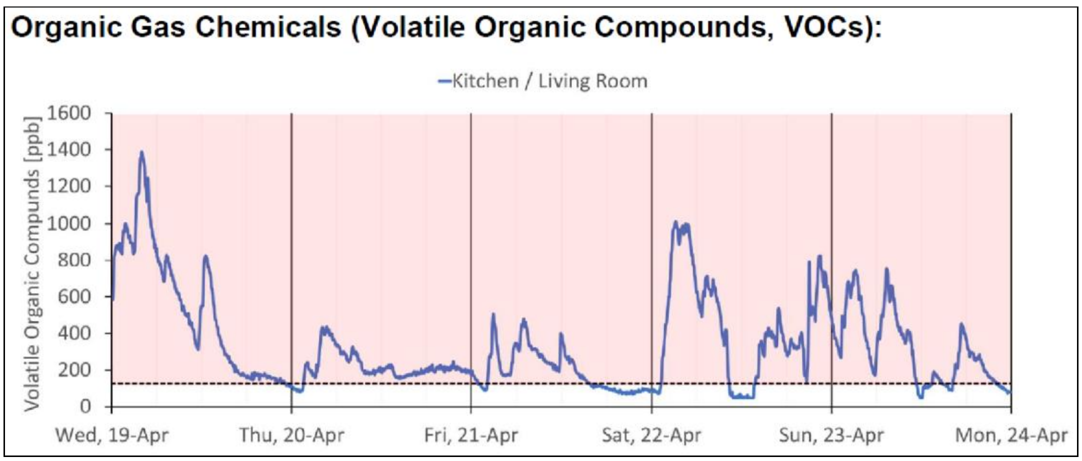

Figure 7. Indoor Volatile Organic Compound measurements at Elk Point West. *Source:* EcoBalance Technologies, 2023

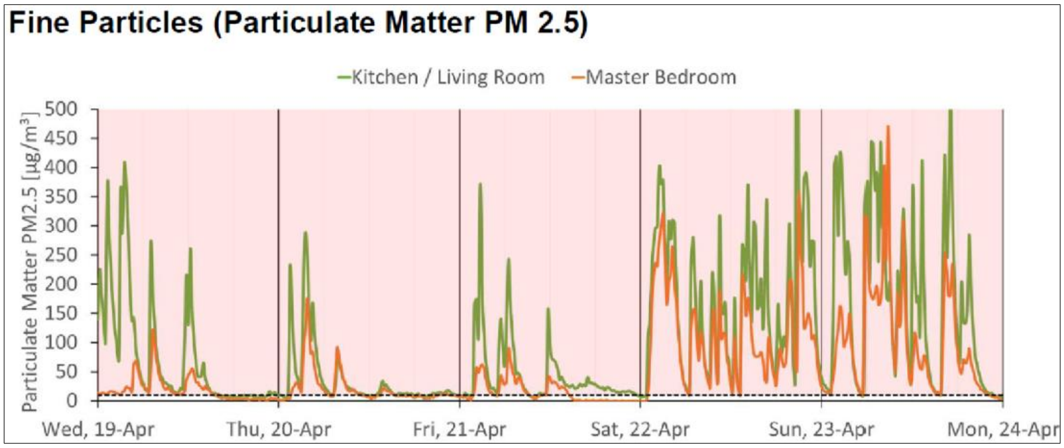

Figure 8. Indoor Particulate Matter 2.5 at Elk Point West. *Source:* EcoBalance Technologies, 2023

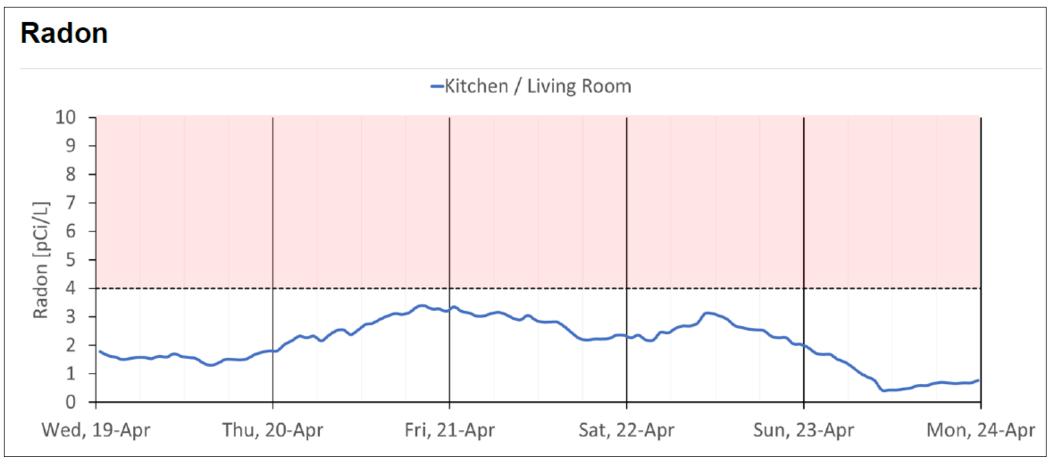

Figure 9. Indoor Particulate Matter 2.5 at Elk Point West. *Source:* EcoBalance Technologies, 2023

