KEEP TRUCKEE GREEN

TOWN OF TRUCKEE

Existing Building Decarbonization Roadmap

TOWN OF TRUCKEE

Executive Summary

Building decarbonization means reducing greenhouse gas (GHG) emissions from building energy use through a variety of strategies, primarily through energy efficiency and use of zero- or low-carbon energy sources. This Existing Building Decarbonization Roadmap outlines strategies that the Town can implement to support decarbonization of existing residential and commercial buildings, addressing one of the largest sources of GHG emissions in the community. Recognizing that building decarbonization requires a coordinated effort between all levels of government, utilities, community-based organizations, and other partners, there are many strategies that are best implemented by other entities. This Roadmap focuses on the areas where the Town can be most impactful due to some level of direct influence and/or control.

This Roadmap endeavors to chart a to building decarbonization that is both locally appropriate and aligned with statewide strategy. Accordingly, Roadmap measures focus on high-efficiency electrification, which was identified by State agencies as the most technologically feasible and cost-effective method of decarbonizing the statewide building stock. This will ensure that Truckee's residents and businesses are better prepared for anticipated changes in statewide policy, are well-positioned to take advantage of local and state funding opportunities and are not left behind as the State focuses on programs supporting efficient electrification.

Along with helping the State and Town reach adopted climate action goals, building decarbonization has numerous local and regional benefits. Through implementation of energy efficiency measures, transitioning to renewable energy, and shifting energy use with demand response strategies, building decarbonization can lower energy costs, improve indoor air quality, increase building comfort, support job creation and workforce development, and increase property value. In addition to these immediate benefits, widespread implementation of decarbonization measures can mitigate the impacts of climate change in Truckee, which include increased threat and severity of wildfires and more extreme winter storms.

This Roadmap is grounded in an assessment of Truckee's building stock, household demographics, and energy use. This includes an analysis of physical characteristics like building size and age, occupancy and use, as well as economic indicators of Truckee households. It also examines how energy is used both at the community scale and at the individual household scale. The existing conditions assessment provides important insights into the decarbonization strategies that may be most effective in Truckee. Recommended measures were also shaped by community and stakeholder engagement that examined the challenges and opportunities of implementing building decarbonization measures in Truckee, including financial barriers, cold climate decarbonization, and power outages.

While building decarbonization has the possibility of bringing many benefits to the Truckee community, policy and program implementation could impact community members differently. In developing and implementing the strategies included in this Roadmap, it will be important to center this work around key principles of inclusion, diversity, equity, and accessibility and ensure community members are included, represented, and have the resources they need to participate fully in the decision-making process. The goal is to ensure that all Truckee community members can share in the benefits of building decarbonization without exacerbating existing burdens that underserved Truckee community members may experience, especially those who may be the most vulnerable to the impacts of climate change.

Strategy Roadmap Summary

Based on community and stakeholder input, the Roadmap proposes a strategy centered around encouraging and supporting voluntary adoption of decarbonization measures to the greatest extent feasible. This includes improved climate action and resilience planning, enhanced education and engagement initiatives, incentives and financing strategies, upgrade programs, and policy and regulation measures as needed to achieve the Town's adopted climate action goals. The Town of Truckee is still in a very early adoption phase for many building decarbonization measures, particularly electrification, and short-term efforts will need to focus on building local confidence in decarbonization among residents, businesses, and contractors.

Climate Action & Resilience Planning

Measure	Description	Timeframe	Building Type	Staff Time	Cost
Update GHG and Energy Goals	Update the Town's adopted GHG emissions reduction and renewable energy goals.	Short-term	SF, MF, NR	●○○	●○○
Building Decarbonization Targets & Emissions Scenarios	Develop specific targets for building decarbonization and integrate these into future climate action plan updates. (CAP-7.A)	Short-term	SF, MF, NR	●○○	●○○
Energy Resilience Plan	Develop an energy resilience plan to identify actionable programs and policies that the Town can implement to improve community resilience to grid outages, support building decarbonization measures, catalyze broader electrification of local buildings, and reduce reliance on GHG-intensive backup power sources like diesel generators.	Short-term	SF, MF, NR	●○○	●●○

Education & Engagement

Measure	Description	Timeframe	Building Type	Staff Time	Cost
Workforce Education & Training Program	In collaboration with local and regional partners, support and expand local training and workshops for energy efficiency and electrification upgrades. (CAP-8.D)	Short-term	SF, MF, NR	●○○	●●○
Technical Assistance Program	Work with local and regional partners to continue and expand technical assistance for residents and small businesses interested in electrification upgrades.	Short-term	SF, NR	●○○	●○○
Induction Cooking Workshop & Lending Program	Support expanded induction cooking workshops and a cooktop lending program to provide residents with the opportunity for hands-on experience with induction.	Short-term	SF, MF	●○○	●○○
Building Energy Use Reduction Education	Develop an educational campaign to promote the benefits of energy efficiency and electrification. (CAP-7.J)	Short-term	SF, MF, NR	●○○	●○○
Retrofit Incentive Information & Promotion	Develop a user-friendly online platform for residents and business owners to navigate available building decarbonization incentives. (CAP-7.I)	Short-term	SF, MF, NR	●○○	●●○
Showcase Local Electrification Projects	Develop an outreach campaign to highlight successful examples of electrification by Truckee residents and businesses.	Mid-term	SF, NR	●○○	●○○

Incentives & Financing

Measure	Description	Timeframe	Building Type	Staff Time	Cost
Heat Pump Air Conditioning Incentives	Develop a residential incentive program to encourage installation of heat pumps instead of traditional air conditioning units.	Short-term	SF	●●○	●●○
Increase Local Contractor Enrollment in State Rebate Programs	Work with partners such as Sierra Business Council and the Contractors Association of Truckee Tahoe to support local contractor enrollment in state rebate programs such as TECH Clean California.	Short-term	SF, MF	●○○	●○○
Equitable Funding Strategy	Develop an equitable funding strategy to support implementation of decarbonization measures identified in this Roadmap.	Short-term	SF, MF, NR	●○○	●●○
Building Decarbonization "Token" Program	Leverage short-term rental "Tokens" as an incentive to encourage voluntary building decarbonization, particularly high-priority electrification measures.	Short-term	SF	●●○	●○○

Forgivable Loans for Rental Improvements	Develop a forgivable loan program to support energy efficiency and/or electrification upgrades in rental housing in exchange for affordability protections.	Mid-term	SF, MF	●●○	●●○
Commercial On-Bill Financing	Develop a program to provide on-bill financing for energy efficiency and electrification retrofits of commercial buildings in partnership with a local utility or other organization.	Mid-term	NR	●○○	●●○

Upgrade Programs

Measure	Description	Timeframe	Building Type	Staff Time	Cost
Truckee Weatherization Program	Develop a 2-year pilot program to offer no-cost weatherization upgrades for income-qualified households making up to 80% of AMI.	Short-term	SF	●●○	●●●
Expanded Building Retrofit Program	Based on the results of the Truckee Weatherization Program pilot, develop an expanded building retrofit program that includes electrification measures. (CAP-7.A)	Mid-term	SF	●●○	●●●
Commercial Energy Audit Program	Offer low- or no-cost energy audits for commercial buildings, prioritizing small businesses.	Mid-term	NR	●○○	●●○
Solar Installation Program	Develop a discounted solar and battery storage installation program in collaboration with regional partners.	Mid-term	SF	●●○	●●○
Building Permit Prioritization Program	Explore the creation of a building permit prioritization program to support building decarbonization in existing buildings. (CAP-7.K)	Mid-term	SF, MF, NR	●●●	●●○

Policy & Regulation

Measure	Description	Timeframe	Building Type	Staff Time	Cost
Heat Pump Air Conditioning Reach Code	Consider a heat pump air conditioning reach code for existing single-family homes in Truckee.	Short-term	SF	●●○	●●○
Renewable Energy Mitigation Program	Explore options for a Renewable Energy Mitigation Program to address energy-intensive outdoor systems that are not covered by existing codes or programs.	Mid-term	SF	●●●	●○○
Time-of-Sale Requirements	Explore time-of-sale requirements for energy use disclosure or assessments for single-family residential homes, with flexible compliance pathways and appropriate exemptions.	Mid-term	SF	●●○	●○○
Flexible Pathway Reach Code	If voluntary measures are unsuccessful in achieving energy efficiency and weatherization measures in existing buildings,	Long-term	SF	●●●	●●○

	consider developing a flexible pathway reach code for residential retrofits.				
Minimum Energy Performance Standards for STRs	Explore minimum energy performance standards for short-term rentals (STRs) if voluntary programs do not achieve sufficient uptake in these homes.	Long-term	SF	●●●	●●○
Building Benchmarking Ordinance	Consider development of a building benchmarking ordinance for larger commercial buildings if voluntary measures are not effective.	Long-term	NR	●●●	●●●

This Roadmap is intended to be an evolving document that is updated periodically to reflect updates to the Town's climate action plan, changes to state policy or programs, new technologies, or changing community needs. Successful building decarbonization in Truckee is contingent on continued support and engagement by the Town and broader community, as well as having the resources needed to support implementation of the Roadmap measures. Most importantly, the Town cannot achieve climate action targets, including building decarbonization goals, on its own. Continued close collaboration with local utilities, other public agencies, community-based organizations and regional partners, both directly and through the Climate Transformation Alliance, will be critical to success.

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Acknowledgements

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Introduction

Truckee is already experiencing the consequences of climate change, from devastating wildfires to more extreme winter storms. In keeping with the severity of the crisis, the Town of Truckee is taking proactive measures to mitigate the impacts of climate change and build community resilience.

The Town of Truckee has committed to reducing community-wide greenhouse gas (GHG) emissions to 80% below 2008 levels by 2040. Energy use is one of the largest contributors to Truckee's community-wide emissions. The Climate Action Plan (CAP) Element in the Town's adopted 2040 General Plan update outlines a strategy to meet the Town's adopted GHG reduction goals, including 9 policies and 16 actions to reduce emission from building energy use.

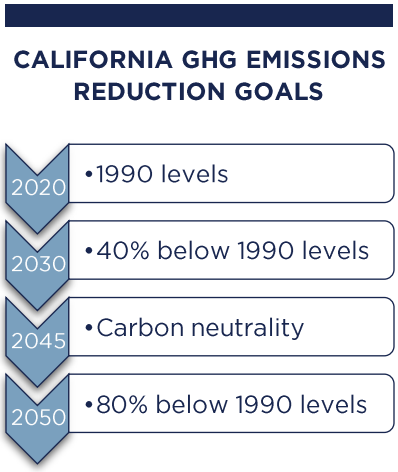
One of the actions included in the CAP is action CAP-7.H: Roadmap to Decarbonization. This calls for the Town to develop a policy roadmap to decarbonize existing buildings while supplementing costs and other burdens for vulnerable populations. This Existing Building Decarbonization Roadmap outlines strategies that the Town can implement to support decarbonization of existing residential and commercial buildings. The primary goals of the Roadmap are to:

- Understand local barriers to building decarbonization and opportunities for local impact.
- Assist the Town in prioritizing its funding and efforts to target areas of highest impact and best supplement existing federal, State, and local programs.
- Identify areas where the Town is best positioned to effect change and avoid duplication of existing programs.
- Ensure the Town's building decarbonization strategy is equitable and designed with consideration to impacts on historically underserved communities.
- Outline an implementation timeline, including high-priority strategies for implementation in the next few years.

This Roadmap is just one part of the Town's broader climate action efforts in the building energy sector. The CAP includes additional building decarbonization strategies that are outside the scope of this plan, including those focused on new construction, or those that would be implemented by utilities. Recognizing that building decarbonization requires a coordinated effort between all levels of government, utilities, community-based organizations, and other partners, there are many strategies that are best implemented by other entities. This Roadmap focuses on the areas where the Town can be most impactful due to some level of direct influence and/or control.

Why Focus on Buildings?

The State of California adopted ambitious climate action goals to set the state on a path to carbon neutrality by 2045. Buildings are responsible for 25% of statewide GHG emissions,[1] and the California Air Resources Board Scoping Plan highlights the critical role of local government in implementing GHG reduction measures in this sector. Building energy use is one of the areas that local governments have the most influence over due to their role in permitting new construction, alterations and additions of existing buildings, equipment installation, and renewable energy resources. The 2022 Scoping Plan[2] recommends that local governments implement the following high-priority strategies to support decarbonization of existing buildings:



- Adopt policies and incentive programs to implement energy efficiency retrofits for existing buildings, such as weatherization, lighting upgrades, and replacing energy-intensive appliances and equipment with more efficient systems.
- Adopt policies and incentive programs to electrify all appliances and equipment in existing buildings such as appliance rebates, existing building reach codes, or time of sale ordinances.
- Facilitate deployment of renewable energy production and distribution and energy storage on privately owned land uses (e.g. permit streamlining, information sharing).
- Deploy renewable energy production and energy storage directly in new public projects and on existing public facilities (e.g. solar photovoltaic systems on rooftops of municipal buildings and on canopies in public parking lots, battery storage systems in municipal buildings).

Community Climate Action Goals

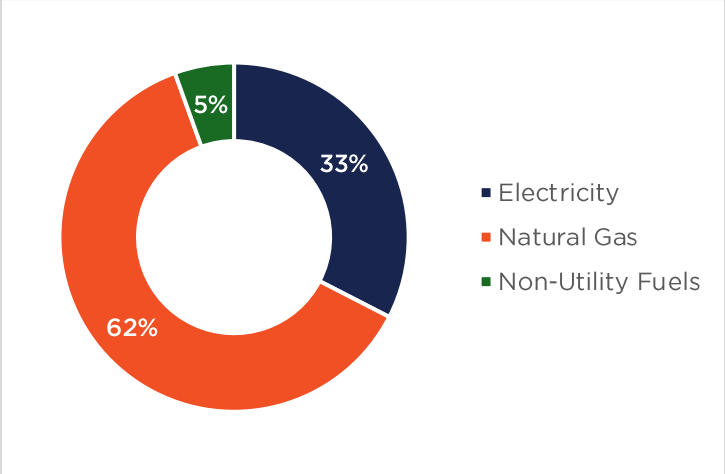
Building energy use is one of the largest contributors to Truckee's community-wide GHG emissions. Addressing these emissions will need to be a key part of local climate action initiatives in order for the Town to meet its climate action goals. GHG emissions from energy use are created by the generation of electricity elsewhere for use in Truckee, as well as the direct on-site combustion of natural gas or non-utility

[1] California Energy Commission. (August 13, 2021). California Building Decarbonization Assessment, Final Commission Report. https://www.energy.ca.gov/publications/2021/california-building-decarbonization-assessment.

[2] California Air Resources Board. (December 2022). Final 2022 Scoping Plan, Appendix D: Local Action. https://ww2.arb.ca.gov/our-work/programs/ab-32-climate-change-scoping-plan/2022-scoping-plan-documents.

fuels such as propane and wood in Truckee's buildings. The majority of energy sector emissions are from natural gas, primarily from use in residential buildings. Residential buildings, which account for 96% of Truckee's total building stock, are responsible for a larger share of energy-related GHG emissions than commercial buildings.

Figure 1: 2022 Energy Use Emissions by Fuel Type



Truckee has several climate action goals to address GHG emissions from energy use. In 2017, the Truckee Town Council adopted Resolution 2017-58, establishing the following goals for community-wide energy and GHG emissions:

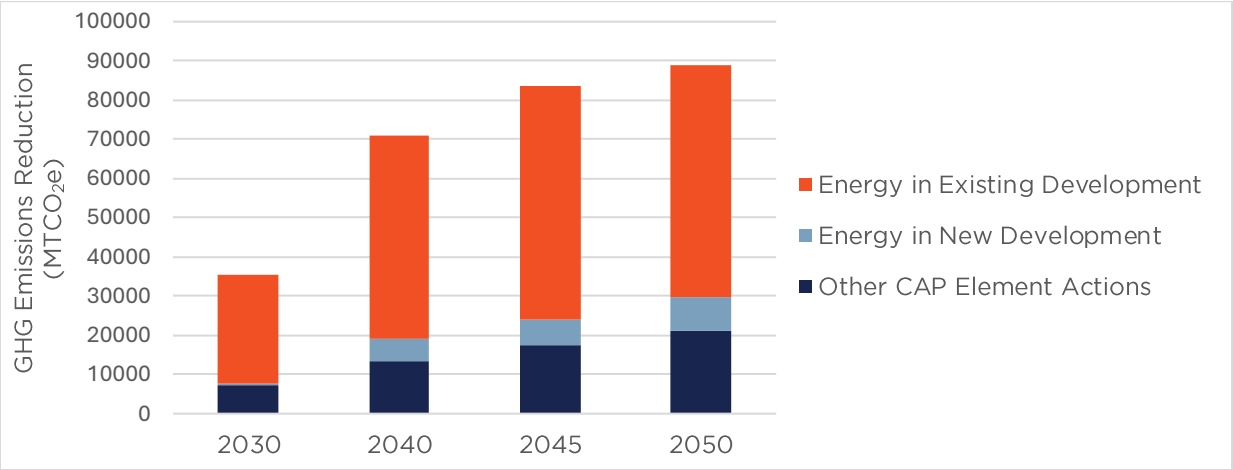
- 100% renewable electricity by 2030
- 100% renewable energy by 2050
- 80% reduction in GHG emissions by 2040 (compared to 2008 baseline)

It is important to note that the Town does not have control over the sources of energy used by Truckee's electric or natural gas utilities, so achieving the renewable energy targets will require close coordination with local utilities. The Town Council will be revisiting these energy and GHG emissions reduction goals in 2025 to determine if updates are needed.

Truckee's CAP outlines a path for GHG emissions reduction towards the Town's adopted 2040 goal, with the majority of emissions reduction coming from the energy sector. As shown in Figure 2, most of the GHG emissions reduction measures included in the CAP are from energy use in existing development, representing 78% of potential emissions reduction by 2030 and 73% by 2040. This includes measures that address energy use in existing buildings as well as decarbonizing the energy generation sector. These are the emissions reductions targeted by this Roadmap.

While the measures included in the CAP are sufficient to meet 2030 goals, they still fall short of the Town's 2040 target by 31% (31,754 $MTCO_2e$), meaning additional GHG reduction measures will need to be identified across all sectors, including energy use, in order for the Town to meet its longer-term goals.

Figure 2: CAP Element GHG Reductions Through 2050



Role of the Town

The Town of Truckee has substantial influence and control over the local built environment because of its role in land use planning and permitting construction. The Town's major areas of influence on building decarbonization are:

- **Building permits:** The Town can adopt local amendments to the state's Building Standards Code and enforces both the state code and local amendments through the building permitting and inspection process. Permits are required for several measures related to existing building decarbonization, including alterations and additions to existing buildings, solar photovoltaic systems and battery storage, and installation of major appliances and equipment such as furnaces, HVAC systems, and water heaters.
- **Other ordinances and regulations:** In addition to local amendments to the building code, the Town can adopt other types of ordinances that can be used to support building decarbonization.
- **Programs:** The Town has the capability to develop new programs or leverage existing ones to support building decarbonization through technical assistance and/or direct implementation of measures.
- **Funding:** The Town can fund building decarbonization through strategies such as rebates or other financial incentives. This is an area the Town has already invested in through its weatherization rebate partnership with the Truckee Donner Public Utility District.
- **Education and outreach:** This is another key area of influence for the Town, both directly through the Town's social media accounts and newsletters, as well as through community partners.

This Roadmap focuses on these areas of influence, rather than other components that are under the control of other entities such as utilities (e.g. utility rate design) or federal and state agencies (e.g. appliance efficiency and emissions standards).

What is Building Decarbonization?

Building decarbonization simply means reducing GHG emissions from buildings, which includes maximizing energy efficiency, use of low- and zero-carbon electricity, demand response, energy storage, and eliminating fuel combustion by electrifying appliances and equipment. The two primary aspects of building decarbonization are energy efficiency and use of zero- or low-carbon energy sources.

Energy Efficiency

This order in which building decarbonization measures are implemented is very important. Prioritizing efficiency and other demand reduction measures ensures that equipment is right-sized and avoids the need to develop additional energy generation capacity. In fact, because of its role in reducing energy demand (and therefore the need for construction of new generation capacity), energy efficiency is considered one of the most impactful long-term GHG reduction measures that can be taken on a local, state, and national level.

Energy efficiency includes weatherizing buildings through measures such as air sealing, duct sealing and replacement, and better insulation. It also includes measures such as replacing older, less efficient appliances with new, high-efficiency models and optimizing energy use with technology such as programmable thermostats and smart appliances. Ensuring that the building envelope and ducting is as efficient as possible can help right-size heating and cooling equipment and reduce overall costs. Properly implemented efficiency measures reduce energy bills, leading to ongoing cost savings for residents and businesses.

Truckee's CAP sets targets for energy efficiency in existing residential and nonresidential buildings. The estimated GHG emissions reductions assume that in addition to energy efficiency upgrades, some electrification measures are implemented to reduce natural gas use. Overall, the CAP assumes a 50% overall reduction in energy use in existing buildings by 2045.

Table 1: CAP Energy Efficiency Targets and Associated GHG Emissions Reduction

Target Year	2030	2040	2045
Assumed percent reduction in existing residential energy use through retrofits	20%	50%	50%
GHG emissions reductions - residential ($MTCO_2e$)	12,280	27,257	22,868
Assumed percent reduction in existing non-residential energy use through retrofits	15%	50%	50%
GHG emissions reductions – non-residential ($MTCO_2e$)	3,585	9,740	6,922
Total GHG emissions reductions ($MTCO_2e$)	**15,864**	**36,997**	**29,790**

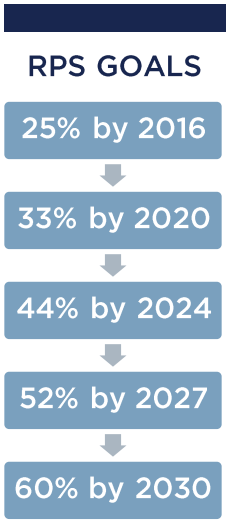
Renewable & Zero-Carbon Energy

Once buildings are as efficient as possible, the next step in decarbonization is switching to renewable energy sources. While the Town does not have control or significant influence over the source of utility-supplied energy, the State of California has adopted many regulations to increase the supply of renewable energy from utilities to support statewide climate action goals.

Electricity

Renewable electricity can be utility-supplied or come from distributed energy resources located in the community, such as rooftop solar photovoltaic (PV), community solar, district-scale energy generation, and energy storage. Most communities, including Truckee, will need to leverage both sources to reach adopted climate action goals. California has enacted several regulations designed to address GHG emissions from utility-provided electricity, most notably the state's Renewables Portfolio Standard (RPS) Program.

California requires all electric utilities to meet the requirements of the RPS Program, which sets a minimum percentage of electricity sales that must come from eligible renewable sources, increasing to 60% by 2030. Eligible renewable sources include biomass, geothermal, small hydroelectric, solar, and wind.



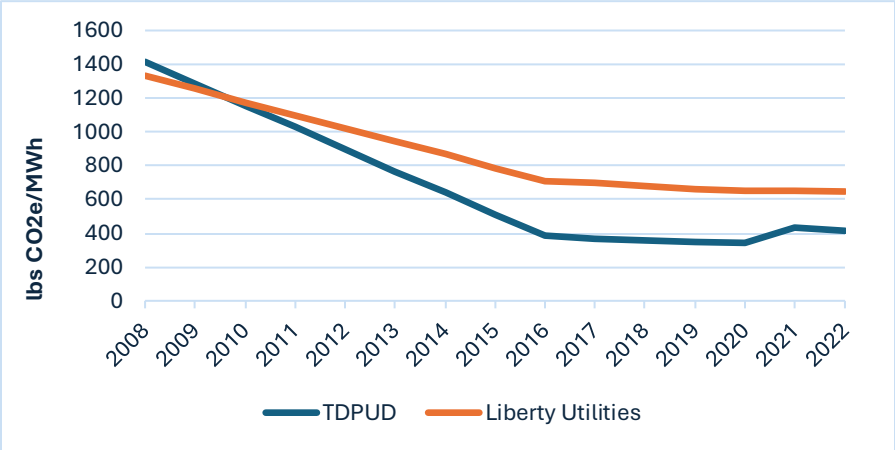
In addition to meeting these targets, utilities must source 100% of electricity sold to California customers from a combination of eligible renewables and zero-carbon resources by 2045 to meet the state's carbon neutrality goals. The distinction between renewable and zero-carbon energy is important, as there are some eligible renewables, such as biomass, that do produce some GHG emissions during the generation process. There are also some non-renewable types of electricity generation, such as large-scale hydropower, that do not produce GHG emissions during generation.

Truckee is served by two electric utilities, Truckee Donner Public Utility District (TDPUD) and Liberty Utilities. TDPUD serves most residential and commercial customers in Truckee, with Liberty Utilities serving a portion of the Glenshire neighborhood. Both electricity suppliers have significantly increased the percentage of renewables in their power mix since the 2008 baseline GHG inventory.

TDPUD sourced 47% of its electricity in 2023 from eligible renewables, exceeding the statewide average renewable content on the California electric grid. An additional 13% of TDPUD's electricity purchases were covered by Renewable Energy Credits (RECs), bringing their total RPS percentage to 60% for 2023. Liberty Utilities sourced only 26% of its electricity from eligible renewables in 2022, falling behind the statewide average of 36%. Liberty covered an additional 11% of electricity purchase of RECs to bring their RPS total to 37% for 2022 (the most recent year of RPS reporting available for Liberty). While RECs count towards compliance with the

state's RPS standards, they are not factored into the electricity emissions factors and therefore don't affect Truckee's community-wide GHG emissions calculations.

Figure 3: Electricity Emissions Factors for Truckee Utilities, 2008-2022



Natural Gas

Renewable natural gas (RNG), sometimes called biomethane, is methane produced from biological sources such as landfills, wastewater treatment plants, food waste, or livestock farms. Because it is derived from biological sources instead of fossil fuel deposits, the carbon dioxide emissions are considered biogenic rather than anthropogenic, leading to a lower carbon intensity compared to fossil gas.

RNG is not currently available in significant quantities compared to the total demand for natural gas, so it comprises only a small percentage of the overall supply. The California Energy Commission assessed the potential of decarbonizing the gas system as part of the California Building Decarbonization Assessment, and determined that the maximum potential for biomethane is likely constrained to 15% of total pipeline gas, assuming all available sources of biomethane were fully utilized.[3] Higher percentages would require use of synthetic gas, and both biomethane and synthetic gas are significantly more expensive than fossil gas.

The California Public Utilities Commission (CPUC) has adopted requirements for natural gas utilities in California to source 3% of their supply from RNG by 2025, and 12% by 2030. Southwest Gas, Truckee's natural gas utility, has indicated they do not currently plan to exceed the minimum percentage of RNG required by state policy.

Truckee's CAP Element includes item CAP-7.B: Renewable Natural Gas Supply, which assumes the percentages of RNG in Truckee's natural gas supply shown in Table 2. Given that Southwest Gas is not expecting to achieve this level of RNG use, the Town will need to pursue an alternative approach to reducing GHG emissions from natural

[3] California Energy Commission. (August 13, 2021). California Building Decarbonization Assessment, Final Commission Report. https://www.energy.ca.gov/publications/2021/california-building-decarbonization-assessment.

gas in order to meet its adopted renewable energy and GHG reduction goals. An alternative approach would also be more consistent with the State's decarbonization strategy and planned regulatory approach.

Table 2: CAP RNG Targets and Associated GHG Emissions

Target Year	2030	2040	2045	2050
Assumed percent renewable natural gas provided to Truckee (i.e., percent reduction in GHG emissions intensity of natural gas)	25%	50%	100%	100%
GHG emissions reductions ($MTCO_2e$)	11,763	14,875	29,471	29,471
% of Total energy-related emissions reductions in CAP	42%	26%	45%	44%

Statewide Building Decarbonization Strategy

The California Building Decarbonization Assessment conducted in 2021 identified building end-use electrification, particularly with high-efficiency heat pump technology, as the most feasible, effective, and cost-effective strategy for building decarbonization in California.[4] This assessment also determined that decarbonizing the gas system was not only among the most expensive potential strategies, but also infeasible beyond a relatively small percentage of overall pipeline gas. Accordingly, building end use electrification forms the backbone of the state's approach to building decarbonization, along with decarbonizing the electricity generation system and promoting energy efficiency.

California's statewide building decarbonization strategy is outlined in the 2022 Scoping Plan, the most recent outline of the State's strategy to achieve its adopted GHG emissions reduction and carbon neutrality goals. Again, efficient building electrification is identified as the most technologically feasible and cost-effective pathway available for building decarbonization[5] and is the focus of the State's regulatory strategy and incentive programs.

State codes, incentive programs, and regulatory actions are increasingly focused on the goal of building end use electrification. This includes developing statewide building codes that support high-efficiency electrification, ensuring that utility rates support electrification, and exploring zero-emissions standards for space and water heating appliances.

Mapping the Road Forward for Truckee

What does this mean for Truckee? To meet adopted goals, the Town will need to identify a path to building decarbonization goals that is appropriate for our local

[4] California Energy Commission. (August 13, 2021). California Building Decarbonization Assessment, Final Commission Report. https://www.energy.ca.gov/publications/2021/california-building-decarbonization-assessment.

[5] California Air Resources Board. (December 2022). Final 2022 Scoping Plan, Appendix F: Building Decarbonization. https://ww2.arb.ca.gov/our-work/programs/ab-32-climate-change-scoping-plan/2022-scoping-plan-documents.

community but still takes the statewide strategy into account. This will ensure that Truckee's residents and businesses are better prepared for anticipated changes in statewide policy, are well-positioned to take advantage of local and state funding opportunities and are not left behind as the State focuses on programs supporting efficient electrification.

The Town's current Climate Action Plan relies heavily on renewable natural gas rather than end use electrification. State agencies have determined that RNG is one of the most expensive and least feasible strategies for building decarbonization.[6] Even if the energy supply was within the Town's control or influence, continuing to pursue this pathway for Truckee would result in higher costs for ratepayers, and likely still not achieve a fully decarbonized gas system due to practical constraints on RNG production. Additionally, the State's Scoping Plan clearly outlines the potential risks to natural gas users as more homes electrify, since an increasingly smaller number of customers will be supporting the full cost of maintaining the gas system infrastructure,[7] even without the added cost of RNG.

The State of California is actively taking steps to transition away from fossil fuels and planning for the eventual decommissioning of the state's natural gas infrastructure. In order to accommodate this reality and avoid stranding local residents and businesses on an increasingly expensive and unsupported natural gas system, Truckee will need to reevaluate its pathway to building decarbonization. This includes identifying alternative sources of GHG emissions reduction to replace those attributed to use of RNG in Truckee's CAP. As RNG was anticipated to account for 42% of near-term energy-related GHG emissions reduction, achieving the same impact will require a greater focus on electrification than is included in the adopted CAP.

Better aligning with the statewide strategy has numerous benefits for the Truckee community. The State is focusing on efficient electrification because it was identified as the most cost-effective and technologically feasible option to decarbonize California's buildings. While there are still costs to decarbonize buildings regardless of the method chosen, efficient electrification represents the lowest cost pathway, and will allow the Truckee community to leverage state funds and take advantage of statewide and federal programs that support building decarbonization.

Aligning more closely with statewide strategy does not mean that our community will take the exact same road to building decarbonization as any other California jurisdiction; some detours are necessary to reflect local conditions. While there are real challenges to successful community-wide building decarbonization in Truckee's climate, there are also numerous potential benefits to the community.

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[6] California Energy Commission. (August 13, 2021). California Building Decarbonization Assessment, Final Commission Report. https://www.energy.ca.gov/publications/2021/california-building-decarbonization-assessment.

[7] California Air Resources Board. (December 2022). Final 2022 Scoping Plan, Appendix F: Building Decarbonization. https://ww2.arb.ca.gov/our-work/programs/ab-32-climate-change-scoping-plan/2022-scoping-plan-documents.

Benefits of Building Decarbonization

Along with helping the State and Town reach adopted climate action goals, building decarbonization has numerous local and regional benefits. Through implementation of energy efficiency measures, transitioning to renewable energy, and shifting energy use with demand response technologies, building decarbonization strategies can:

- **Lower energy costs.** Energy efficiency improvements and use of high-efficiency appliances can reduce energy bills for building owners and occupants.
- **Improve indoor air quality.** Combustion of fossil fuels such as natural gas or propane inside residential and commercial buildings not only creates GHG emissions but also releases air pollutants that affect indoor air quality and public health. This includes carbon monoxide, oxides of nitrogen (NOx), particulate matter (PM 2.5 and ultrafine particles), and formaldehyde. These pollutants affect both indoor and outdoor air quality, and are linked to health effects including childhood asthma, cardiovascular disease, and premature death. [8] Air sealing homes as part of weatherization and efficiency measures also reduces wildfire smoke penetration.
- **Improve building comfort.** Building envelope improvements make homes more resilient to extreme heat and cold and help maintain comfortable temperatures year-round. This can be an important passive resilience strategy during both winter and summer power outages.
- **Support job creation and workforce development.** Decarbonizing buildings will require retrofitting a substantial percentage of existing buildings, supporting high-quality local jobs. Relevant training provided by the state and local organizations on new, highly efficient technologies also provides value to the local workforce.
- **Increase property value.** Buildings that have undergone decarbonization retrofits are often more attractive to potential buyers or tenants, as they are more energy efficient, comfortable, and resilient.

In addition to these more immediate benefits, widespread implementation of building decarbonization measures can mitigate the impacts of climate change in Truckee, which include the increased threat of wildfires and more severe winter storms. Of course, building decarbonization is not without its challenges, particularly in Truckee's climate; these are examined in more detail later in this Roadmap.

[8] Zhu, Y., R. Connolly, T. Mathews, and Z. Wang. 2020. "Effects of Residential Gas Appliances on Indoor and Outdoor Air Quality and Public Health in California." UCLA Fielding School of Public Health Department of Environmental Health Sciences. Available at: https://ucla.app.box.com/s/xyzt8jc1ixnetiv0269qe704wu0ihif7.

Truckee: Existing Conditions Assessment

The first step in developing this Roadmap was conducting an assessment of Truckee's building stock, household demographics, and energy use. This existing conditions assessment provides important insights into the decarbonization strategies that may be most effective in Truckee.

Building & Household Assessment

The purpose of this assessment is to analyze characteristics of Truckee's existing building stock and household demographics that impact the type and effectiveness of building decarbonization strategies under consideration by the Town. This includes technical indicators, economic indicators, and ownership and occupancy indicators.

Data sources analyzed in this assessment include:

- Town of Truckee GIS data, including parcel data from the Nevada County Assessor's office
- Census Bureau 2022 American Community Survey 5-year Estimates
- Department of Energy data on energy cost and affordability

Technical Indicators

Technical indicators cover the physical characteristics of buildings, including the type, size, and age. These characteristics influence the types of policies and programs that would be most effective in reducing GHG emissions from building energy use in a given community.

Building Type

Detached single-family homes are the dominant building type in Truckee, comprising 85% of all buildings and total square footage. Combined with condos and townhomes, individually owned dwelling units comprise 94% of all buildings in Truckee. As the dominant building type, single-family dwellings are responsible for the vast majority of residential energy use and should be prioritized for program development.

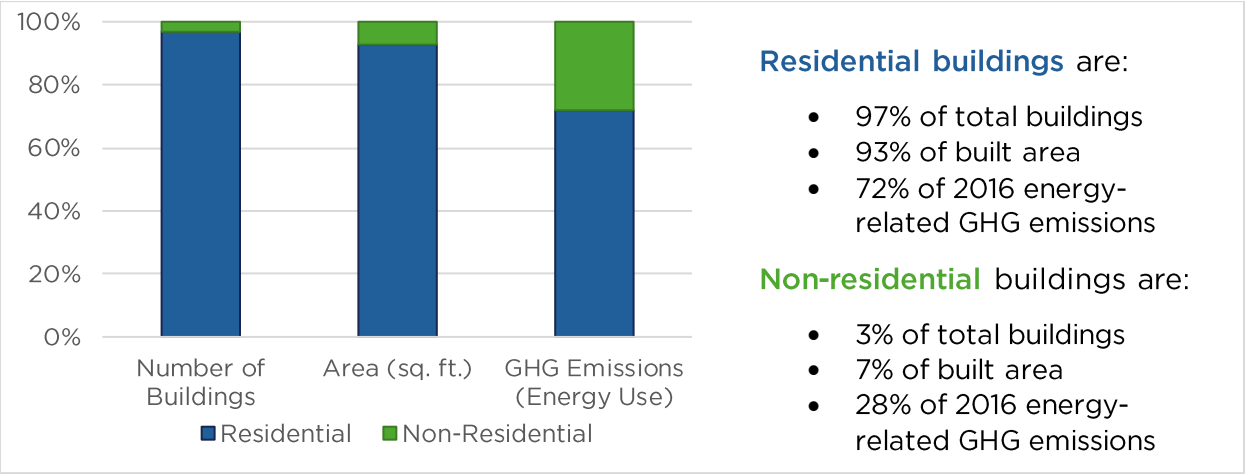
Table 3: Buildings and Square Footage by Typology

Typologies	Total Bldgs.	% of Bldgs.	Total sq. ft.	% of sq. ft.
1 Commercial	324	2.47%	1,553,032	5.99%
2 Industrial	24	0.18%	225,266	0.87%
4 Mixed Use	26	0.2%	92,896	0.36%
5 Single Family Home	11,144	84.8%	22,101,150	85.29%

6 Condo/Town Home	1,242	9.45%	1,585,895	6.12%
7 2-4 Family Homes	11	0.08%	17,313	0.07%
8 5+ Unit Multifamily	28	0.21%	320,502	1.24%
9 Manufactured/ Mobile Homes	270	2.05%	9,291	0.04%
Missing Data	73	0.56%	6,614	0.03%
TOTAL	**13,225**	**100%**	**25,911,959**	**100%**

Multifamily housing of two or more units comprises only 1% of all buildings and 1.3% of total square footage. Similarly, manufactured or mobile homes are a small part of the building stock at 2%, with an even smaller footprint of only 0.04% of total square footage. While these building types are a relatively small share of the building stock and related GHG emissions, they are more likely to house lower-income households and renters than other residential building types in Truckee and are therefore very important to include in the Town's building decarbonization approach.

Figure 4: Impact of Residential and Non-Residential Buildings in Truckee



Non-residential buildings in Truckee include commercial and industrial buildings. Truckee's mixed-use buildings, which contain some residential units as well as commercial space, are also designated as non-residential. (Institutional buildings, which are non-residential buildings owned by government agencies, special districts, and public education facilities are excluded from this analysis because they do not have square footage or other data in the County Assessor database.) Non-residential buildings are on average larger than residential buildings but still account for only 7% of total square footage. Despite this small share, non-residential buildings account for 28% of community-wide GHG emissions from energy use. This is because many non-residential use types are far more energy intensive than residential buildings. Higher energy intensity is not necessarily reflective of a greater potential for energy efficiency savings, as many commercial uses inherently require more energy due to their equipment needs and extended operating hours compared to residential uses.

Building Size

Building size is an important factor affecting building energy use. Most buildings in Truckee are relatively small, likely due to the dominance of single-family dwellings in the Town's building stock.

Figure 5: Size of Buildings in Truckee

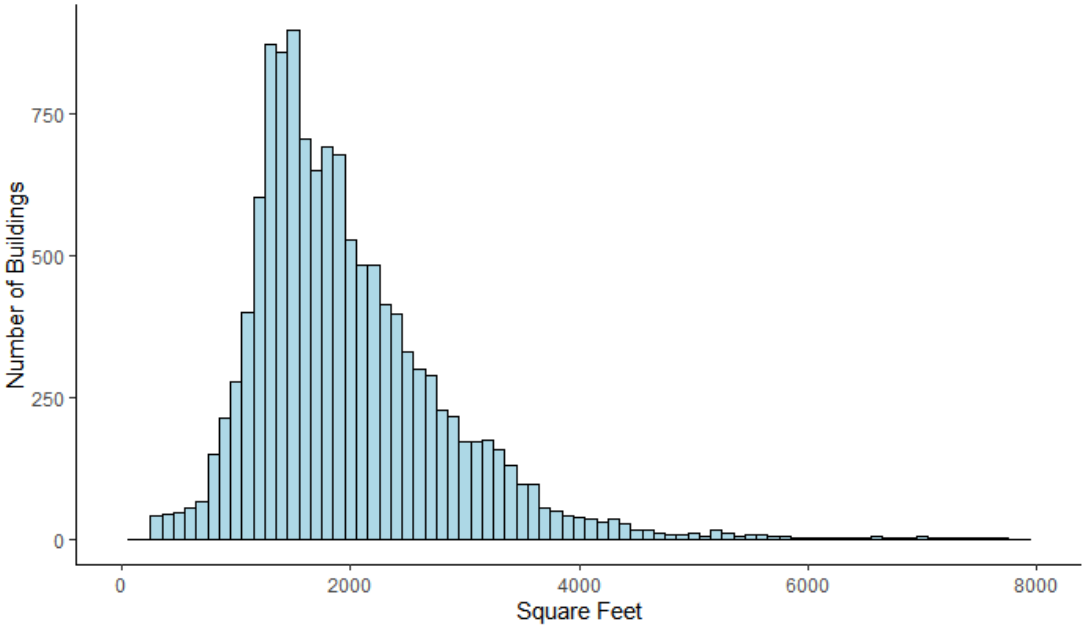


Table 4: Square Footage of Non-Residential Buildings in Truckee

Size Threshold	*Total Buildings*	*% of Buildings*
<4,999 SF	144	61%
5,000 – 9,999	55	23%
10,000 – 14,999	11	5%
15,000 – 24,999	17	7%
25,000 – 49,999	6	3%
50,000 +	3	1%
TOTAL	**236**	**100%**

Most of Truckee's non-residential buildings are also relatively small for this building typology, with 84% having less than 10,000 square feet of floor area. There are only a handful of large non-residential buildings within the Town. This limits the applicability of policies best suited to larger building types, such as building benchmarking ordinances or building performance standards.

Building Vintage

Building vintage is a factor closely tied to building energy use. Older buildings are often less energy efficient, so potential energy savings from retrofits on these

buildings may be greater. Building vintage was analyzed in four intervals often used at the state level to assess cost-effectiveness of various existing building retrofits. These intervals are roughly divided by national and state policies that influence building energy use, beginning with the adoption of the nation's first energy efficiency standards for buildings and creation of California's first unified Building Standards Code (Title 24) in 1978. While California has continued to increase the energy efficiency standards for new construction with each building code cycle, the incremental cost and energy savings from upgrade measures in buildings constructed in 2011 or later is generally minimal compared to older building vintages. There were some gaps in the dataset, which is sourced from the Couty Assessor's office, so this data was not available for 11% of buildings in Truckee.

Table 5: Age of All Buildings in Truckee

	Pre-1978	1978-1991	1992-2010	2011+	No Data
Number of Buildings	2383	3985	4465	903	1429
Percentage of Total	18%	30%	34%	7%	11%

Overall, Truckee's building stock is on the newer side. Residential buildings are, on average, older than non-residential buildings, with most built before 1992. These older buildings are more likely to have opportunities for cost-effective building envelope upgrades (better insulation, higher-performing doors and windows, etc.) and duct measures that achieve greater energy efficiency outcomes. This indicates good potential for GHG emissions reductions from weatherization and efficiency programs in these older buildings, which can also help lower energy bills.