The existing propane water heaters did not have sealed combustion and instead sourced combustion air from the utility room. A duct with a motorized damper directed combustion air to the room from outside. Replacing the propane water heaters with electric resistance water heaters allowed the combustion air system to be removed, and the former combustion air opening was sealed and insulated. The propane boilers have sealed combustion and did not need combustion air from the room.

Both the ventilation system and the elimination of combustion air allowed the building to be well-sealed, which reduces drafts and improves comfort. Adding insulation to the attic and air sealing improved the air leakage and thermal properties of the building's envelope.

Anticipated Impacts of Solar Plus Storage Implementation

Solar PV with battery storage is planned for the near future. Ideally, the solar PV would have been installed at the same time as the weatherization and electrification work, but timing of funding forced a phased approach. Without solar, the carbon dioxide emissions are expected to remain about the same due to the addition of ventilation and cooling. Adding a 36 kW solar system and 132 kWh storage system to the building will offset electric energy usage and provide much needed back-up power for critical systems during power outages. Overall, the air-source heat pump system coupled with the solar PV and storage is estimated to reduce fossil fuel use in the building by over 70%.

The energy generated by the 36 kW onsite solar system is estimated to produce approximately 64,890 kWh per year, directly minimizing the electricity taken from the grid and reducing energy and operating costs by an estimated $3,400 annually. The introduction of onsite solar generation alone will reduce electricity taken from the grid by an estimated 59%. The electrical load profiles used for this analysis were projected based on the air-source heat pump system specs being installed. The solar generation was modeled using PVWatts[1] from the National Renewable Energy Laboratory (NREL), considering local irradiance data and assuming minimal shading. PVWatts was used in place of typical commercial solar PV system simulation software (e.g., Helioscope[2]) because it can capture the extra solar production created by the proposed dual-axis tracker system. Most commercial solar design software, including Helioscope, cannot model dual-axis tracking systems.

As part of the demonstration project, the battery's inverter controls will involve load shifting and peak power shaving. While the focus of the battery system is to provide backup power for the heating and cooling load for the apartments, additional savings are expected by using the proposed battery and inverter controls to pull energy from the grid at the least expensive times of the day and dispatch energy to the building at the most expensive times of day to avoid power draw from the grid. An hourly load model was completed as part of the analysis for the air-source heat pumps operation and was used to build a model in HOMER (Hybrid Optimization of Multiple Energy Resources)[3], a tool developed by NREL and Underwriters Laboratory. This provided projected utility cost savings from reducing peak demand by an estimated 5-10 kW on average per month, resulting in savings of $1,000 to $1,500 per year.

Peak power and load shifting have benefits beyond utility cost and energy savings. A major benefit expected from the solar and storage measures is increased resilience, both to the resident by insulating them from utility power outages and to the utility by reducing demand during time periods when the grid is stressed.

The financial and health and safety benefits of resilience are also substantial. These include reducing operating costs to help sustain this building as affordable housing and minimizing risk from extreme heat or cold during power outages. The battery system is projected to provide 12 hours of continuous power to the heating and cooling systems. HOMER Grid was used to size a battery system that would meet the power needs of the heating and cooling systems for a minimum of 12 hours. Modeling shows that the solar and battery system should be able to run continuously even if the power is out for multiple days. This depends on the time of year in which the outage occurs, since long-duration outages in winter months with high heating loads and low solar production are more difficult to cover with battery backup power than outages that occur in summer months, which have lower heating or cooling loads and higher solar production. However, quantifying resilience is complicated, reliable best practices are difficult to find, and the tasks associated with most methodologies are beyond the scope of this application.

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[1] PVWatts Calculator (nrel.gov)
[2] HelioScope | Commercial Solar Software (aurorasolar.com)
[3] HOMER - Hybrid Renewable and Distributed Generation System Design Software (homerenergy.com)

Preliminary Project Findings

Due to the project being completed within the last year, actual post-retrofit utility data and air quality monitoring results are not yet available to compare with the utility data from before the retrofits. The following findings from the decarbonization demonstration project at Elk Point West highlight the necessity for:

- TDHE collaboration with knowledgeable about energy efficiency, building science, and HVAC systems to provide data-driven guidance, project management support, and construction oversight. Elevate was able to bring project management, engineering, and construction capacity to the project to ease the time and capacity strain on CHA staff. Elevate also provided technical knowledge for indoor air quality and energy conservation technology such as energy recovery ventilation system and air-source heat pumps.