Figure 6: Residential Buildings by Year Built

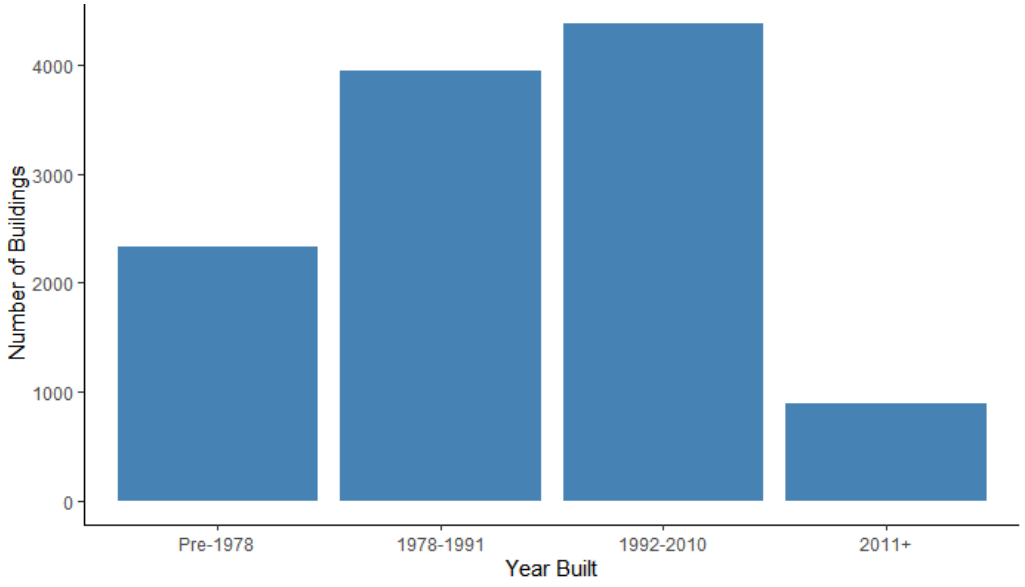
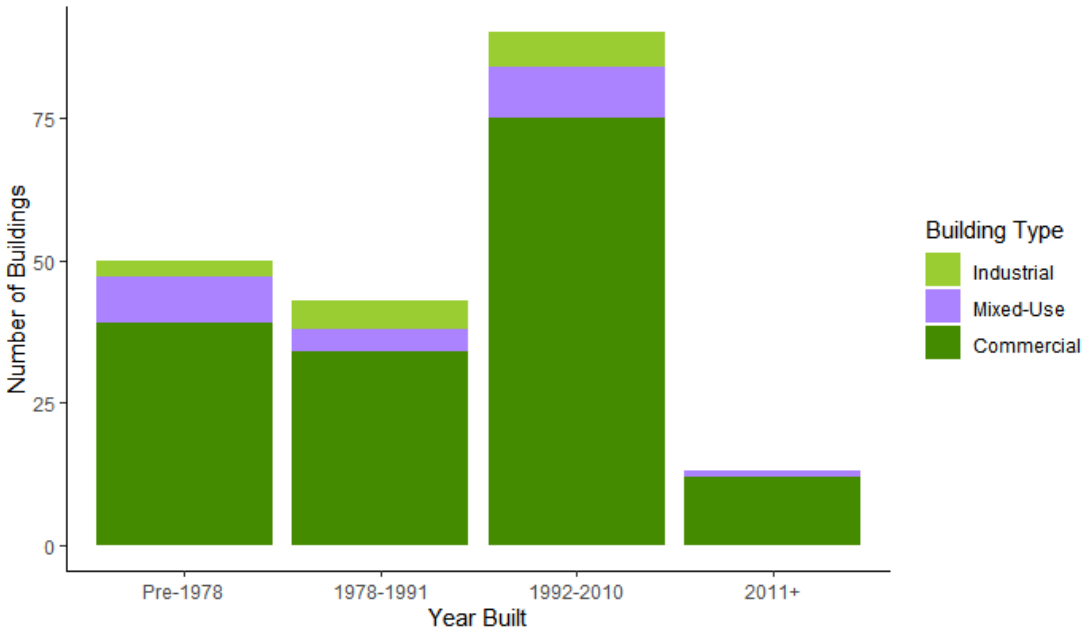


Figure 7: Non-Residential Buildings by Year Built



A larger percentage of Truckee's non-residential buildings were built in 1992 or later, indicating more of these buildings were likely designed to higher energy efficiency standards.

Recommendations based on Technical Indicators:

- Prioritize decarbonization strategies for single-family homes, which are applicable to up to 94% of Truckee's buildings and responsible for the majority of community-wide GHG emissions from building energy use.
- With such a small number of multifamily buildings that vary in size and age, flexible or custom incentive programs and/or technical assistance may be best to accommodate the variety of building vintages and sizes.
- Given that Truckee's building stock is on the newer side, focus upgrade programs on older building vintages to have the most impact.
- While commercial buildings are a very small portion of the overall building stock, they have a disproportionate impact on GHG emissions and should still be supported by the Town's building decarbonization strategy.
- Prioritize commercial building decarbonization strategies most appropriate for smaller buildings (under 10,000 square feet).

Economic Indicators

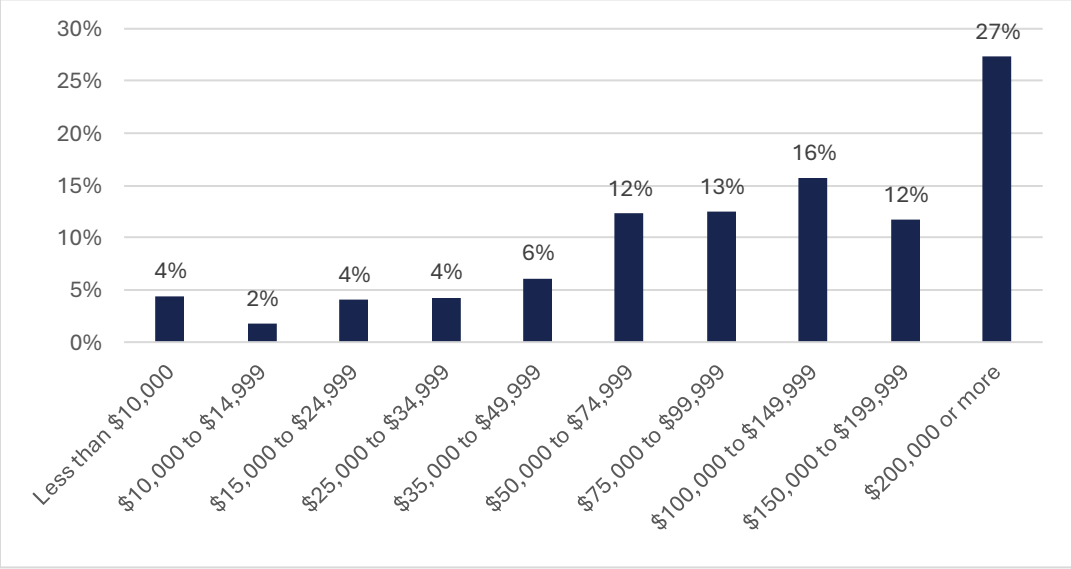
Economic indicators contain important information about housing and energy costs that can affect a household's ability to implement energy efficiency and decarbonization measures. These factors also demonstrate the importance of designing equitable programs and policies to ensure that lower-income households can share equally in the benefits of decarbonization programs that reduce utility bills, and that programs or policies don't negatively impact housing affordability or energy costs. These indicators include:

- Household income
- Housing costs
- Energy burden (% of household income spent on energy bills)

Household Income

Truckee's demographics reflect the high cost of living in the area, with a median household income of around $107,000. The chart below shows Census Bureau data[9] (2022 American Community Survey 5-year estimates) for households in Truckee. Since the Census Bureau only collects data on resident households, this data does not reflect the income status of second homeowners.

Figure 8: Household Income Distribution in Truckee



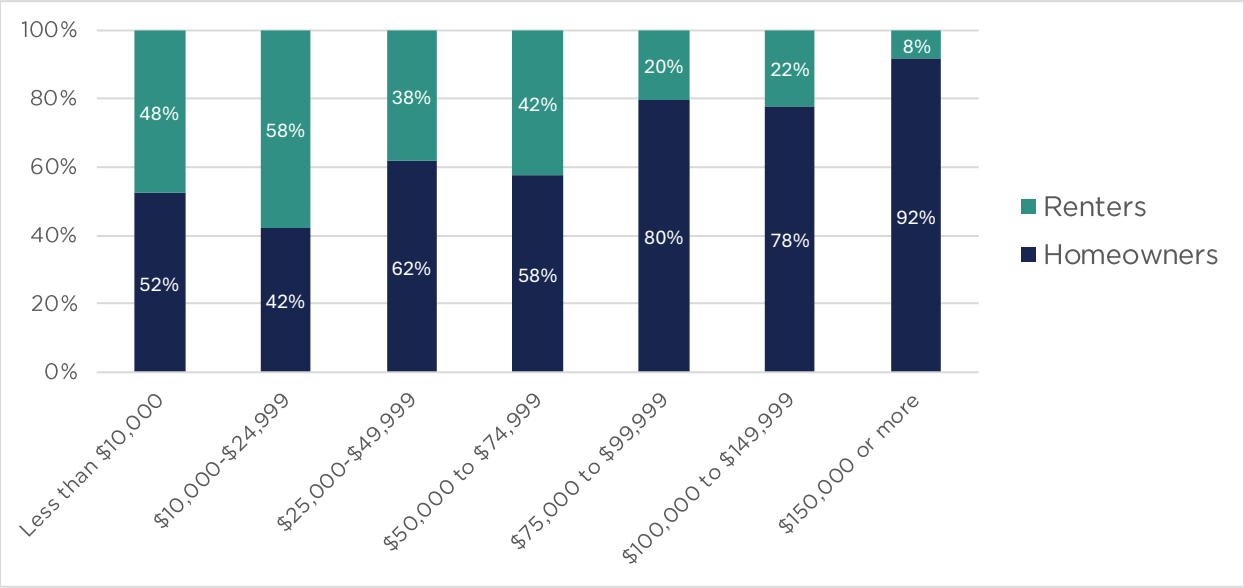
While Truckee's median household income is higher than the statewide median, there is a significant percentage of lower-income households in Truckee. More than 20% of Truckee's households have annual incomes below $50,000, which presents significant challenges in a high-cost-of-living area.

Renters in Truckee are disproportionately lower income than residents who are homeowners. The median household income for owner-occupied housing is

[9] Census Bureau, 2022 American Community Survey 5-year estimates, Table S1901

$154,020, more than twice the median household income for renter-occupied housing ($67,152).[10] However, there are still many homeowner households in the lowest household income categories.

Figure 9: Share of Renters and Homeowners by Household Income Level[11]



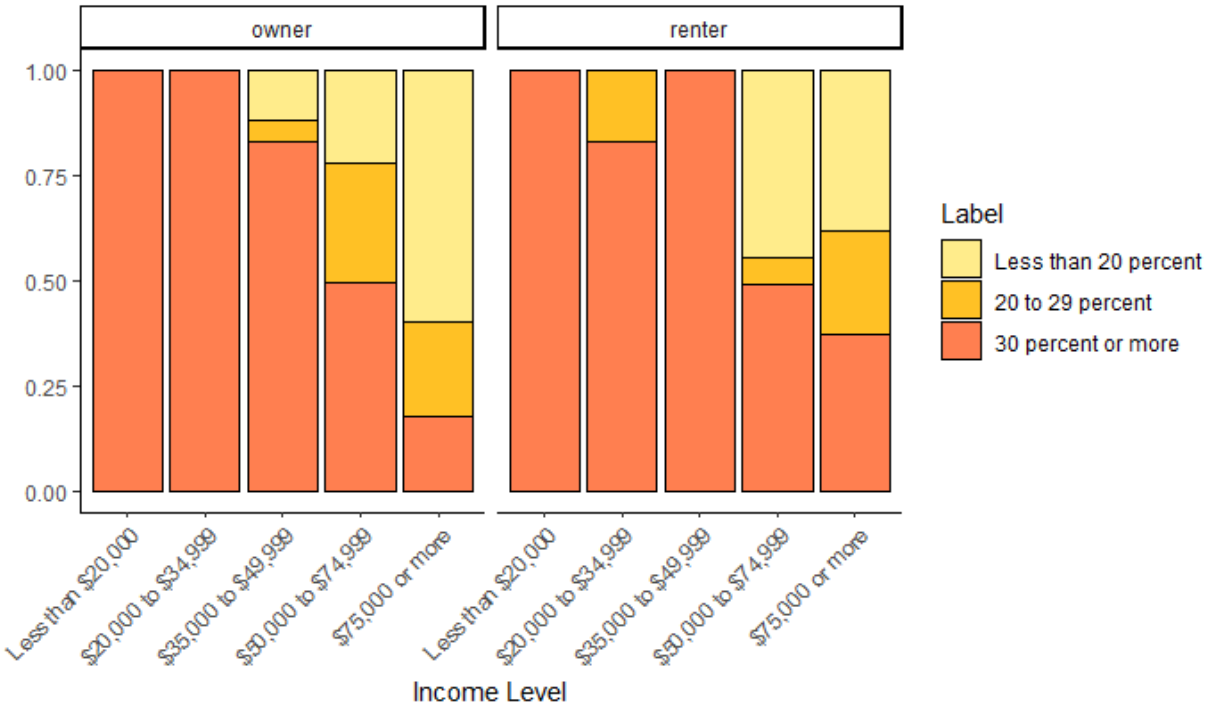
Housing Costs

Collectively, housing costs generally represent one of the largest household expenditures, and can be a key indicator for the economic stability of households and displacement risk. Housing costs include mortgage or rent payments, homeowners association or condominium fees, property taxes, and utilities. For mobile homes, they include installment loan payments, site rent, license and registration fees, and personal property taxes.

An analysis of monthly housing costs in Truckee as a percentage of household income shows that while renters are slightly more likely than homeowners to have unaffordable monthly housing costs, both lower-income homeowners and lower-income renters in Truckee are cost-burdened, meaning that they pay 30% or more of monthly income towards housing costs. These households are likely to be the most vulnerable to displacement and require special consideration when designing a building decarbonization strategy to avoid adding to housing cost burden.

[10] Census Bureau, 2023 American Community Survey 5-year estimates, table B25119.
[11] Census Bureau, 2023 American Community Survey 5-year estimates, table B25118.

Figure 10: Monthly Housing Costs as a Percentage of Income in Truckee



Energy Costs

Energy burden, the percentage of income a household spends on energy bills, is high for many Truckee residents. Lower-income households are more likely to spend a larger percentage of their income on energy bills. The Department of Energy considers an energy burden above 6% to be high, and at 10% or above to be severe. According to the Department of Energy, nearly 1,000 Truckee households likely have a high or severe energy burden.[12]

Table 6: Energy Cost by Household Income

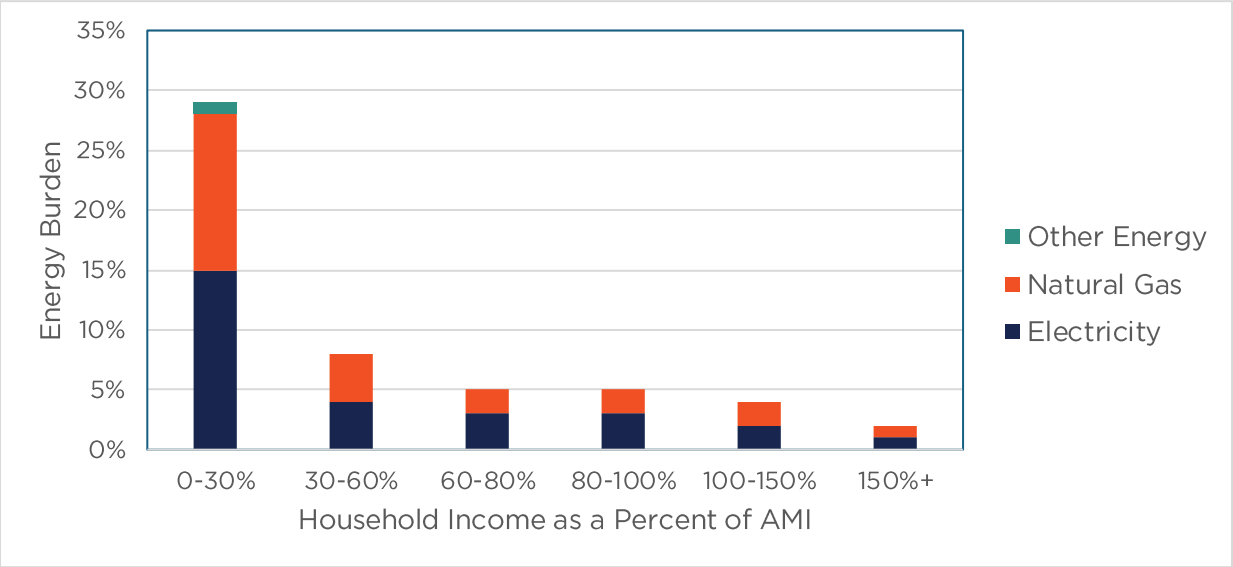
% of Area Median Income (Nevada County)	Total Energy Burden	Avg. Annual Energy Cost	Total Households
0-30%	29%	$3,012	433
30-60%	8%	$3,332	547
60-80%	5%	$3,362	495
80-100%	5%	$3,515	471
100-150%	4%	$4,075	813
150%+	2%	$4,290	2226

Figure 10 shows the energy burden by energy type and household income as a percent of Area Median Income (AMI). Electricity and natural gas bills comprised a

[12] Department of Energy Low-Income Energy Affordability Data Tool

roughly equal share of overall energy burden for all income groups, reflecting Truckee's cold winters and high reliance on natural gas for home heating.

Figure 11: Energy Burden by Household Income in Truckee



Residents with lower household incomes are more likely to live in older buildings, multi-unit buildings, or be renters, all of which are associated with higher energy burdens. Truckee's lowest-income households have a staggeringly high energy burden of 29%, meaning they spend more than a quarter of household income on their energy bills. Properly implemented weatherization measures can reduce energy use by 10-20%, lowering energy bills and making these homes much more comfortable in extreme temperatures. Unfortunately, the households who could benefit the most from reduced energy bills are the least likely to be able to afford the up-front costs of weatherization and efficiency measures, even if those measures are cost-effective in the long term.

Recommendations based on Economic Indicators:

- Focus financial assistance on lower-income households and design programs that provide access to cost savings without requiring an upfront investment.
- Care should be taken during program design to avoid unintended consequences that could increase housing costs or energy burden, particularly for lower-income households.
- Multifamily buildings and manufactured homes are a very small percentage of the overall building stock but are also more likely to house lower-income households, so it is important to include these building types in the Town's decarbonization strategy to ensure an equitable approach.

Ownership and Occupancy Indicators

Ownership and occupancy indicators are another set of factors that influence the effectiveness of various decarbonization strategies. These indicators include:

- Housing tenure (renter/owner)
- Occupancy or use type (primary residence, second home, short-term rental)
- Homes sales

Housing Tenure

Most of Truckee's primary residences are owner-occupied, with renter-occupied housing units comprising less than a quarter of the total. Owner-occupied housing is more straightforward to address with incentive and assistance programs, as it avoids the "split incentive" problem seen in renter-occupied housing. For owner-occupied housing, property owners have an incentive to invest in energy upgrades that result in cost savings over time and increased comfort, since they directly experience those benefits. However, in renter-occupied housing, the property owner is generally responsible for paying the upfront cost of any building upgrades, but energy bill savings often accrue to the tenant (if they directly pay utility bills). This creates a "split" or misaligned incentive that requires targeted strategies to address, as it can discourage investment in energy efficiency in renter-occupied housing.

Figure 12: Tenure of Primary Residences

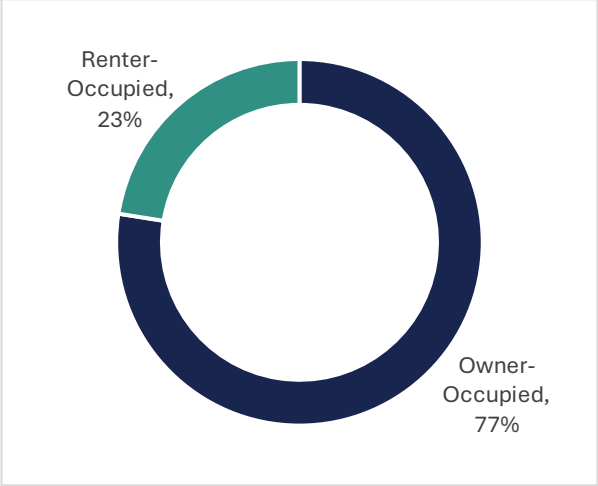
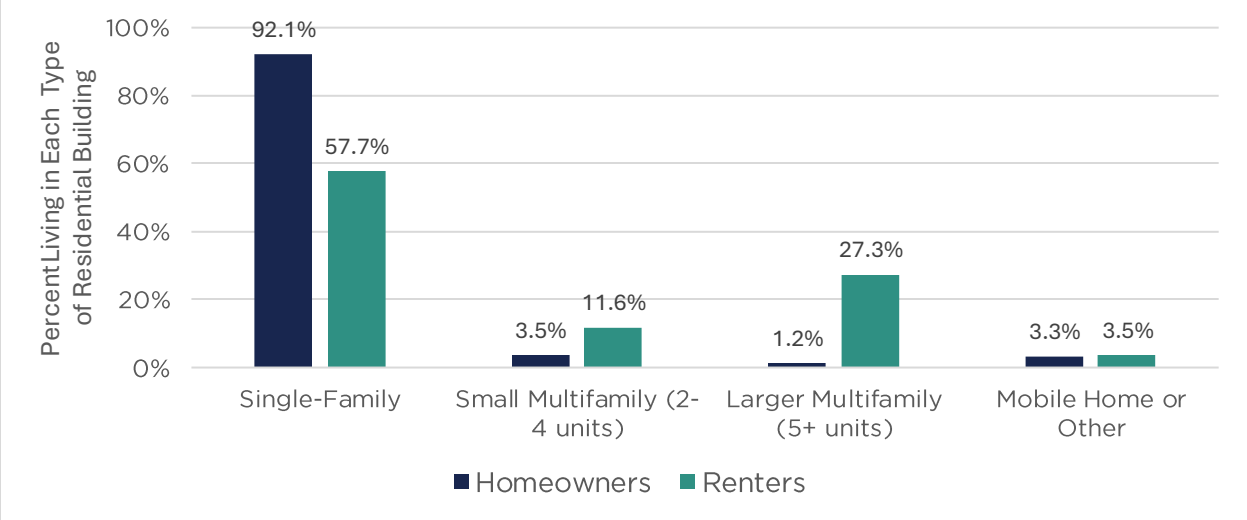


Figure 13: Percent of Truckee Homeowners and Renters Living Each Building Type

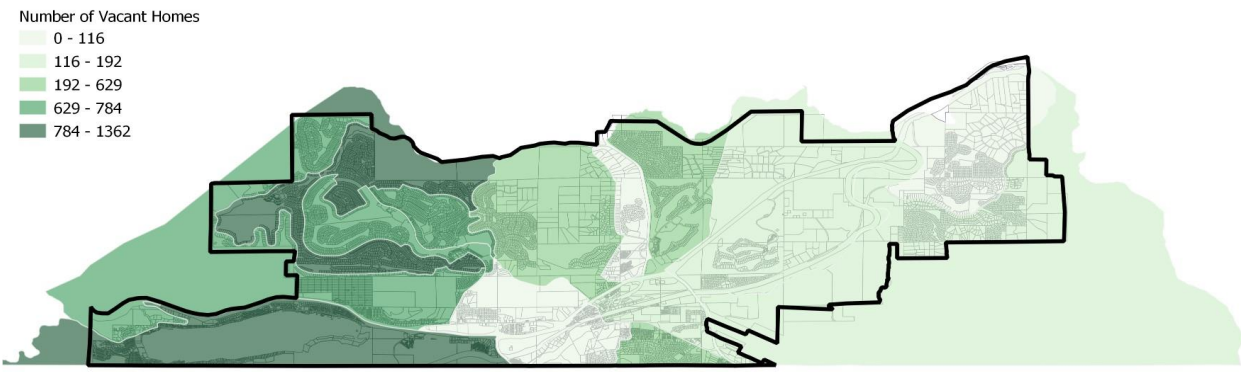


The vast majority of owner-occupied housing (primary homes only) in Truckee is single-family homes, with a very small percentage of homeowners living in condos or mobile homes. Renter-occupied housing in Truckee includes a variety of building types. While there are significant numbers of renters in multifamily units (both apartment and condos), the majority are living in single-family homes,[13] and could take advantage of programs targeted at single-family residential buildings (with owner approval). However, these programs would need to address the split incentive problem in order to be implemented successfully in renter-occupied housing.

Occupancy and Use

Truckee has a high vacancy rate for residential units, estimated at around 52-54%.[14] Vacancy indicates that a residential unit is not a primary residence, but does not mean it is unused. Because the type and frequency of use for second homes can vary significantly, it is difficult to predict the impact of energy efficiency measures in these buildings. Truckee's vacancy rate has stayed relatively close to 50% since 2010, so these relatively minor changes in occupancy are not expected to have a major impact on GHG emissions.

Figure 14: Vacant Homes by Census Block Group



Some of Truckee's "vacant" homes are used as short-term rentals (STRs), which are concentrated in the Tahoe Donner and Donner Lake neighborhoods. The Town adopted an ordinance that beginning in 2021 requires STRs to register and meet new permitting requirements, and in 2022 the Town capped the number of total STRs Town-wide at 1,255. Data collected by the Town of Truckee suggests that at least some short-term rentals may be unoccupied a large share of the year. The median number of rented nights was 74 in 2022 and 60 in 2023, with 150-200 registered STRs reporting zero rented nights each year. This self-reported data on number of rented nights does not fully represent the occupancy for registered STRs, which may also be used for other purposes such as unpaid stays by owners and their friends/families, ski leases, or other stays of more than 30 days. Because of this gap

[13] Census Bureau, 2022 American Community Survey 5-year estimates, Table S2504

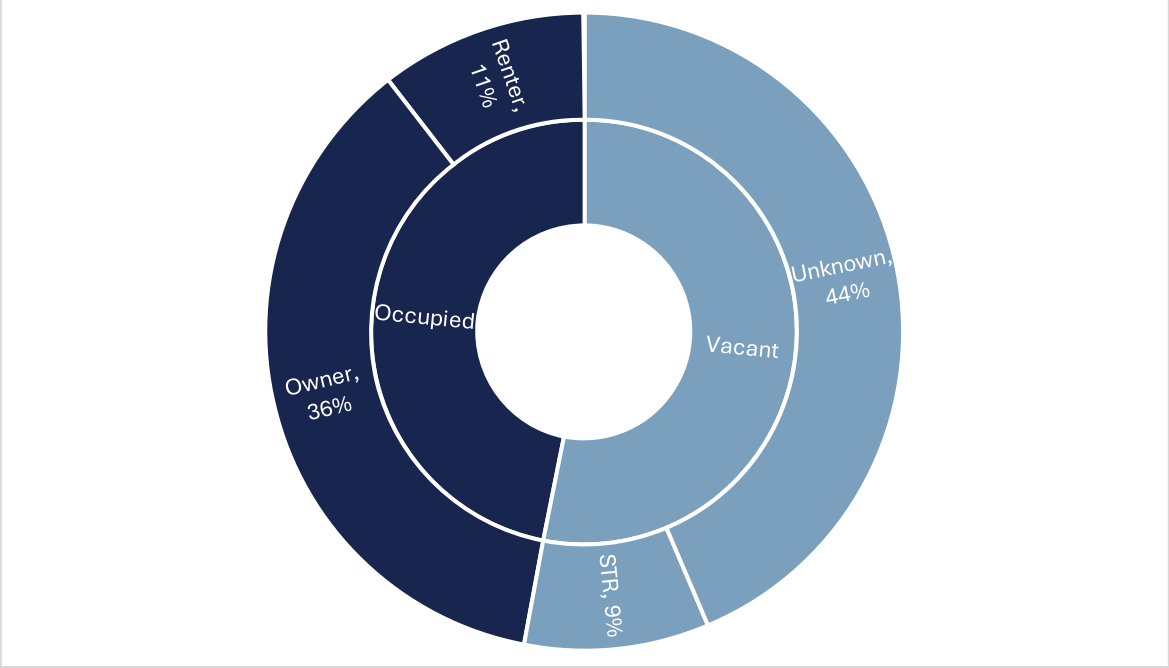
[14] Estimates from the Mountain Housing Council and Census Bureau 2022 American Community Survey 5-year estimates (B25002 Occupancy Status).

in usage data, it is impossible for the Town to estimate the average occupancy of STRs and assess the likely impact of decarbonization policies.

STR owners do have an incentive to invest in efficiency and weatherization measures, as they pay utility bills but have little control over energy use on their property when it is rented to visitors. However, the cost savings from these investments are much harder to predict than in primary residences and will be heavily impacted by how frequently the STR is occupied, particularly in winter, and the behavior of the occupants. While the STR ordinance and required permitting process represents a strong mechanism to enforce any energy-related requirements the Town may consider, the highly variable occupancy and lack of data complicates the use of policies such as energy benchmarking or energy performance standards.

Combining Census Bureau data on housing occupancy and tenure with the number of permitted short-term rentals yields the housing occupancy and use breakdown shown in Figure 14. The largest share (44%) of housing units in Truckee are vacant units that are not short-term rented, meaning the Town has no data on how frequently these homes are occupied. While many of these are likely second homes with occasional use, some may be vacant because they are on the market or not in habitable condition. Similar to STRs, the effectiveness and cost savings of decarbonization measures will be heavily impacted by frequency of use. These vacant residential buildings with unknown use may be a particular challenge to address through decarbonization programs since unlike STRs, the Town does not have a regulatory mechanism for these types of buildings aside from the building permit process.

Figure 15: Housing Occupancy and Use in Truckee



Home Sales

Time-of-sale regulations have been used by some jurisdictions to require energy use disclosure and/or upgrades on single-family homes. In considering whether these types of policies would be a good fit for Truckee's building decarbonization strategy, it will be important to understand what percentage of Truckee's homes are sold each year and how this compares to the percentage subject to existing control points such as building permits.

An estimate of home sales per year in the Truckee area was obtained from Redfin. This data includes single-family detached homes, condos and townhomes, and small multifamily buildings of 2-4 units.

Table 7: Home Sales in Truckee

Year	Homes Sold	% of Total
2017	731	5.9%
2018	652	5.3%
2019	658	5.3%
2020	909	7.3%
2021	772	6.2%
2022	572	4.6%
2023	465	3.8%

It is unclear whether the geographic limits of this data is limited to the Town of Truckee or any home with a Truckee address, which could include some parts of neighboring unincorporated Placer County. While more precise data from the County was not available in time for this analysis, it will be collected periodically moving forward as part of enforcing the Town's STR requirements, as STR permits do not transfer to new owners. This will allow Town staff to obtain better estimates of the number of home sales within Town limits if a point-of-sale ordinance is under consideration.

Based on these estimates and assuming a low percentage of repeat sales of an individual home, a time-of-sale requirement could impact 20-30% of Truckee's single-family residential building stock over a 5-year span. This suggests that this type of policy could be very effective in impacting a large share of Truckee's existing building stock in a relatively short period of time.

Recommendations based on Ownership and Occupancy Indicators:

- Develop programs to address the "split incentive" problem for renter-occupied housing and support energy cost savings for renters.
- Design targeted programs for short-term rentals to address the unique occupancy conditions of this use type.
- Consider time-of-sale requirements for single-family homes.

Energy Use Assessment

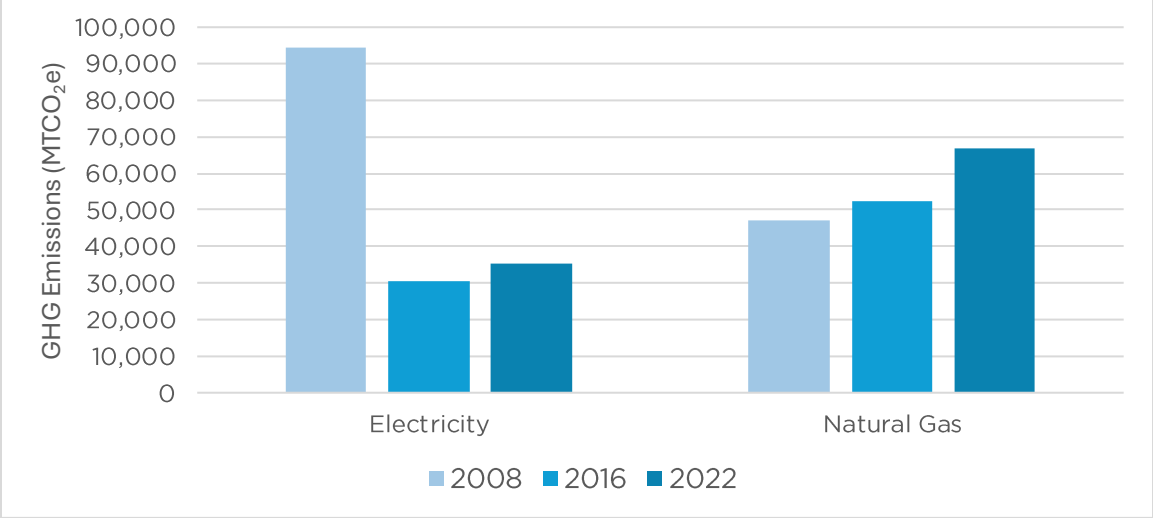
This section provides an analysis of energy use trends at the community and building scale to identify the building types, fuel types, and end uses of energy that contribute the most to community-wide GHG emissions. This analysis also provides insight into the types of strategies that will be most impactful in achieving building decarbonization based on rates of renovations and equipment replacement in existing buildings. Data sources include:

- Utility-provided energy use data
- Town building permit data
- TDPUD's 2022 Residential Energy Use Survey
- Data from the U.S. Energy Information Administration

Community-Wide Energy Use Trends

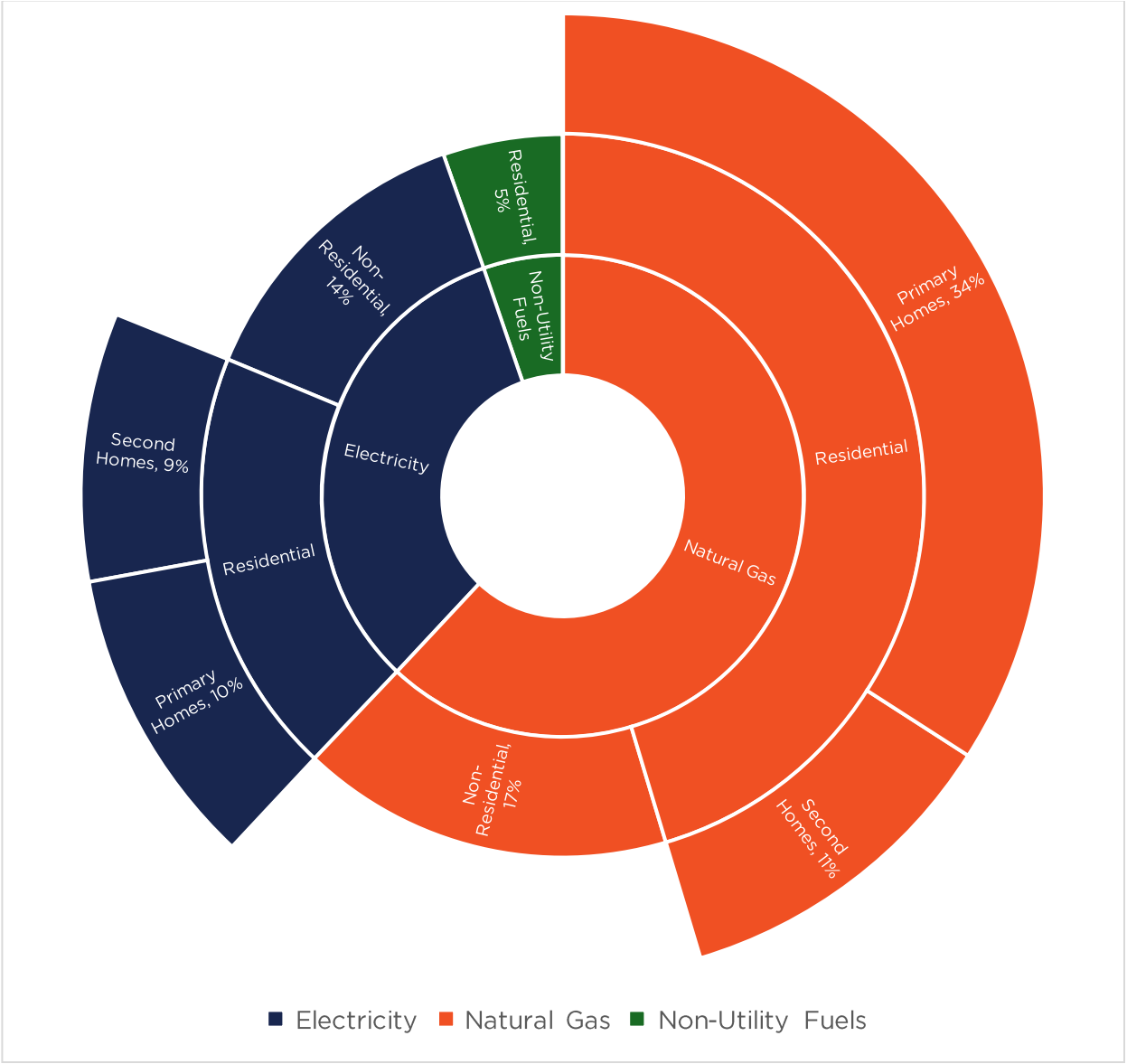
Community-wide utility energy use has increased substantially since 2008, with a 38% total increase in natural gas use and a 25% increase in electricity use. However, GHG emissions from energy in Truckee declined over this period due to increasing use of renewable electricity sources. As of 2022, natural gas comprises the majority of energy-related GHG emissions and will likely account for an increasing share of energy sector emissions as the electric grid continues to decarbonize.

Figure 16: Community-wide GHG Emissions from Utility Energy



Energy-related GHG emissions come from three sources in Truckee: utility-provided electricity (from either TDPUD or Liberty), utility-provided natural gas, and non-utility fuels such as propane and wood. While non-utility fuels are not measured, estimated usage is included in the Town's GHG inventories. Use of non-utility fuels is not a large source of GHG emissions in Truckee, as only a small number of buildings use propane for significant uses such as space or heating. Residential natural gas use is the largest contributor to Truckee's energy-related GHG emissions, followed by residential electricity use.

Figure 17: 2022 Energy-Related GHG Emissions by Fuel and Building Type



Residential Energy Use

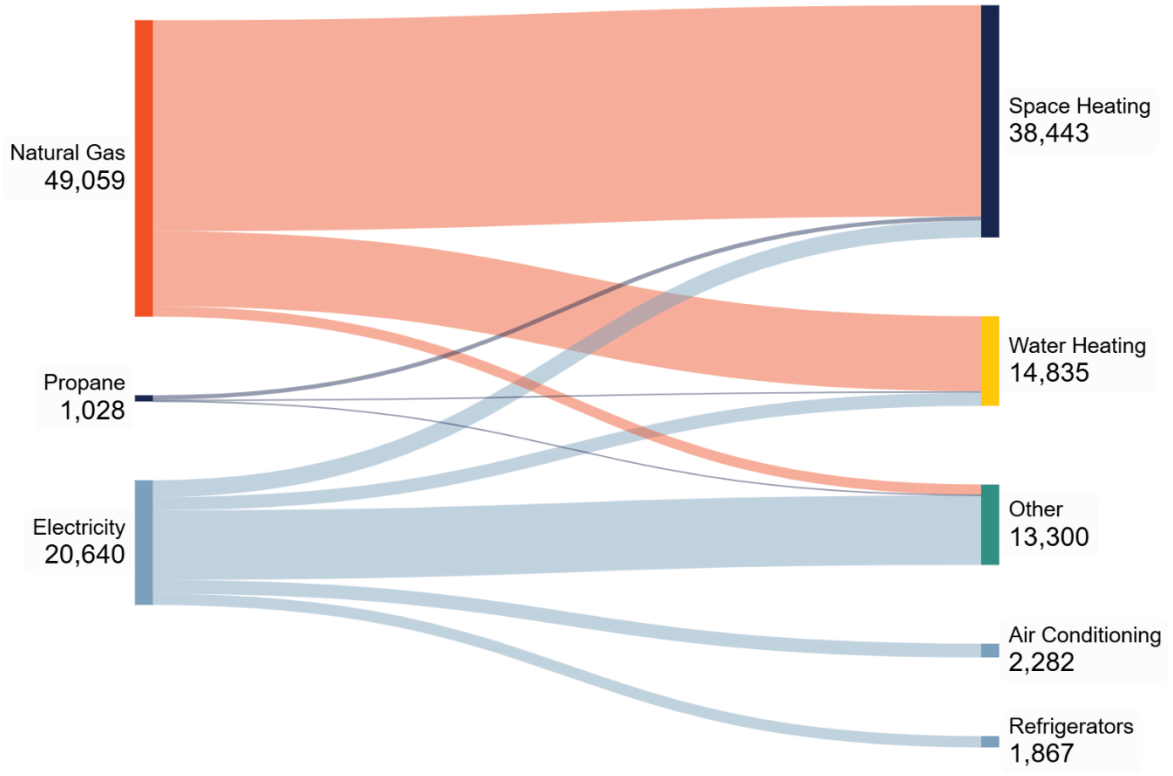
Residential energy use in Truckee has increased 38% since 2008. Most of Truckee's residential energy use (and associated GHG emissions) comes from primary residences, despite these being less than half of the overall residential building stock. This is due to most second homes being used only intermittently, including most permitted short-term rentals. In 2022, 74% of total residential energy use in Truckee was from primary homes.

While consumption of utility-provided energy in second homes decreased 18% from 2008-2022, energy use in primary homes increased by a staggering 80% during the same time, almost entirely from increased natural gas use. This dramatically exceeds

the population growth of only 5% during the same timeframe. While energy use data was not weather-normalized to adjust for differences in temperature from year to year, that alone would be unlikely to account for an increase of this size.

In order to prioritize the Town's strategies to address GHG emissions from residential energy use, it is important to understand the end uses of electricity, natural gas, and propane in residential buildings. Town staff estimated community-wide 2022 residential energy GHG emissions by end use for each of these three fuel types.[15]

Figure 18: Residential GHG Emissions by End Use and Fuel Type ($MTCO_2e$)



Space heating accounts for over half of all GHG emissions from residential energy use, with over 90% of these emissions coming from natural gas heating equipment. Electrifying residential space heating is therefore the most impactful action the Town can take to address energy-related GHG emissions. Weatherization measures (better insulation, high-performance windows, air sealing, duct sealing, etc.) that improve the efficiency of home heating can also reduce these emissions to a lesser degree but are best implemented as a complement to heating system electrification to help reduce utility costs.