- A critical need to engage existing Tribal housing operations and maintenance staff and Tribal citizen contractors with decarbonization projects, including providing training in current international building codes and renewable energy, efficiency, and decarbonization technologies like solar PV and heat pumps. This would ensure TDHEs can operate and maintain new equipment as well as identify opportunities for future upgrades.

- Identifying electrical, HVAC, and solar contractors proved to be challenging in the remote area of the LDF reservation. This is generally true for many rural areas.

- Longer project timelines to account for difficulty in procuring clean energy equipment and contractors in remote and/or rural areas. Finding an electrician and air-source heat pump installer that were both relatively local and a large enough company to take on the project was challenging. Supply chain delays associated with the ERV system and some electrical equipment also resulted in project delays.

- Resident education about the project and how to use the equipment. It is important that residents understood how the air-source heat pump system differs from their previous system and how to best adjust the thermostat for energy savings and comfort. CHA notified residents of the project prior to construction and are planning to conduct a community event with Elk Point West residents to discuss the project results.

- Secure funding prior to starting a project to avoid project delays. This project secured a portion of the funding through philanthropic sources and the remainder through federal funds allocated to the state of Wisconsin. Federal funding is typically distributed via reimbursement leaving TDHEs responsible for obtaining gap funding to cover the project cost until reimbursement is received. It is important to identify low to no cost sources of gap funding to avoid project delays. With the recent passage of IRA and BIL, there has been an increase in the amount of federal funding available for decarbonization projects for TDHE's (see funding analysis and Table 3).

Funding Analysis: Tribal Affordable Housing Decarbonization

Implementation of the LDF CHA decarbonization project highlighted critical funding and capacity shortages when attempting to decarbonize Tribal housing stock. LDF CHA had limited administrative and construction staff to manage the decarbonization project. Furthermore, without outside funding, the cost of upgrades would have been out of reach for CHA. When energy efficiency upgrades can be made, the health and safety measures that address unsafe conditions and deferred maintenance can cause the simple payback periods to be excessive. The Justice 40 Initiative has changed the administration of federal funding allocation by requiring that 40% of the benefits of federal clean energy funding be administered to Low Income Disadvantaged Communities (LIDACs), which includes Tribal lands and may be used to address gaps in funding (DOC 2024). The following paragraph outlines key considerations needed for Tribes and TDHEs to take advantage of the IRA and BIL to upgrade their existing housing stock.

Although many Tribes and some TDHEs have completed clean energy and/or climate planning prior to the IRA and BIL, funds for planning were generally limited in availability at the federal, state, and local levels to finite public and philanthropic sources. IRA and BIL provide unprecedented levels of federal funding for implementation of decarbonization and clean technology programs on Tribal lands. Specific programs and set asides for Tribes have been created for each funding source and technical assistance is available, summarized in Table 3. One specific example is the Climate Pollution Reduction Grant (CPRG) opportunity, outlined in the IRA and administered by the EPA, which provides Tribes with non-competitive funding to complete clean energy planning and develop a Primary Climate Action Plan. The Primary Climate Action Plan (a document that incorporates a variety of measures to reduce GHG emissions from across economies) allows Tribes to apply for competitive implementation funding of approximately $300 million total, which will be distributed in grants between $1 million–$25 million per awarded Tribe (EPA 2023).

Table 3. Summary of federal funding opportunities for Tribes

Agency	**Program**	**Administrator**	**Building use type**	**Focus**	**Funding level**
BIA	Tribal Electrification Program	Tribes	Varies	Decarbonization	Varies, Competitive
DOE	Whole House Rebates Program	States	Residential	Energy efficiency	$4,000 per home based on efficiency measures and savings
DOE	Home Electrification and Appliance Rebate Program (HEAR)	States	Residential	Decarbonization	Up to $14,000 per home
DOE	Tribal Home Appliance Rebate Program	Tribes	Residential	Decarbonization	Varies, based on formula allocation
DOE	Clean Energy Projects	Tribes	N/A	Clean energy	Competitive
EPA	Climate Pollution Reduction Grant (CPRG)	Varies (State, Tribe, or other entity)	N/A	Community-led planning	Planning- Formula, Implementation- Competitive
EPA	Community Change	Varies	N/A	Community-led planning	Competitive
EPA	Greenhouse Gas Reduction Fund (GGRF)	Eligible organizations (e.g.,	Varies	Lending program	Competitive