[15] U.S. Energy Information Administration (March 2024). 2020 Residential Energy Consumption Survey, Table CE4.5: Annual household site end-use consumption by fuel in the West – totals, 2020. https://www.eia.gov/consumption/residential/data/2020/index.php. Totals for cold and very cold climates in the West used for disaggregation analysis.

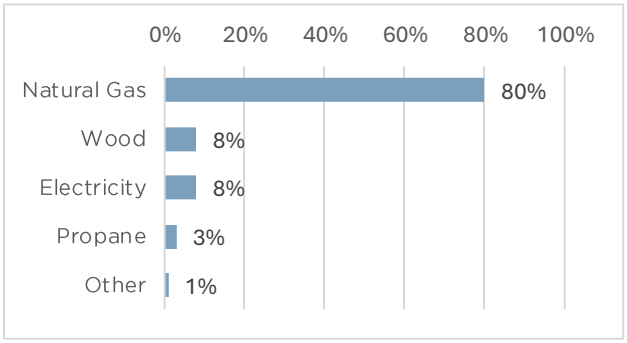
Water heating is the second largest contributor to residential energy GHG emissions, again primarily from natural gas equipment. This is another key end use to target through electrification programs, though it is less of a priority than space heating. Cooking equipment represents a very small portion of overall electricity and natural gas use and is aggregated in the "Other" category in the disaggregation chart along with a variety of small individual end uses. Because of its extremely small contribution to community-wide GHG emissions, electrification of residential cooking equipment is much less impactful than electrifying other end uses of natural gas.

The majority of household electricity is for uses other than heating/cooling, water heating, and refrigeration. This includes lighting, cooking equipment, microwaves, dishwashers, clothes dryers, electronics, and other plug loads.[16] None of these "other" end uses represent a significant individual use of electricity in the household, making it more difficult to pinpoint a specific impactful strategy to address these emissions. All emissions from electricity use will also be reduced as Truckee's electric utilities comply with state requirements to decarbonize electricity generation.

Residential Heating Equipment

Natural gas is overwhelmingly the most common heating fuel in Truckee, with an estimated 80% of homes having natural gas heating.[17] According to the Residential Energy Use Survey conducted by TDPUD in 2022, central forced-air gas furnace systems are the most common primary heating equipment in Truckee homes at 71%. Supplemental or secondary heating is common in Truckee, with most survey respondents (58%) indicating they used a fireplace or wood stove as a secondary heat source.

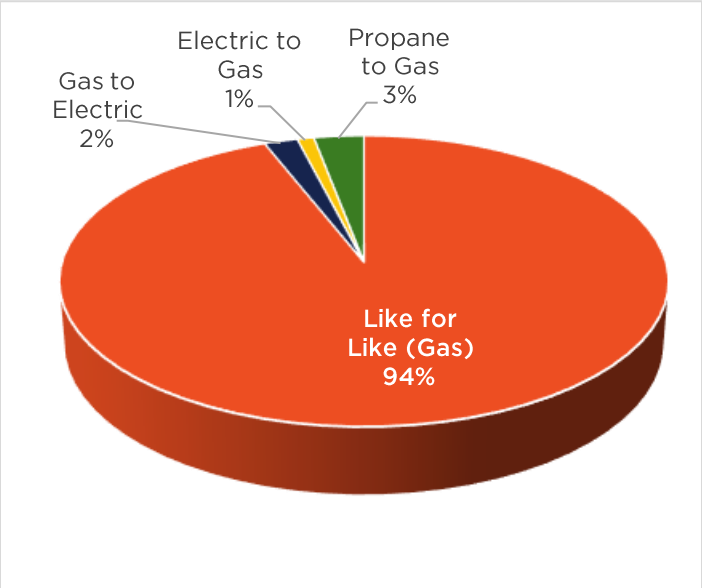
Figure 19: Primary Home Heating Fuel



While occupant behavior has a significant influence on energy use, TDPUD's survey indicates relatively low potential for behavioral shifts to impact energy use for heating. Reported thermostat setpoints were relatively low, with 96% of survey respondents reporting a setpoint for heating at or below 70 degrees Fahrenheit. The majority of respondents indicated a setpoint of 65 degrees Fahrenheit or below. Survey response rates were similar for primary and second homeowners, so this data does not disproportionately represent homes that are vacant a large portion of the winter.

[16] U.S. Energy Information Administration (March 2024). 2020 Residential Energy Consumption Survey, Table CE5.1a&b: Detailed household site electricity end-use consumption, part 1 and part 2 – totals, 2020. https://www.eia.gov/consumption/residential/data/2020/index.php.
[17] TDPUD Residential Energy Use Survey, 2022.

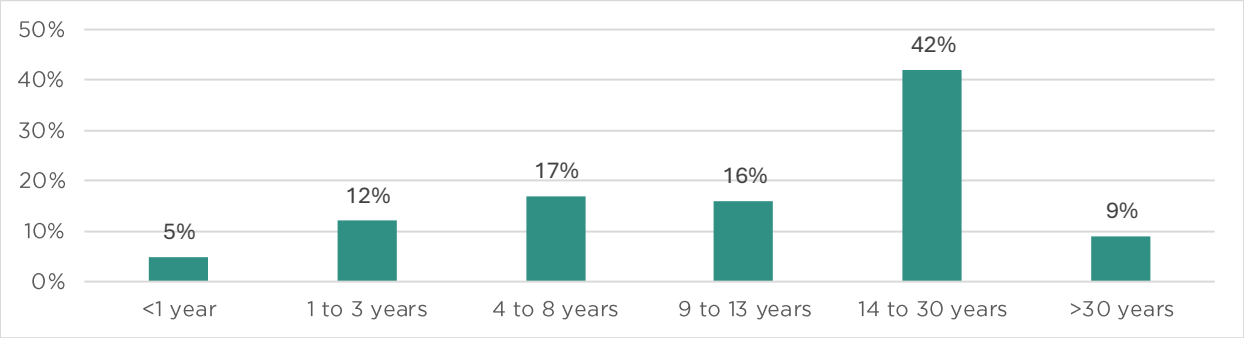
Figure 20: Residential Heating System Replacements by Fuel Type, 2021-2023



From 2021-2023, there were an average of 139 annual heating equipment installations in Truckee, representing approximately 1% of total residential units each year. This indicates that time-of-replacement interventions may have a limited impact on the Town's overall residential building stock in the near term. Nearly all installations were like-for-like replacements of gas equipment, with a very small number of system electrifications, and a few converting from electric to gas. There were only six net total heating system electrifications in Truckee over these three years.

While the current rate of heating system replacement is low, TDPUD's survey results suggest that the majority of residential heating equipment is reaching or at its end of life (usually 15-30 years) and will likely need replacement in the next decade. Without intervention, heating system replacement will likely continue to primarily result in installation of gas furnaces that will create GHG emissions for another 15-30 years.

Figure 21: Age of Residential Heating Equipment in Truckee

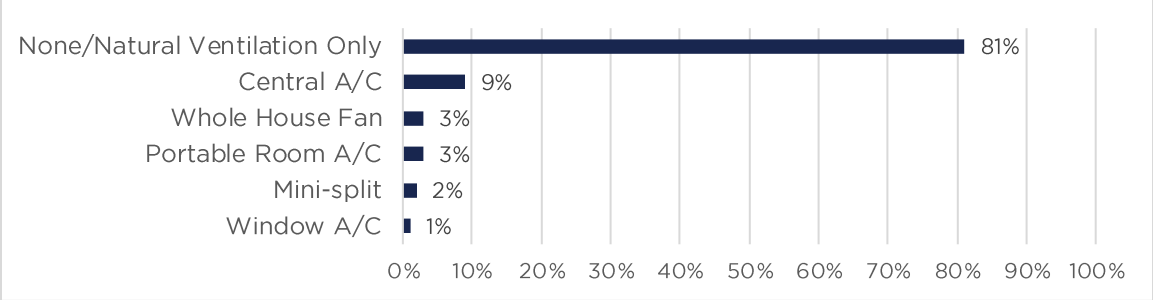


Residential Cooling Equipment

Air conditioning (A/C) is still relatively rare in Truckee, though this is expected to change. According to the 2022 TDPUD Residential Energy Use Survey, only 15% of residential customers had some form of mechanical cooling, with central A/C being the most common type of cooling equipment. The rate of A/C installation is increasing rapidly, with 85% of A/C units installed in the last three years.[18]

[18] TDPUD Residential Energy Use Survey, 2022.

Figure 22: Type of Cooling Equipment in Truckee Residences



This trend is expected to continue as Truckee experiences the impacts of climate change. Truckee's average high temperature is expected to increase by around 4-5 degrees Fahrenheit by mid-century compared to historical averages, with a sharp increase in the average number of extreme heat days (days with a high temperature above 88.8F) and cooling degree days, which measures demand for A/C.

Table 8: Anticipated Climate Change Impacts on Cooling Demand in Truckee[19]

Metric	Baseline (1961-1990)	Mid-Century (2035-2064)
Average High Temp. (F)	58.1	62.5-63.4
Annual Extreme Heat Days	3	22-30
Annual Cooling Degree Days	16	114-178

Cooling equipment can offer an alternative way to get heat pumps into Truckee homes, rather than focusing on heating system replacement. Air conditioners and heat pumps are essentially the same type of equipment, which move heat from one place to another rather than generating it through combustion. Heat pumps have a reversing valve that allows them to transfer heat in both directions, providing either heating or cooling, while A/C units can only provide cooling. The installation process is nearly identical for similar configurations of A/C and heat pump units, so contractors familiar with A/C installation would be capable of performing heat pump A/C installation.

Heat pump air conditioning can provide the same cooling benefits as traditional A/C but also offset at least a portion of natural gas used for heating by creating a dual-fuel heating system. While only 2% of heating equipment was fully electrified from 2021-2023, 21% of gas furnace replacements included simultaneous A/C unit installation that could have easily been converted to heat pump A/C. This represents only nine permitted gas-to-electric heating conversions compared to 172 central A/C unit installations during the same time. This suggests that focusing on cooling equipment instead of only heating equipment may be a much more effective pathway to broader deployment of heat pumps in Truckee homes.

[19] Data from Cal-Adapt.org, with Mid-Century ranges based on Medium (RCP 4.5) and High (RCP 8.5) Emissions Scenarios

Residential Building Envelope

The 2022 TDPUD Residential Energy Use Survey indicated potential for efficiency from weatherization measures and other improvements to the building envelope. This includes better insulation, higher-performance windows and doors, and weatherstripping and other air sealing measures. A large share of homes reported air leaks from windows (19%), doors (33%), and walls (6%), which are easy opportunities for efficiency improvements from air sealing. While most homes reported having all double-pane windows, 11% had at least some single-pane windows, representing more than 1,400 homes.

Only 20% of survey respondents indicated their home had undergone any renovations in the past 5 years, with a majority of remodels targeting a single room rather than representing a comprehensive efficiency upgrade. This indication that more comprehensive efficiency upgrades are relatively rare is supported by Town building permit data. This indicates good potential for effective energy efficiency improvements from comprehensive weatherization and efficiency upgrade programs.

Residential Water Heating Equipment

A large share of residential water heating equipment in Truckee is aging and nearing end-of-life. While water heaters are on average newer than space heating equipment, the majority of residential water heaters will likely need to be replaced over the next decade.[20] Natural gas is the dominant water heating fuel in Truckee, and most (77%) are tank-style. Nearly 20% of water heaters are electric, though only 2% are highly efficient heat pump water heaters.

Figure 25: Age of Residential Water Heating Equipment in Truckee

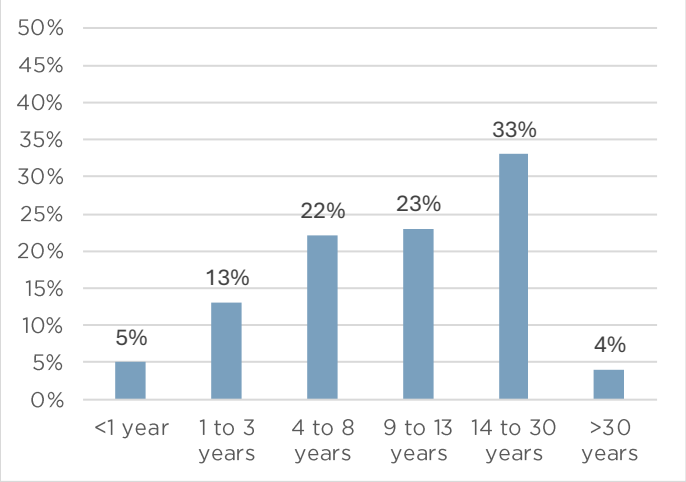
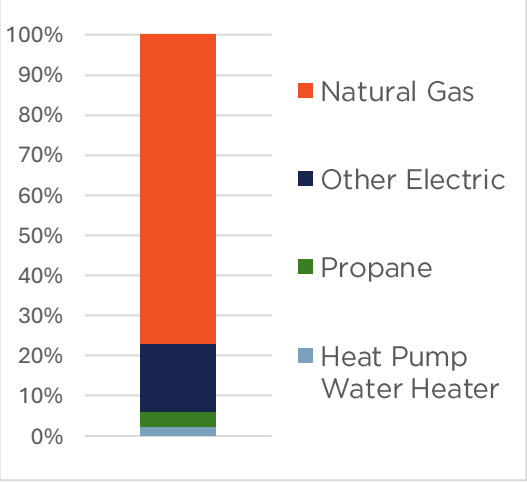


Figure 24: Water Heating Fuel in Truckee



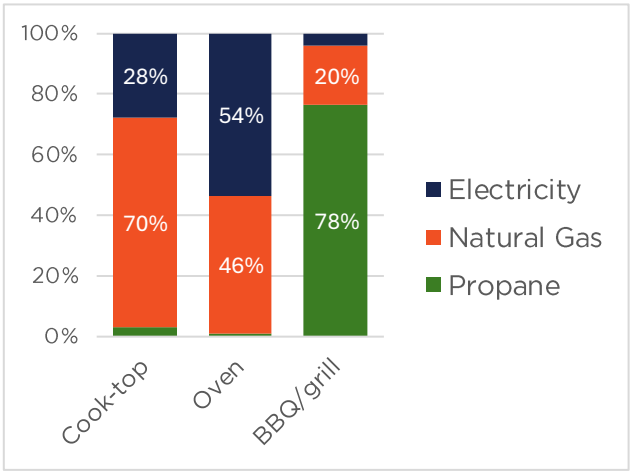
[20] Data from 2022 TDPUD Residential Energy Use Survey, provided by TDPUD.

Water efficiency measures for hot-water fixtures can provide additional energy efficiency and GHG emissions reduction benefits. However, TDPUD's Residential Energy Use Survey suggests that there may already be widespread implementation of these types of measures, with 69% of respondents indicating they had installed low-flow shower heads in all showers in the home, and an additional 11% having installed them in at least some showers.

Other Residential End Uses

A very small percentage of residential natural gas is used for purposes other than space and water heating. This includes cooking equipment such as cook-tops, ovens, and grills. While the majority of ovens are electric, other cooking equipment is predominantly natural gas or propane. In TDPUD's 2022 survey, 20% of respondents indicated interest in replacing their existing cooktop with one that uses induction, though most respondents felt gas was a better fuel for cooking.

Figure 26: Cooking Fuel Sources



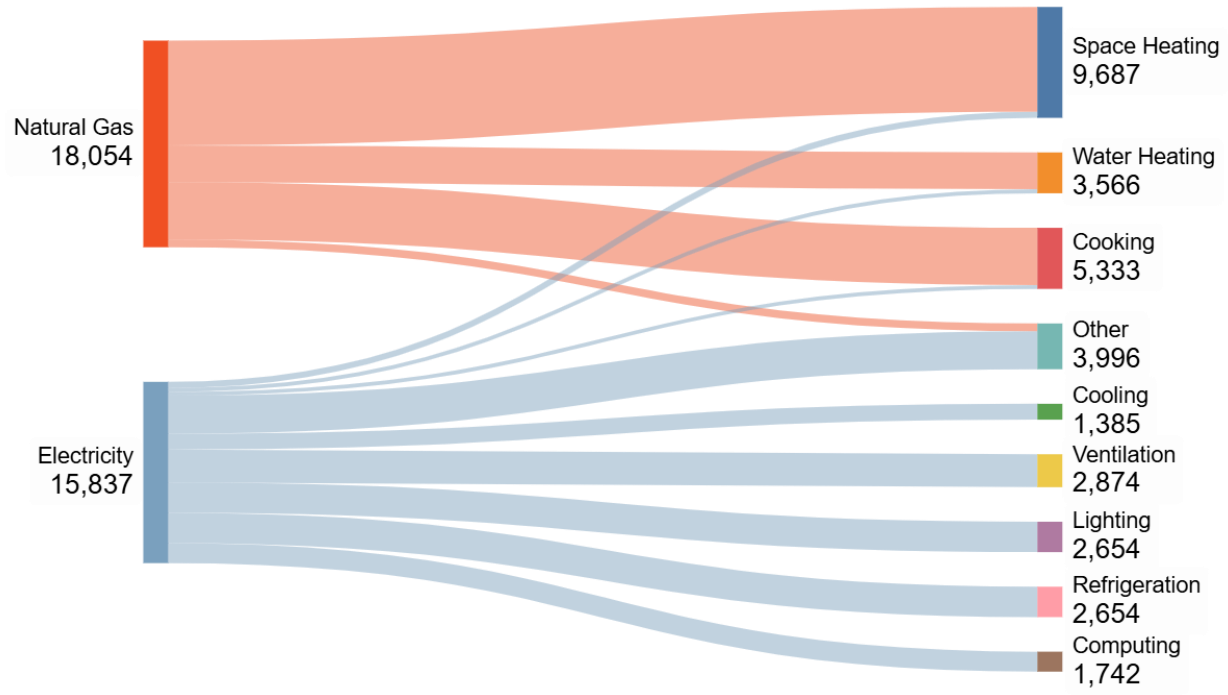
The majority of household electricity in Truckee is for uses other than heating and water heating, including other household appliances like cooking equipment, clothes washers and dryers, dishwashers, and refrigerators. TPDUD data suggests that the majority of these home appliances are EnergyStar certified, though there may be some room to increase the use of high-efficiency appliances.

Commercial Energy Use

Commercial buildings are much more varied in size and use than residential buildings, so it is harder to model the energy use of a "typical" commercial building. Data from the 2018 Commercial Building Energy Consumption Survey for all building types in Truckee's general geographic region (Pacific) was used to disaggregate community-wide GHG emissions from non-residential energy use.[21] The resulting chart gives a high-level estimate of the overall end uses for commercial energy and how they contribute to GHG emissions at the community scale. Unlike the residential GHG emissions disaggregation, this chart is not representative of any individual building's GHG emissions profile due to the high variation of end uses and fuel types across different types of commercial buildings.

[21] U.S. Energy Information Administration. (December 21, 2022). 2018 Commercial Building Energy Consumption Survey Data, Table E5: Electricity consumption (kWh) by end use, 2018 and Table E7: Natural gas consumption and conditional energy intensities (Btu) by end use, 2018. https://www.eia.gov/consumption/commercial/data/2012/

Figure 27: Commercial GHG Emissions by End Use and Fuel Type ($MTCO_2e$)

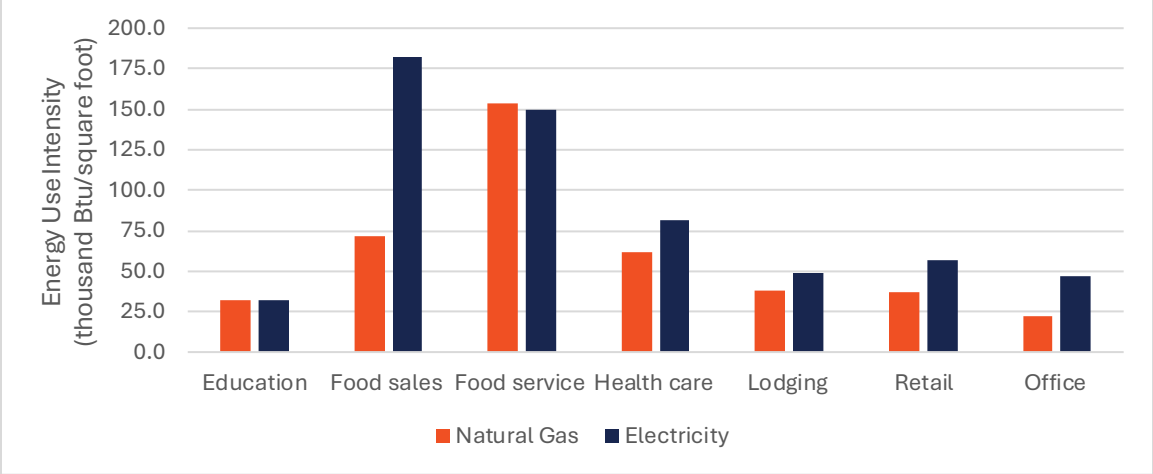


Unlike residential energy, GHG emissions from commercial energy are much more evenly distributed among different fuel types and end uses at the community scale. Natural gas comprises a smaller share of GHG emissions from non-residential energy than residential energy, though this share will increase as electric utilities increase use of renewables. Commercial use of natural gas is predominantly for space heating, water heating, and cooking. While large commercial equipment can be more challenging to electrify than residential equipment due to technological barriers and high cost, the predominance of small commercial buildings in Truckee makes it more likely that some space and water heating equipment can be more easily electrified.

Due to higher use of electricity in commercial buildings, there are also more opportunities to reduce near-term GHG emissions through measures such as high-efficiency electric appliances and lighting retrofits, which can also offer utility bill savings for business owners.

Energy use intensity for both electricity and natural gas varies significantly across different types of commercial uses, due to very different equipment and appliance needs. Because end uses of energy and fuel type can be highly variable across commercial building types, sizes, and vintages, programs and policies with a more flexible approach may be more successful in addressing GHG emissions reduction.

Figure 28: Energy Use Intensity by Commercial Use Type[22]



Challenges & Opportunities

While building decarbonization can provide many benefits to individual households and the community, there are barriers to successful implementation in Truckee that will need to be addressed in program and policy development. In order to better assess community concerns about building decarbonization, Town staff released a Community Building Energy Use survey in August 2024, which received 88 responses. The results are incorporated into the analysis in this section.

Financial Barriers

Equipment & Installation Cost

Building decarbonization measures, both efficiency and electrification, require an upfront investment that can be a barrier to implementation, particularly with Truckee's high construction costs. This upfront cost, particularly the incremental cost of electrification measures compared to like-for-like replacement of fossil gas appliances, is one of the most common barriers to decarbonization cited by the Truckee community.

While the incremental cost of high-efficiency electric appliances compared to their fossil-fuel counterparts can discourage end use electrification, many types of high-efficiency electric appliances are already cost-competitive with fossil gas counterparts, particularly for residential uses. Heat pumps are generally cheaper than simultaneous gas furnace and air conditioning installation, which currently accounts for over 20% of permitted furnace replacements in Truckee. Heat pump water

[22] U.S. Energy Information Administration. (December 21, 2022). 2018 Commercial Building Energy Consumption Survey Data, Table E4: Electricity consumption intensities (Btu) by end use, 2018 and Table E7: Natural gas consumption and conditional energy intensities (Btu) by end use, 2018. https://www.eia.gov/consumption/commercial/data/2012/. Pacific region values used for analysis.

heaters are similarly priced to tankless gas units, though they are more expensive than other tank-style water heaters.[23]

However, there are applications where high-efficiency electric appliances are not close to achieving cost parity with fossil gas equipment. Induction cooktops are still much more expensive than a gas range, and homeowners may incur additional costs for the purchase of new cookware if their existing pots and pans are not compatible with induction. Commercial equipment can also be very expensive to electrify, and there are some applications with technological barriers to electrification. For example, commercial chiller-boiler systems difficult to electrify, as they require higher water temperatures than can easily be achieved by heat pumps.[24]

Upfront costs can be addressed through financial incentives such as rebates, tax credits, and financing strategies (no- or low-cost loans, on-bill financing, etc.). There are currently a number of federal, state, and utility incentives available to Truckee residents and businesses, though there are some gaps. Respondents to the Town's Building Energy Use Survey cited financial incentives as the most impactful support for building decarbonization. While financial incentives may be very effective in supporting adoption of building decarbonization measures for building owners that are already interested, incentives may not have much impact on a building owner's willingness to electrify natural gas equipment. For example, in TDPUD's 2022 Residential Energy Use Survey, only 7% of respondents said a financial incentive would affect their decision to purchase a heat pump water heater.

Utility Cost

Lower energy bills and improved energy efficiency were cited as the best motivations to implement building decarbonization measures in the Town's community survey. However, there is a perception among a large share of the community that many electrification measures are likely to increase utility costs.[25] Addressing these concerns through education, outreach, and thoughtful program design will be important as the Town supports building decarbonization measures.

While energy efficiency and weatherization measures reduce energy use and associated utility costs, this is not always the case with electrification measures. In general, the low cost of natural gas compared to electricity can be a barrier to end use electrification, since increased electricity use can result in an overall increase in utility costs. However, the TDPUD's relatively low electricity rates make it much easier to find cost-effective pathways to end-use electrification.

When implementing building decarbonization measures, it is important to prioritize highly efficient electrification rather than focusing solely on fuel-switching to support

[23] California Air Resources Board. (December 2022). Final 2022 Scoping Plan, Appendix F: Building Decarbonization. https://ww2.arb.ca.gov/our-work/programs/ab-32-climate-change-scoping-plan/2022-scoping-plan-documents.

[24] California Air Resources Board. (2022).

[25] Based on responses to the TDPUD 2022 Residential Energy Use Survey and Town of Truckee 2024 Community Building Energy Use Survey.

net cost savings for Truckee residents and businesses. This can be accomplished by using high-efficiency electric appliances as well as complementary energy efficiency and weatherization measures, which have the added benefit of improving the resilience, safety, and comfort of buildings. Thoughtfully designed building decarbonization programs can utilize these strategies to reduce net utility costs.

While many community members are concerned about utility cost impacts from electrification, there is also a very real danger of cost increases for residents and businesses that continue to use natural gas over the next few decades. As more households and businesses electrify appliances and/or entire buildings, remaining natural gas users will take on an increasingly larger share of system costs. [26] This could lead to large utility cost gaps for households or businesses that were not able or willing to decarbonize earlier.

Split Incentives

A split incentive occurs when one party invests in energy savings improvements, while the benefits primarily go to another party. This is a particular barrier to decarbonization in renter-occupied buildings, both residential and non-residential. While energy savings measures are usually appealing to building owners because of the cost savings over time, owners of tenant-occupied buildings generally don't pay electricity bills, and do not have the same incentive to invest in measures that would be cost-effective in owner-occupied buildings.

Split incentives are not always addressed by traditional financial incentives such as rebates, so additional strategies may be needed to ensure that building decarbonization measures are implemented in renter-occupied housing and tenant-occupied commercial buildings. The Roadmap includes several strategies to address this barrier, to ensure that renters and small business owners have equal access to the building decarbonization programs and their benefits.

Practical Barriers

Cold Climate Decarbonization

Truckee's cold winters can make building decarbonization more challenging than in more moderate climates, though there are numerous examples of successful building decarbonization in communities in much colder climates.[27] While many community members cite Truckee's cold climate as a major technical barrier to building decarbonization, this is more of a perceived barrier than an actual one. However, many community members and contractors mistakenly believe that heat pumps

[26] California Air Resources Board. (December 2022). Final 2022 Scoping Plan, Appendix F: Building Decarbonization. https://ww2.arb.ca.gov/our-work/programs/ab-32-climate-change-scoping-plan/2022-scoping-plan-documents.

[27] For more information on cold climate building decarbonization, see Appendix C: Building Decarbonization Myths & Realities.

don't work in cold climates, which can be a strong impediment to electrification in the region.

While cold climate heat pump technology is widely available and works well, cold climate heat pumps can be more expensive than those designed for more moderate climates. This can exacerbate existing financial barriers to decarbonization. It is also important to ensure that homeowners are installing equipment that is actually cold-climate rated, as use of improper equipment can reinforce misconceptions and create resistance to electrification of heating systems. There are resources that can help identify cold-climate appropriate equipment, such as the Northeast Energy Efficiency Partnerships cold-climate air source heat pump (ccASHP) specification and product list.[28]

Cold climates can present more of a complication for decarbonizing water heating, however. Standard heat pump water heaters operate best in spaces with ambient air temperatures of 40°F or above and require at least 1,000 cubic feet of ventilated space around the water heater.[29] These additional limitations can make it more challenging to install this type of equipment in existing homes, particularly if the current water heater is located in unconditioned space like a garage. However, there are equipment options such as split-type heat pump water heaters that can work well in temperatures as low as -25°F,[30] though these may be more expensive than standard heat pump water heaters.

These barriers can be addressed through education and training for both residents and contractors, to make sure they are familiar with cold climate heat pump technology. Promoting local examples of successful building decarbonization can also help community members feel more comfortable in taking this step themselves. In designing incentive programs, it is also important to ensure that covered equipment is appropriate for cold climates and that financial incentives take into account any additional incremental cost for cold-climate technology.

Power Outages

Truckee experiences both planned and unplanned power outages due to natural hazards such as wildfires and severe winter storms. These outages can affect a small area or the entire Truckee-Tahoe region and can occur at any time of year, though they are most common during extreme summer or winter weather. As Truckee experiences the impacts of climate change, these conditions will occur more frequently, potentially leading to longer and more frequent outage events.

Winter storms can result in smaller, localized outage events that impact a portion of the community and are more likely to be relatively short in duration. Community-wide outage events include Public Safety Outage Management (PSOM) events

[28] https://neep.org/heating-electrification/ccashp-specification-product-list
[29] https://www.energy.gov/energysaver/heat-pump-water-heaters
[30] https://www.energystar.gov/products/ask-the-experts/do-heat-pump-water-heaters-work-cold-climates

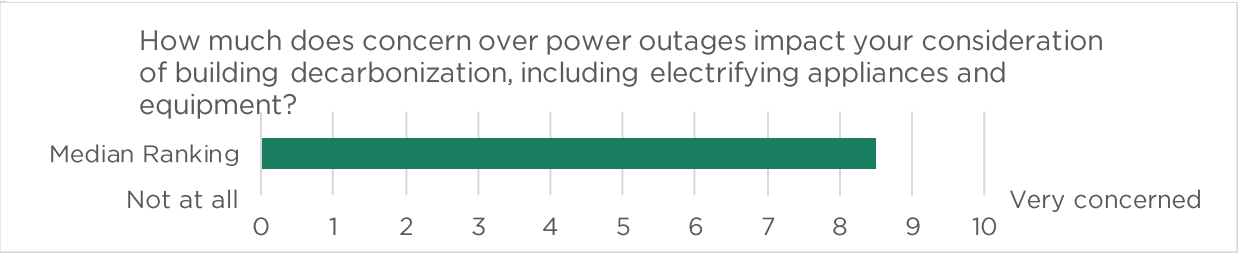
(usually called Public Safety Power Shutoffs or PSPS events in California). During a PSOM event, transmission lines will be preemptively de-energized in elevated fire-risk zones during extreme weather conditions to reduce the chance of fires being sparked by power lines. PSOM events affect the entire Truckee community, and can last for hours or even days, depending on weather conditions. Advance notice of a potential PSOM event is provided to the community, allowing some time to prepare.

More recently, NV Energy has announced a policy of emergency de-energization when an active wildfire moves close enough to power lines or other equipment. This is done to reduce the risk of electrical equipment creating additional ignitions and to protect first responders and the community and are likely to affect the entire Truckee community. Unlike a PSOM event, no advance notice is generally provided. Truckee first experienced this type of emergency de-energization during the 2024 Gold Ranch fire in Verdi, which resulted in power being shut off to the entire North Tahoe and Truckee region for several hours. Before power can be restored after a de-energization, electrical infrastructure must be inspected visually to check for damage. The transmission lines that supply power to Truckee go through remote and rugged terrain, which makes these inspections much more challenging and can further delay power restoration after an outage.

Power outages can result in a number of health and safety as well as financial impacts on the community. The impact depends on the scale and duration of the outage, as well as other concurrent emergency conditions such as an active local wildfire or extreme weather. Milder potential impacts include the cost of generator fuel or replacing spoiled food. More serious are business closures, losing heat in winter, or disruption of power to critical home medical equipment. Severe and extended outages can lead to widespread displacement, impact emergency communications, and impede evacuation during wildfires or other emergencies. Preparing for outages can also have cost impacts for homeowners and businesses, for everything from small power banks for charging phones and other devices to whole-building backup power from generators or battery systems.

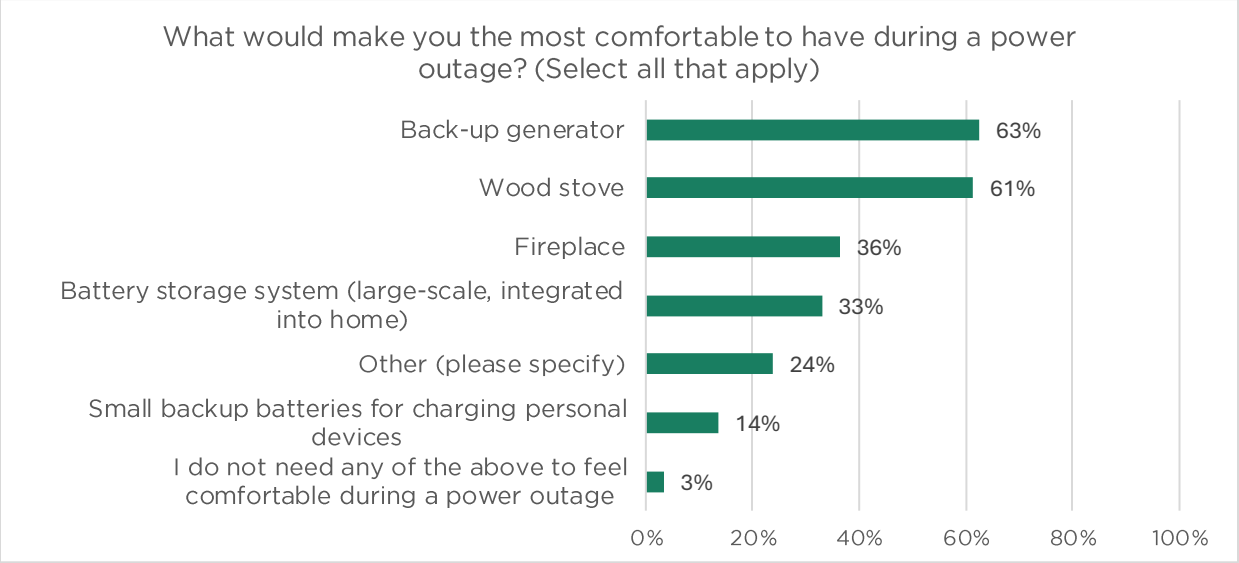
Concern over power outages is a major factor in community consideration of building decarbonization. When community members were asked how much this concern impacted their consideration of building decarbonization on a scale of 0 (Not at all) to 10 (Very concerned), the median ranking was 8.5. Only 20% of respondents ranked their level of concern at less than 5 out of 10.

Figure 29: Community Concern Over Power Outages



When asked what they would need to feel comfortable during a power outage, most respondents indicated they would want both a back-up generator and wood stove. Many of those selecting "Other" indicated they already rely on most or all of these resilience strategies. Notably, several respondents indicated that a gas range cooktop was an important resource for them during power outages.

Figure 30: Power Outage Resilience Preferences



When asked why they selected those resilience strategies, a common theme was the need to have systems that are resilient and not fully reliant on electricity due to power outages. Most respondents expressed a particular unwillingness to rely on electricity for heat in case of an outage during winter. However, most natural gas appliances do not work during an outage either without a backup source of electricity, suggesting some residents are overestimating their current level of resilience to power outages.[31]

Many building decarbonization measures can improve the resilience of buildings to power outages. Weatherization upgrades help buildings retain heat longer in winter and avoid heat gain in summer, improving comfort throughout the year. Both weatherization and other efficiency measures can also reduce the amount of backup power needed during outages. However, community concern over power outages remains a substantial barrier to local end use electrification. Without action to improve community resilience to outages, Truckee may struggle to achieve widespread building decarbonization.

Community Knowledge & Interest

To collect information about the community's understanding of and interest in building decarbonization, Town staff developed a community survey on building

[31] For more detail about the functionality of natural gas appliances during a power outage, see Appendix B: Building Decarbonization Myths & Realities.

energy use that was open for responses in August 2024. This survey was distributed via social media, the Town's newsletter, the Keep Truckee Green website, and in-person via QR code at the Keep Truckee Green booth at Truckee Thursdays. The majority of responses (66%) were collected from links on the Town's and Keep Truckee Green's social media posts. The survey was available in both English and Spanish, though only English-language responses were received.

Most respondents were Truckee residents, with smaller percentages of second homeowners or Truckee business owners that primarily lived elsewhere. Of those selecting "Other," most indicated they were residents of a nearby community and/or worked in Truckee.

Figure 31: Building Energy Use Survey Respondents

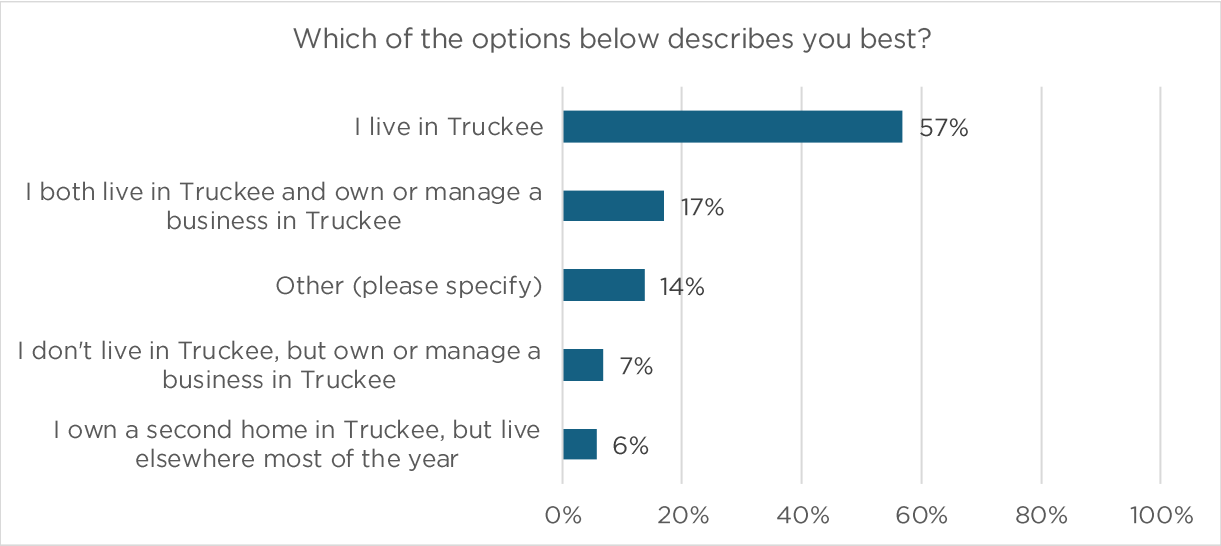
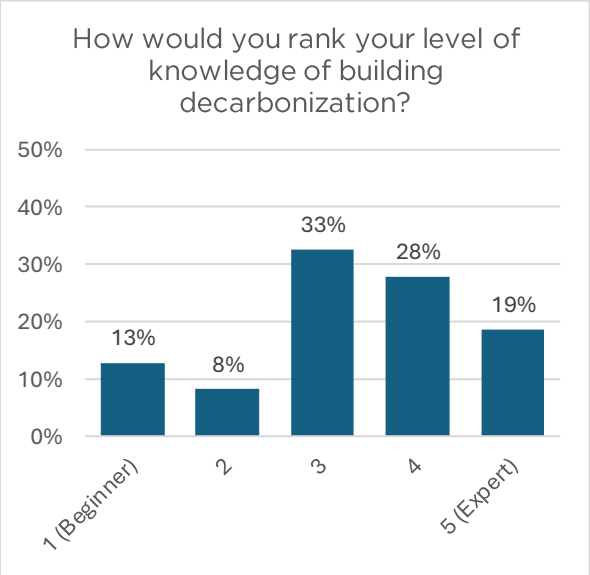
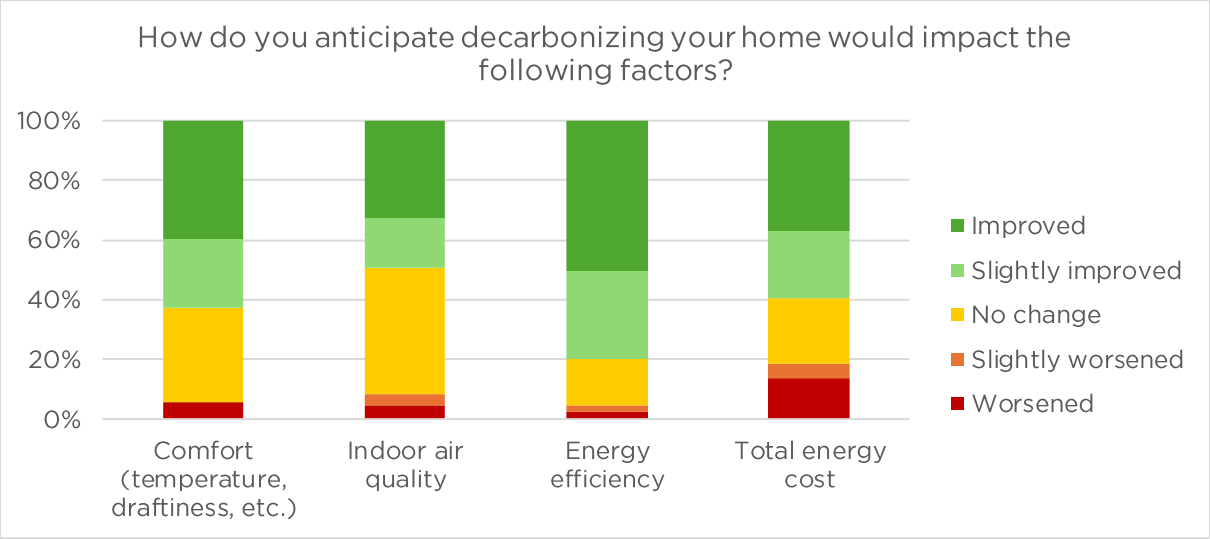


Figure 32: Community Knowledge of Building Decarbonization



While community members have a wide range of existing knowledge about building decarbonization, most seem to have at least a basic understanding of this topic. Respondents to the Town's Building Energy Use Survey were asked to self-assess their knowledge of building decarbonization on a scale from "Beginner" to "Expert." The average ranking was 3.3 on a scale of one to five. Only 21% of respondents indicated a relatively low level of expertise. This suggests that while there are definitely some members of the community that could benefit from additional education on building decarbonization, this is not likely a primary barrier for most people.