Agency	Program	Administrator	Building use type	Focus	Funding level
	- National Clean Investment Fund	non-profit organizations)			
EPA	GGRF- Clean Communities Accelerator	Eligible organizations	Varies	Lending program	Competitive
EPA	GGRF- Solar for All	States, Tribes, other eligible entities	N/A	Solar	Competitive
HUD	Green and Resilient Retrofit Program (GRRP)	Housing developers with HUD subsidy	HUD-subsidized affordable housing	Technology	Competitive
DOI	Bipartisan Infrastructure Law (BIL)	Tribes	N/A	Energy and internet infrastructure	Competitive
DOE	Low-Income Communities Bonus Credit Program (48e)	Office of Energy Justice and Equity	N/A	Renewable energy	10-20% increase to existing investment tax credit; competitive

Note: This list is not comprehensive and may change based on future roll-out of Federal funding and State administration requirements. *Source:* Grants.gov

Opportunities to address Tribal staffing and technical capacity constraints will require forethought by federal and state administrators of BIL and IRA. This is already happening through various technical assistance offices and programs, such as Thriving Communities Technical Assistance Centers. Additionally, available funding needs should continue to be flexible enough that Tribes can self-determine the highest and best use for their communities. For example, flexible funding available through IRA and BIL includes formula funds through DOE earmarked for specific measures that allow for Tribes to prioritize and stack projects. Competitive funds, such as EPA Community Change grants, are also flexible and could be used for workforce development, but because those grants are competitive, they require capacity to develop applications. The EPA CPRG process provides another opportunity for flexible funding to spur clean technology projects; states are encouraged to create set-asides within their CPRG applications that would be available to Tribes that may not have applied for the competitive funding for Tribes. Finally, philanthropic grant dollars must play a role in the funding and capacity building strategy for Tribes by providing flexible funds that can build internal Tribal capacity and/or fill project level funding gaps.

One of the most promising yet complex IRA funding opportunities for Tribal renewable energy projects is the 48e elective pay, also known as the direct-pay, tax credit where tribes can receive a refund up to 30% or more of the project cost through 48e bonus tax credits (DOE 2023). According to a partner at Quarles & Brady LLP, Pilar Thomas, who specializes in energy, "tax credits are the single most effective way to obtain money for a new project. Grants are competitive and loans must be paid back, which makes tribes hesitant to pursue them and banks equally hesitant to issue them," (Tribal Business News 2024).

The Low-Income Communities Bonus Program under 48e is currently under-subscribed for projects on Tribal land. Many of the categories in the program have reached their power capacity for both approved and pending projects while a total of 149 MW of capacity remains for eligible renewable energy projects on Indian Land. Tribes have an opportunity to increase possible refundable direct pay by 20% through these bonuses but many Tribal lawyers are not acquainted with tax law. This indicates a chance to provide education on the direct pay option and a significant need to work with tax accountants to interpret the complexities of the filings (Tribal Business News 2024). This is an area of opportunity and a possible pathway to pursue increased access and participation in the 48e Elective Pay resource.

One of the most critical areas that needs to be supported by all available funding programs discussed in this paper is resources to grow a Tribal workforce to install and maintain newly installed equipment. According to a 2017 report from HUD on Housing Needs of American Indians and Alaska Natives in Tribal Areas, “the availability of labor is affected because tribal housing agencies do not have enough construction activity to support construction workers (either in-house employees or contractors) on a consistent basis.” While some of the programs, such as Community Change grants, are explicit about funding for workforce, other sources are not clear on how funding for building a Native-led clean energy workforce can be included. This is an issue that needs to be resolved since most TDHE maintenance and operations staff are typically over capacity, managing many units at once with limited time available to manage multiple major housing renovation projects.

Conclusion

In summary, the preliminary findings from the decarbonization demonstration project at Elk Point West highlight the necessity for TDHE collaboration with an energy expert on decarbonization projects to provide data-driven guidance, project management support, and construction oversight; resident education about the project and how to use equipment; longer project timelines to account for difficulty in procuring clean energy contractors in remote and/or rural areas; and secured funding prior to starting project.

Implementation of the LDF CHA decarbonization project highlighted critical funding and capacity needs to decarbonize Tribal housing stock. When pursuing federal funding it is important for TDHEs to consider sources of gap funding and explore new funding mechanisms like 48e elective pay. One of the most critical needs in all the available funding programs discussed in this paper is resources to grow a Tribal workforce to install and maintain newly installed equipment.

Finally, this project is an example of a successful Tribal affordable housing decarbonization project that can be referenced as inspiration for future projects across Tribal communities nationally with specific considerations for cold climate heat pump technologies specific to colder climate areas such as those in the Midwest.

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