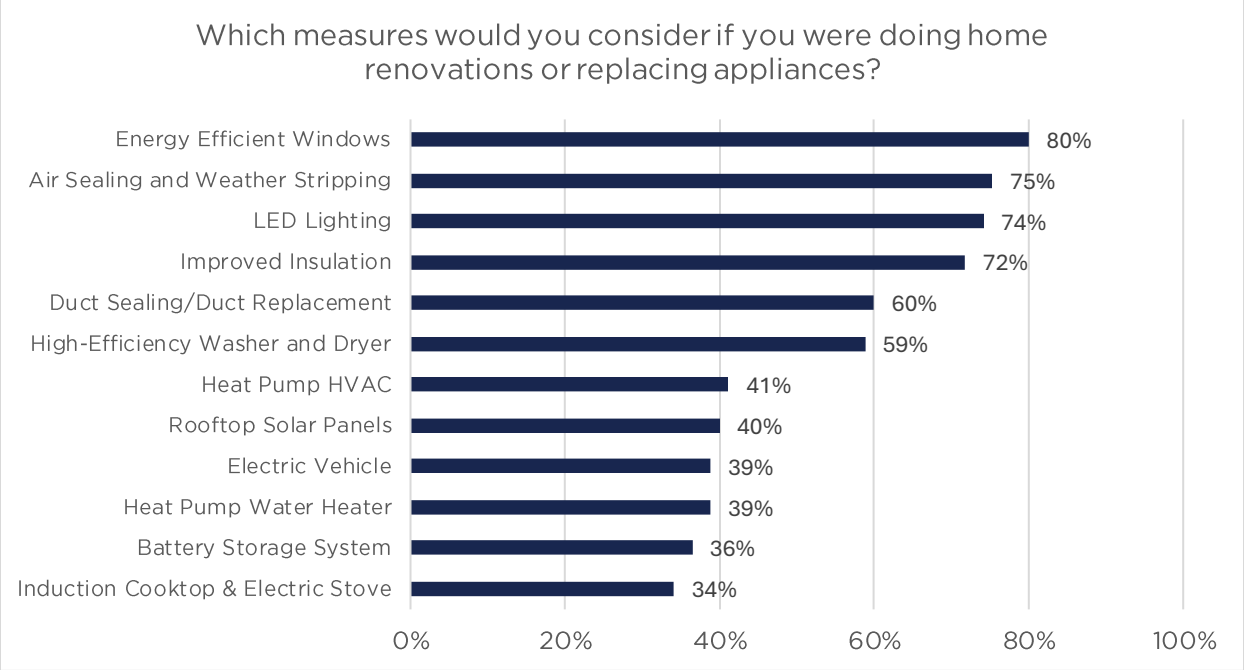
However, there are still many misconceptions about the impacts of building decarbonization in the local community, particularly for individual measures such as end-use electrification. When asked how they anticipated decarbonizing their home would impact factors like comfort, indoor air quality, energy efficiency, and total energy cost, most respondents expected these factors would be improved to some degree. However, a large percentage of respondents did not expect improvement in comfort or indoor air quality from building decarbonization measures. Respondents were most skeptical of the impact on total energy cost, with close to 20% of respondents expecting it to be worsened to some degree. This indicates potential for more targeted education about the benefits of decarbonization.



There were many other common misconceptions expressed during community engagement on building decarbonization, including concerns over how well some electric appliances perform in cold climates. The most common misconceptions encountered by Town staff during the community engagement process are addressed in Appendix B: Building Decarbonization Myths & Realities.

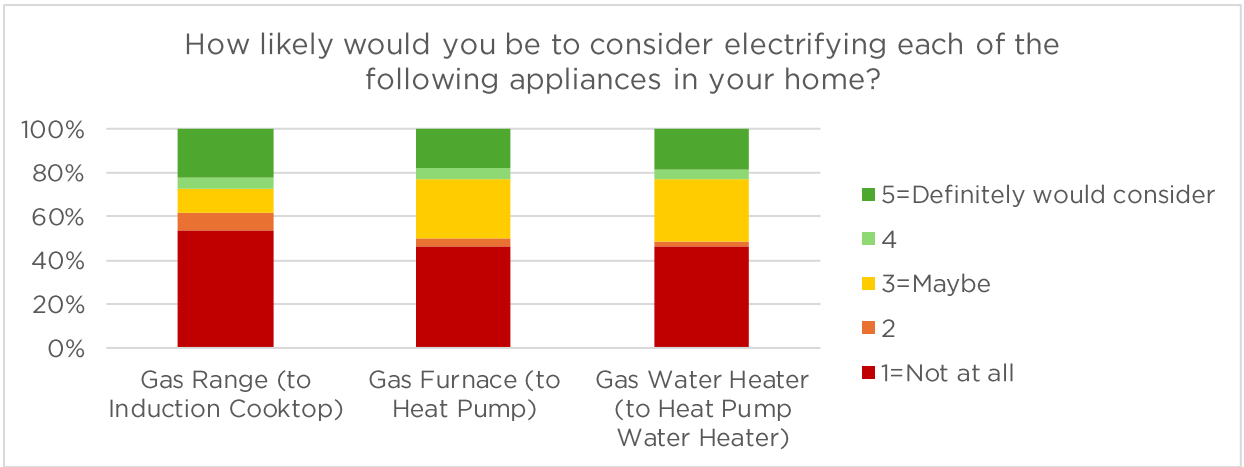
Overall interest in building decarbonization in Truckee is mixed, due to the previously mentioned barriers. In general, there is much higher interest in weatherization and energy efficiency measures than electrification measures. Many of the comments received in the Town's Building Energy Use Survey indicated an interest in efficiency measures that could save money but viewed other measures as prohibitively expensive, impractical in Truckee's climate, and/or reducing resilience to power outages. A minority of respondents were still potentially interested in implementing some types of electrification measures such as heat pump space or water heating and induction cooktops, particularly if concerns over cost could be addressed.

Figure 33: Interest in Building Decarbonization Measures

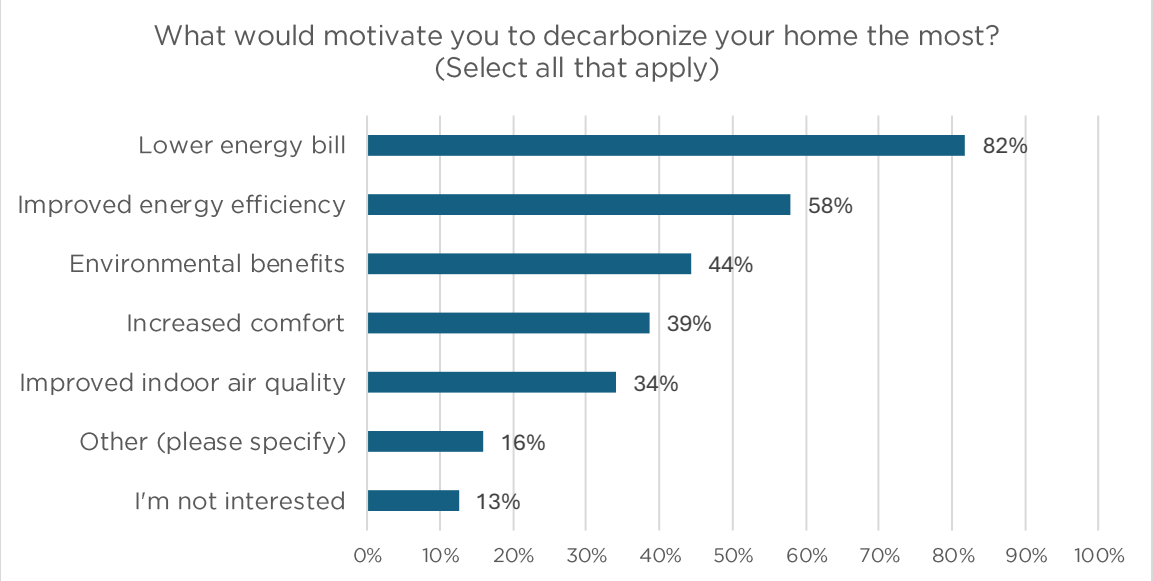


Overall, interest in electrifying existing gas equipment was low among survey respondents, with roughly half of respondents indicating no interest in electrifying heating, water heating, or cooking equipment. Despite this high level of resistance, around 20% of respondents stated they "definitely would consider" each electrification measure. This indicates that with the right supportive programs, the Town could catalyze early adoption of electrification among a sizeable share of the community. Resistance to electrification was highest for cooking equipment, with a strong preference for gas cooktops, a trend seen in other California jurisdictions. However, many respondents also noted that a gas range cooktop provided a key source of resilience in a power outage, a concern more unique to Truckee.

Figure 34: Interest in Electrifying Major Appliances



When asked what would motivate them to decarbonize their home the most, lower energy bills was overwhelmingly the most popular answer. Less than half of respondents (44%) stated that environmental benefits would be a motivating factor for decarbonizing their home. Of the 14 respondents selecting "other," many expressed concerns over cost, and some noted that financial incentives or other strategies to address the cost of decarbonization measure would be a motivating factor. Several respondents again mentioned concern over power outages.



Recommendations

While there seems to be broad support for weatherization and efficiency measures, many community members are clearly hesitant to embrace building electrification measures out of concern they are not a good fit for Truckee's cold winter climate. Based on community feedback, Town staff have the following recommendations for the Town's building decarbonization strategy:

- In the near-term, focus on voluntary decarbonization programs and supporting early adopters of electrification measures.
- Develop equitable financing strategies to address the upfront cost of decarbonization measures and design programs to ensure they do not increase energy bills.
- Invest in an energy resilience strategy to identify policies and programs to improve the resilience of Truckee homes and businesses, both all-electric and mixed-fuel, with the goal of removing barriers to electrification and reducing reliance on fossil-fuel backup power.
- Focus on educational measures that correct common community misconceptions about building decarbonization, emphasizing cost savings,

health and safety improvements, and other co-benefits, rather than centering messaging on environmental impacts.

- Continue to invest in real-world, local case studies of the impacts of electrification through programs such as the Climate Transformation Alliance Building Decarbonization pilot program.

Leading with Equity

By prioritizing equity in policies and programs, we can ensure that the benefits of cleaner buildings extend to those who need them most, mitigating existing disparities in living conditions and health outcomes. Equity, in this context, is the distribution of information, financial assistance, and other resources based on the specific needs of an individual, family, or community. This approach to equitable climate action includes actively seeking direction from, prioritizing investment in, reducing stressors and preventing new stressors to, and shifting power to historically disadvantaged groups or populations. Building decarbonization has the potential to offer enormous health benefits to the community and individual households, reduce energy costs, and increase the comfort and resilience of homes, yet there are still many equity concerns that need to be considered while developing policies and programs.

Defining Underserved Communities

Through the Existing Building Decarbonization Roadmap, words such as "underserved", "disadvantaged" and "vulnerable" may be used. These phrases can refer to a wide range of Truckee community members depending on the context but usually refer to those who may not have as many resources or are less able to participate in local decision-making processes. These community members may also face additional barriers in accessing information about or participating in building decarbonization programs, which should be taken into consideration.

For example, there are many community members within Truckee that may be vulnerable to potential disproportionate negative impacts caused by building decarbonization such as increased housing costs, increased energy costs, displacement, and more. These may include, but are not limited to, mobile-home owners, low-income renters/homeowners, non-English speakers, seniors, households with small children, people with disabilities or serious medical conditions, fixed-income seniors and others whose health and safety need to be prioritized when planning the transition to decarbonization.

The Equity and Wellness Institute recently conducted an assessment for the Town of Truckee on environmental justice, meaning equitable access to a clean and healthy

environment and to be able to participate meaningfully in the community.[32] It was found that although Truckee does not seem to be experiencing significant issues related to environmental justice, some improvements could be made to reduce physical and economic barriers for people who face inequities. However, special care must be taken to ensure that as the Town moves forward with developing and implementing building decarbonization measures, vulnerable community members are equally able to participate and receive the benefits of these initiatives and are not negatively impacted. Below are the key equity considerations specific to building decarbonization and how they may be best approached to ensure an equitable and environmental justice focused future.

Key Equity Considerations and Approach

While building decarbonization has the possibility of bringing many benefits to the Truckee community, policy and program implementation could impact community members differently. This section will explore the key equity considerations in Truckee related to building decarbonization policies and programs. The goal is to ensure that all Truckee community members can share in the benefits of building decarbonization without exacerbating existing burdens that underserved Truckee community members may experience, especially those who may be the most vulnerable to the impacts of climate change.

Health Impacts

As climate change accelerates, the health impacts associated with it become increasingly evident, disproportionately affecting vulnerable communities. Those who are most vulnerable to the effects of climate change include lower-income residents, people who work or live outdoors, infants and older adults, and people with existing health conditions such as asthma, emphysema, and heart disease, and people experiencing mental health challenges and isolation. Building decarbonization can provide solutions to help address these issues, but underserved communities may need additional support and resources to be able to participate in programs.

Smoke from wildfires is the most serious climate-related threat to health in the Truckee region. Wildfire smoke contains harmful substances such as carbon monoxide and particulate matter (PM 2.5), which can enter deep into the lungs and cause heart attacks, strokes, cancer, and more. Climate Ready Truckee, the Town's adaptation and resilience plan, highlights the importance of protecting the community from this health hazard. Lower-income residents without access to HVAC systems that filter the air, those who work or may live outdoors, and those with existing respiratory illnesses are some of the most vulnerable to these impacts.

[32] Town of Truckee, Ecological Society of America, & National Resource Defense Council. (n.d.). *Town of Truckee Environmental Justice Analysis +Executive Summary*. https://mccmeetingspublic.blob.core.usgovcloudapi.net/truckeeca-meet-d5d49ebccbbd4a73a7c6367fc05e7887/ITEM-Attachment-001-a7a2dd94ef174c4ea3f38072477ee8d2.pdf

Lower-income households in Truckee are more likely to live in older homes that are not properly air-sealed and unlikely to have air conditioning or other mechanical cooling systems. Without properly insulated buildings, cooling systems, or air filtration, these residents must rely on natural ventilation to stay cool during summer, even if wildfire smoke makes air quality unhealthy. Building decarbonization measures such as weatherization and air-sealing or installation of heat pumps with air filtration can help mitigate the infiltration of wildfire smoke into homes, which will become more of a public health threat as climate change makes wildfires more frequent and severe.

Installation of heat pumps to replace gas furnaces has the added benefit of providing summer cooling to households, increasing household resilience to extreme heat. Extreme heat is the most dangerous natural hazard in the U.S. in terms of health impacts, and while Truckee currently only has 3-5 extreme heat days per year, they are expected to be up to 10 times more frequent by mid-century (2035-2065). Those who are most affected include older adults, infants, people working and living outdoors, and lower income residents, particularly those without air conditioning. Building decarbonization programs that weatherize homes and add cooling will improve community resilience to heat impacts, particularly for these highly vulnerable groups.

For this reason, it is important that vulnerable community members have access to information about the health impacts of wildfire smoke and extreme heat, can properly air seal and weatherize their homes, install heat pumps to cool homes when it is too hot or unsafe to rely on natural ventilation, and have access to air filtration systems. Underserved community members will need sufficient financial support and technical assistance to implement these building decarbonization measures, as well as culturally appropriate outreach materials.

Building electrification has additional benefits for indoor quality, as gas appliances are a major source of indoor air pollution. Gas stoves emit several kinds of dangerous pollutants, such as benzene, a known carcinogen. Even with a ventilation hood running while cooking, benzene levels never reach a safe level and can linger in a home, including bedrooms, for hours.[33] The pollution emitted from gas stoves causes almost 13% of all childhood asthma in the United States. People with respiratory issues such as asthma, or those who are prone to developing new conditions such as infants, children, and older individuals, are the most susceptible to the negative consequences of gas appliances inside of a home.

Many underserved community members are more likely to have underlying health conditions that make them more vulnerable to the health impacts of indoor air pollutants from gas stoves. This problem is exacerbated by the fact that underserved

[33] Wesseler, S., & Wesseler, S. (2024, December 3). *Gas stoves are even worse for our health than previously known, new study finds*. Yale Climate Connections. https://yaleclimateconnections.org/2023/06/gas-stoves-even-worse-for-health-than-previously-known/

community members face additional barriers to electrification of gas equipment in their homes.s Lower-income households may not be able to afford the upfront cost of electrifying gas stoves or other equipment, even if it will be largely reimbursed by rebates, and renters may not have the authority to change out major appliances. For these reasons it is important to not only ensure there is ample financial and technical support for underserved community members, but that there are also incentives and renter protections available as well to make it easier to switch from toxin-emitting gas appliances.

Power Outages

Disruptions in electricity can pose a danger to Truckee residents due to loss of key building systems such as heating, cooling, and air filtration. The loss of these systems can be especially dangerous for older residents, children, and those with respiratory issues. For residents who rely on electricity for equipment that addresses critical medical needs, power outages pose an immediate and serious threat to their life and health. As power outages are expected to become more frequent and severe in both summer and winter, it will become increasingly important for the Town to address these challenges, particularly for its most vulnerable residents.

Lower-income households are particularly vulnerable to the impacts of power outages, as they are more likely to live in older homes that may not be well-maintained or properly weatherized. These homes may lack adequate insulation or air sealing, making it especially difficult to stay warm during winter outages. They are also significantly less likely to have air conditioning or other mechanical cooling systems. Without cooling systems and air filtration, these residents must rely on natural ventilation during summer outages, even if wildfire smoke makes air quality unhealthy. Prolonged power outages can also lead to food spoilage, endangering health and creating another financial burden for families already struggling. Lower-income households are also less likely to be able to afford generators or other backup power solutions to address these challenges.

These risks are not unique to buildings with electric equipment, as most gas equipment does not function in a power outage without backup power. They are also not unique to underserved communities in Truckee, though these households are more vulnerable. Building decarbonization programs can be designed to incorporate energy resilience measures such as weatherization and battery backup systems to assist underserved residents in addressing key vulnerabilities from power outages. Instead of seeing electrification as a threat to safety, we can instead see it as an opportunity to make existing infrastructure resilient while prioritizing the needs of our most vulnerable community members.

It is also important to recognize that not all impacts of outages can be addressed through building decarbonization programs. Extended outages can also result in business closures and loss of work, putting community members at risk of losing valuable wages when they are already financially vulnerable. Additional supportive

programs may be needed outside of the scope of this Roadmap to fully address the impacts of power outages on Truckee's underserved community members.

Energy Burden and Utility Costs

The impact of building decarbonization measures on energy costs must be considered to ensure that decarbonizing buildings is an equitable process, especially for households that are already energy burdened. Energy costs are already unaffordable for many lower-income households in Truckee, as detailed in the Existing Conditions Assessment section of this Roadmap. Truckee households making up to 60% of area median have a high energy burden by U.S. Department of Energy standards, meaning they spend more than 6% of household income on energy costs. Truckee's lowest-income households (income of 30% AMI or below) have a severe energy burden, spending a staggering 29% of their income on average just to pay their energy bills. This means that 9% of Truckee households are spending nearly a third of their income on their energy bills.

There are many reasons lower-income households may disproportionately face such a high energy burden, including being more likely to live in older buildings with poor insulation or inefficient appliances. Building decarbonization programs can be designed to address these issues through weatherization and efficiency upgrades, improving the building envelope and replacing older, less efficient appliances. Ensuring that Truckee's lowest-income residents are prioritized for these types of upgrades will ensure they can benefit from lower energy bills, improved home comfort, and be more resilient to temperature extremes.

While weatherization and other efficiency measures will reduce energy costs, this is not always the case with electrification measures. Gas rates in California are often lower than electricity rates on a cost per-unit energy basis, particularly in investor-owned utility territory, meaning switching to electric appliances can increase overall energy bills.[34] This highlights the importance of prioritizing efficiency throughout the building decarbonization process, including packaging electrification with complementary weatherization and efficiency measures and ensuring use of high-efficiency electric appliances rather than less efficient electric resistance ones. For example, heat pumps are generally 2-4 times more efficient than gas furnaces on a per-unit energy bases, so they can reduce overall building energy use, particularly when packaged with other efficiency measures.

While heat pumps can provide an important source of resilience to households by providing air conditioning during summer heat, adding cooling capacity to homes that previously only used natural ventilation may increase overall household energy use and therefore increase energy costs. As with any building decarbonization program, it will be important to assess likely impacts on future utility costs and

[34] California Air Resources Board. (December 2022). Final 2022 Scoping Plan, Appendix F: Building Decarbonization. https://ww2.arb.ca.gov/our-work/programs/ab-32-climate-change-scoping-plan/2022-scoping-plan-documents.

ensure participating households are educated on these impacts, particularly households with already high energy burdens.

Despite the potential for electrification to increase energy costs in the near term, there is a risk of even higher energy cost increases for households that do not electrify. Even though California's extensive fossil fuel networks make gas inexpensive for now, as the state's infrastructure becomes more electric, gas pipelines will be decommissioned.[35] As more pipelines are decommissioned, fewer and fewer customers will be left to bear the financial burden of maintaining this infrastructure. According to the California Energy Commission, those left on these few functioning gas lines could have gas bills of over $600 a month by 2050. The people who are most likely to bear this burden are disadvantaged community members who have little control or cannot afford to make this transition such as renters, low-income residents, and fixed-income seniors, who can afford these gas price increases the least.[36]

California's shift toward an electrified future and the growing impact of climate change on utility bills will make electrification the most economic choice in the long term. However, significant support for low-income households and renters will be essential to prevent inequitable increases in energy costs. Any increase in energy costs can be devastating for households that are already severely energy burdened, leaving households at risk of displacement.

Housing Scarcity, Cost, and Displacement Risk

Housing for the local workforce within Truckee can be difficult to find, and even more difficult to afford. The large numbers of homes used as vacation homes or short-term rentals creates a housing market that caters to those who do not necessarily work or live full-time in the area. As second homes outnumber primary residences in Truckee, housing prices are not strongly linked to local wages or cost-of-living for residents.

Truckee's high vacancy rate does not reflect the actual percentage of homes available for local residents to rent or buy. Truckee's estimated vacancy rate of 52-54% is substantially higher than the 4-6% considered "normal" for most communities. However, after accounting for the number of second homes used for seasonal, occasional use, or short-term rental and not available for sale or long-term rental, a more realistic assessment of Truckee's vacancy rate is 2-3%. From 2010 to 2017, the number of occupied housing units decreased and the number of vacant units, particularly seasonal units, increased significantly. This means that even though there are many "vacant" residences, housing is scarce, competitive, and expensive for those trying to live in Truckee long-term. Home sales prices are out of reach for most local residents, due to a housing market driven primarily by investment and vacation

[35] California Air Resources Board. (2022). *California Air Resources Board 2022 Scoping Plan November 2022*. https://ww2.arb.ca.gov/sites/default/files/2022-11/2022-sp-appendix-f-building-decarbonization.pdf

[36] Perez, C. M. a. E. (n.d.). *Charting California's gas infrastructure transition*. https://blog.advancedenergyunited.org/charting-californias-gas-infrastructure-transition

properties. The median home sale price in Truckee was approximately $490,000 in 2013, and is now well over $1,000,000 as of 2024, more than doubling in those 12 years. This is over twice what is considered affordable for the median household income in Truckee.

A large share of households across all income levels are housing cost burdened, meaning their housing costs are at least 30% of their total income, with nearly all households making under $50,000 a year exceeding this threshold. Truckee households that are housing cost burdened are at much higher risk of displacement from even modest cost increases. Displacement in this context is when tenants must involuntarily leave the property where they are living. This can be due to several factors such as being unable to afford rent or mortgage, being evicted, or the residence being torn down.[37] When the local workforce cannot find housing they can afford within Truckee, they must resort to other locations such as Reno. This can lead to increased traffic, increased greenhouse gas emissions, or a workforce that will seek work in other more accessible locations. This in turn creates a strain on local businesses, who may struggle to find enough staff.

While comprehensive building decarbonization programs can provide numerous benefits to households in older housing by reducing energy bills, addressing critical repairs, and improving home safety and comfort, they also have the potential to put renters at risk of increased housing costs and displacement in a market that is already highly competitive and unaffordable for many in the community. Lower-income households in Truckee are also more likely to be renters, making them more likely to face the "split incentive" problem that can discourage efficiency upgrades in renter-occupied housing. There are few incentives for landlords to conduct energy efficiency improvements on their property because the landlord would need to invest in the cost of upgrades, but tenants would receive the benefit of lower utility bills.

To address this disparity, the Town can ensure that building decarbonization programs include solutions to address the split incentive problem so that renter households can share in the benefits of decarbonization upgrades. This includes no-cost, income-qualified upgrade programs like the Truckee Weatherization Program that allow renters to participate with landlord approval, as well as strategies like on-bill financing. [38] On-bill financing allows upgrades to be financed with no upfront cost and paid back over time on utility bills without increasing total cost to tenants, eliminating the cost to landlords and providing tenants with modest near-term utility cost savings and larger reductions in their energy costs over time.

Without strategies to address the split incentive issue or cover the cost of critical repairs, there is also the risk that landlords may raise rent to recover the cost of upgrades. As Truckee's renters are disproportionately lower-income, even small

[37] *What is Displacement? | Community and Neighborhoods*. (n.d.). Community and Neighborhoods. https://www.slc.gov/can/what-is-displacement/

[38] *On-Bill financing and repayment programs*. (n.d.). Energy.gov. https://www.energy.gov/scep/slsc/bill-financing-and-repayment-programs

increases in housing costs can lead to displacement. Tenants may be hesitant to advocate for energy efficiency improvements, even though it can decrease utility bills and increase comfort or even addressing critical health and safety repairs out of concern their rent may increase due to the renovations. If an older home is in dire need of repairs, tenants may be "temporarily" forced to relocate, leaving them displaced and with few options. This is known as "renoviction" where landlords use renovations to evict tenants to raise rent prices.[39] The Town can explore options for renter protections that can be included in building decarbonization programs, to ensure that they do not increase housing costs or lead to displacement.

Financial and housing instability is also expected to increase over time due to climate change related maintenance and damage, as well as increasing severity of climate-driven hazards such as wildfire. Climate impacts will likely increase utility and insurance costs, and insurance may become difficult to obtain altogether, something that is already a challenge in Truckee. This can lead to a devastating situation for low-income households that are least able to absorb these additional cost increases. Properly designed building decarbonization programs can create a strong and updated housing stock, but if underserved community members are left out of this process, it could leave already weakened buildings and their occupants even more vulnerable to climate change impacts. If building decarbonization policies and programs prioritize Truckee's most vulnerable communities, the transition to more energy efficient buildings can both mitigate the amount of greenhouse gas emissions that are contributing to climate change and extreme weather patterns, and help residents adapt to these changes with safer, more efficient, and more resilient homes.

Cost of Decarbonization: Money and Time

There are several existing incentive programs available for building decarbonization measures, but they can often be inaccessible to households due to the money, time, and knowledge needed to utilize them. For example, traditional rebates require an applicant to pay the upfront costs for renovations and wait for reimbursement. This can be an impossible ask for any household, but especially so for low-income households that do not have hundreds or thousands of dollars available to cover these costs while they wait for reimbursement.[40] Tax credits are another kind of inequitable incentive that disproportionately benefits those with higher incomes. If a household doesn't have enough tax liability, then they cannot take advantage of the tax incentive. For this reason, having more accessible types of programs, such as point-of-sale rebates where the discount is applied at the time of purchase, low- or no-cost direct install programs for income-qualified residents, and more funding for critical repairs can ensure that these programs are not only accessible to those who already have enough money to pursue building decarbonization upgrades.

[39] California Air Resources Board. (2022). *California Air Resources Board 2022 Scoping Plan November 2022*. https://ww2.arb.ca.gov/sites/default/files/2022-11/2022-sp-appendix-f-building-decarbonization.pdf

[40] California Air Resources Board. (2022).

Another often overlooked barrier to participation in energy upgrade programs is the time and knowledge required to utilize them. For example, many types of incentive programs require applicants to independently find and hire qualified contractors to perform the upgrades. This process can be particularly challenging for households that lack the time, resources, or expertise to navigate the contractor selection and retrofit process on their own. Many under-resourced residents may not have the privilege of excess spare time due to working longer hours, handling personal medical issues, caring for children, relying on forms of transit that take longer than having a personal car, and more. To address this barrier, the Town can provide technical assistance to support residents in navigating the process. Direct installation programs for low-income households are an even more comprehensive way to support under-resourced residents with building decarbonization measures, as they handle all parts of the process at no or little cost to residents.

Lower-income households, including both homeowners and renters, are more likely to live in "naturally" affordable housing. Unlike income-restricted housing that is monitored by government entities and must be maintained to a certain standard, this naturally affordable housing is generally cheaper because it needs repairs, weatherization improvements, equipment replacement, or other upgrades. In addition to contributing to high energy bills, this creates additional barriers to implementing building decarbonization measures.

Even no-cost direct installation programs that provide free upgrades to low- or moderate-income households can face barriers due to the need for repairs outside the scope of the program. Older housing often has health and safety concerns such as deferred maintenance, outdated wiring and electrical systems, water damage or mold, or pre-existing hazards like asbestos or lead paint that need to be addressed before building decarbonization measures can be implemented. Often, these measures are not included in building decarbonization programs. Even when they are included, costs for critical health and safety repairs often exceed allowable limits for income-restricted programs such as utility or federal programs that provide no-cost weatherization assistance. As a result, many of the lowest-income households in the Truckee area are unable to receive the benefits of these upgrades, even though they may need them the most.

Costs outside of the program scope are common barrier in no-cost direct installation programs that target low- and moderate-income households. A program in Marin County offering free home energy upgrades, including heat pumps for both space and water heating found that many prospective participants were unable to participate because heat pump installation would require repairs or other upgrades (electrical panel replacement, etc.) that the homeowners could not afford.[41] To properly implement decarbonization measures, homes need sufficient electrical capacity, adequate ventilation, and critical repairs. Essentially, the lack of coverage

[41] Franklin Energy. (August 14, 2024). *Addressing Home Repair Barriers in Marin Clean Energy's Home Energy Savings Program.* https://apppack-app-tpr-prod-privates3bucket-tvt5lpzx0gqm.s3.amazonaws.com/documents/Franklin_Energy_-_Final_Report_v240813.pdf

for these additional upgrades created a cost barrier to participation in a "no-cost" program. This is why a "whole building approach" to building decarbonization is important, where health and habitability improvements are included to make the renovation process as efficient as possible.[42]

Because lower-income households are more likely to live in housing with deferred maintenance and need additional upgrade work to prepare for decarbonization measures, they can be unintentionally excluded from these programs if the measures and costs are not covered. Ensuring that decarbonization programs consider the full cost of participation is necessary to address this barrier. This has been cited by California's TECH Quick Start program as a critical component of equitable building decarbonization program design.[43]

Equity Principles

To address these key equity considerations, the Town has developed the following set of Equity Principles to guide the Town's building decarbonization strategy. These are principles that each policy and program is assessed against to try to ensure the most equitable outcome for the Truckee community possible.

Climate Resilience and Energy Reliability: Truckee's location and climate make it more at risk of losing power, including planned and emergency grid de-energization during high wildfire risk and unexpected power outages during snowstorms. It is crucial to ensure that all community members, particularly those who are most vulnerable, have access to safe temperatures, clean air, and critical medical equipment. This includes improving backup power solutions to safeguard health and well-being during the power disruptions caused by natural events.

Financial Support and Health Benefits: Building decarbonization retrofits can be unaffordable for many Truckee residents, especially marginalized groups, and incentive programs may not be accessible to already under-resourced residents. Adequate and appropriately structured financial support will be needed to be provided to ensure that no community members are left out from experiencing the health, safety, and comfort benefits that come from these improvements.

Economic Benefits: Due to Truckee's more rural location, access to high quality job opportunities can be limited. It is important to ensure that building decarbonization brings highroad job opportunities. This includes accessible training programs so that the Truckee workforce is adequately prepared to experience the benefits from this future transition, and well-trained to implement climate-appropriate weatherization, efficiency, and electrification measures.

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[42] California Air Resources Board. (2022). *California Air Resources Board 2022 Scoping Plan November 2022*. https://ww2.arb.ca.gov/sites/default/files/2022-11/2022-sp-appendix-f-building-decarbonization.pdf

[43] Franklin Energy. (August 14, 2024). *Addressing Home Repair Barriers in Marin Clean Energy's Home Energy Savings Program.* https://apppack-app-tpr-prod-privates3bucket-tvt5lpzx0gqm.s3.amazonaws.com/documents/Franklin_Energy_-_Final_Report_v240813.pdf

Comprehensive and High-Quality Support: It is crucial to ensure that incentives and programs for the community provide not only financial, but also technical support to renters, owners, and disadvantaged community members to minimize the burdens and impacts that can be associated with the installation of weatherization improvements and high-quality electric equipment.

Housing Affordability and Anti-Displacement: Truckee already faces challenges with housing availability and affordability, which is why it is critical to ensure building decarbonization programs do not displace renters or over-burden homeowners. Instead, programs should support housing production, preservation, affordability, and tenant protections.

Equitable Community Engagement

The IDEA program is the foundation of equity at the Town of Truckee and stands for inclusion, diversity, equity, and accessibility. The purpose behind these four principles is to ensure that Truckee community members are included, represented, and have the resources they need to participate fully in events and decision-making processes.

The IDEA program is meant to ensure that information shared by the Town is accessible and that community members are engaged in the way that works best for them, as policies and programs are only as effective as the quality of community engagement that is conducted to create them. Building decarbonization can be a complicated policy field that intersects with housing affordability, energy consumption, workforce development, and more. This is why before and throughout the process of developing and implementing programs and policy, community engagement should be prioritized to assess community knowledge and needs, understand concerns and barriers, and to solicit meaningful input for program design. Thinking about how to reach different members of the community will be crucial when understanding what policy and program solutions will work best to both improve community health and reduce greenhouse gas emissions.

While no engagement strategy is perfect, a combination of different strategies can increase the likelihood that the different voices and perspectives of the Truckee community are heard. Drawing upon the IDEA framework, which is still in development at the time this Roadmap was written, the goals for equitable engagement for the building decarbonization roadmap are:

- **Have a wide range of community engagement methods** to ensure that diverse segments of Truckee's community are reached. This means not only relying on traditional methods such as online engagement, flyers, and tabling events, but holding listening sessions and other events that community members request to see.
- **Work with community-based partners and organizations**, such as Sierra Community House and the Promotoras, Hispanic outreach workers, to gain better insight into how to best interact and build trust with the community.

- **Provide materials in English and Spanish at the same time.** While the predominant language spoken in Truckee is English, there is still a sizeable Spanish speaking population. It is crucial to translate all engagement material and to distribute this material at the same time as collateral in English to demonstrate that the Spanish community holds that same priority to the Town as English speakers. If resources for the community are needed in a language other than English and Spanish, the Town can provide those services.
- **Provide culturally appropriate material.** This not only includes translating materials but crafting culturally appropriate messaging so that all members of the Truckee community are able to relate to the programs and policies that are developed and implemented.
- **Work directly with community members, especially those from underrepresented groups**, to understand their perspective and adequately compensate those who provide invaluable insight, expertise, and wisdom when possible.
- **Have an adaptable outreach strategy.** Having a perfect outreach strategy is unrealistic, but constantly improving one is not. For this reason, receiving feedback and having an adaptable engagement strategy can help to ensure that communication caters to all Truckee community members as priorities change.

With building decarbonization, creativity is key. Traditional methods of interacting with the community may not be effective due to the complexity of building decarbonization, thus it will be necessary to think outside of the box and be open to understanding how the community would like to be engaged with. By following the goals listed above, the Truckee community will not only be able to participate fully in the transition to building decarbonization but lead it.

Strategy Roadmap

This section outlines the Strategy Roadmap for decarbonization of existing residential and commercial buildings in Truckee. It identifies the types of measures that are recommended for consideration by the Town Council and provides a brief overview of the various policy and program criteria that can be considered if and when the Town Council does direct staff to begin work on that measure. This Roadmap does not propose specific program or policy criteria at this stage, with the exception of the few measures that the Town Council has already provided direction on. Determining those criteria is in many cases a substantial effort that will require extensive research, community and stakeholder input, and direction from the Town Council.

The measures included in this Roadmap are based on the analysis in the Existing Conditions Assessment section of this document, results of community and stakeholder engagement, and the equity considerations outlined in the previous

section. Based on the Existing Conditions Assessment, these are the highest priorities in terms of GHG emissions reduction:

- Single-family homes, which comprise over 90% of Truckee's total building stock, house the majority of Truckee homeowners and renters, and are responsible for the majority of energy-related GHG emissions
- Residential space heating, which is the largest single contributor to GHG emissions from energy use, particularly from primary homes
- Smaller commercial buildings, using flexible strategies to address the wide variety of energy end uses

While these priority areas are the focus of the Roadmap, the full range of measures takes into account the need for more specialized programs to address the needs of all members of the Truckee community. The goal is to create an equitable approach to decarbonization and ensure that all community members can share in the benefits of these programs.

This Roadmap is intended to be an evolving document that is updated periodically as the Town conducts GHG emissions inventories and updates the Climate Action Plan. Two of the measures included in this Roadmap – the Equitable Funding Strategy and the Energy Resilience Plan – are expected to identify additional measures recommended for implementation. Additional updates may be needed due to changes in state policy or programs, new technologies, or other factors.

The Town of Truckee is still in a very early adoption phase for many building decarbonization measures, particularly electrification, and short-term efforts will need to focus on building local confidence in decarbonization among residents, businesses, and contractors. While this can be accomplished to some degree through education and training, particularly around cold-climate decarbonization technologies, significant progress on electrification of key building systems is unlikely to happen without resilience measures to address power outages.

Based on community and stakeholder input, the Roadmap proposes a strategy centered around encouraging and supporting voluntary adoption of decarbonization measures to the greatest extent feasible. This includes improved climate action and resilience planning, enhanced education and engagement initiatives, incentives and financing strategies, upgrade programs, and policy and regulation measures as needed to achieve the Town's adopted climate action goals. In most cases, the Roadmap focuses on voluntary measures and incentives in the short- and mid-term. The goal is to address barriers to decarbonization and provide residents and businesses the support they need to implement efficiency and electrification measures in a way that best suits their individual needs.

Long-term measures include a small number of regulatory strategies that can be considered if voluntary measures alone are unable to achieve the Town's building decarbonization and climate action goals. These are included as an example of the Town's options for a regulatory approach if needed in the future but are not

recommended as a primary strategy for achieving the Town's goals due to the factors explained in the descriptions of each measure. Other possible regulatory approaches are not included in this Roadmap at all because they require a heavy-handed and strict approach to enforcement that is not considered practical, locally appropriate, or consistent with the Town's general approach to achieving sustainability goals. Additional long-term measures are expected to be added as the Roadmap is revised and updated periodically.

Roadmap Measures

Each measure included in the Roadmap is assessed on the following four categories:

Timeframe: Recommended actions are categorized into approximate timeframes for potential implementation:

- **Short-term** (1-4 years):
- **Mid-term** (5-10 years):
- **Long-term** (10+ years):

The recommended timeframe is based in part on the overall strategy described above as well as consideration of staff time and other resources needed to support each initiative. Some of the constraints on short-term measures are whether or not significant additional staff capacity would be needed, the need to develop new regulatory frameworks or control points, or other practical constraints that limit the Town's ability to implement a measure within the next few years.

Building Type: This indicates which type(s) of buildings a particular measure would apply to, using the following three categories:

- **SF**: Single-Family Residential, including both detached single-family homes and attached single-family homes like townhomes.
- **MF**: Multi-Family Residential, including apartment buildings and condos.
- **NR**: Non-Residential, including commercial buildings.

Staff Time: Estimated staff time required for each potential measure is provided as a rough order of magnitude for initial planning purposes; more specific estimates of the staff time needs for each measure will be assessed when additional program details are developed if and when items are added to the Council Priorities Workplan. Staff time is assessed as **Low**, **Moderate**, or **High** for each measure based on the following approximate ranges of staff time measured in full-time equivalent (FTE):

- **Low** (<0.1 FTE)
- **Moderate** (0.1-0.5 FTE)
- **High** (>0.5 FTE)

This staff time level represents the estimated average Town staff capacity required to support a given measure after taking into account use of consultants. This includes all phases of development and implementation throughout the lifetime of the

measure. For policies and regulations, these estimated staff time needs will extend on an ongoing basis as long as the policy is in effect to support implementation and enforcement. While measures with **Low** or **Moderate** staff time needs may be individually feasible with current staffing levels, collectively measures may exceed total available staff capacity for building decarbonization programs. All measures with **High** staff time needs exceed current available staff capacity available for building decarbonization.

Cost: Assessed as **Low**, **Moderate**, or **High**. More detailed estimates of the cost for each measure will be assessed if and when they are added to the Council Priorities Workplan. The cost assessment does not consider grant funding or other external funding sources, which could lower the cost to the Town.

Climate Action & Resilience Planning

Update GHG and Energy Goals

Timeframe	Building Type	Staff Time	Cost
Short-term	SF, MF, NR	Low	Low

Update the Town's adopted GHG emissions reduction and renewable energy goals.

The Town Council adopted Resolution 2017-58 in November 2017, establishing community-wide GHG emissions reduction targets and renewable energy goals for the community and municipal facilities. This included the following renewable energy goals:

- 100% renewable electricity for municipal facilities by 2020
- 100% renewable electricity Town-wide by 2030
- 100% renewable energy Town-wide by 2050

Updating the Town's renewable energy goals is important to better align the Town with statewide building decarbonization strategy and to guide local priorities for adoption of renewable and zero-carbon energy sources. In 2020, the Town Council determined not to move forward with a solar PV installation project that would have supported the Town's 100% renewable electricity for municipal facilities goal, determining that other GHG reduction measures would be more cost effective. Therefore, the 2020 target was not achieved. The goal update process will provide an opportunity to revise or replace this 2020 goal. In addition, the Town can adopt a carbon neutrality target to bring it into alignment with both the state's goal of carbon neutrality by 2045 and the mission of the Climate Transformation Alliance, of which the Town is a founding member.

This item is included in the current Council Priorities Workplan and is expected to be complete in FY 24-25.

Building Decarbonization Targets and Emissions Scenarios

Timeframe	Building Type	Staff Time	Cost
Short-term	SF, MF, NR	Low	Low

Develop specific targets for building decarbonization and integrate these into future climate action plan updates. (CAP-7.A)

The Town's adopted Climate Action Plan included targets for community-wide energy efficiency and renewable energy, including reducing energy consumption by 20% in existing residential buildings and 15% in existing non-residential buildings by 2030. As outlined in action CAP-7.A, the Town should establish additional energy consumption targets for 2035 and 2040 to guide program development. Progress towards these goals can be assessed as part of community-wide GHG inventories.

In addition, the CAP updates should re-evaluate renewable energy goals to include specific targets for electrification. The original CAP relied heavily on use of RNG to meet building decarbonization and overall GHG emissions reduction goals, which is not currently considered a realistic or feasible strategy. Future CAP updates can utilize climate planning tools to run emissions scenarios and set specific targets for building decarbonization metrics such as energy efficiency, electrification, and renewable electricity that will achieve the Town's adopted GHG emissions reduction goals without relying on RNG. This would provide Town staff with a framework to guide building decarbonization program development and more accurately assess progress towards adopted goals.

Energy Resilience Plan

Timeframe	Building Type	Staff Time	Cost
Short-term	SF, MF, NR	Low	Moderate

Develop an energy resilience plan to identify actionable programs and policies that the Town can implement to improve community resilience to grid outages, support building decarbonization measures, catalyze broader electrification of local buildings, and reduce reliance on GHG-intensive backup power sources like diesel generators.

Energy resilience is a critical component of Truckee's emergency preparedness and climate adaptation strategy. Due to its location and climate, Truckee is at high risk of experiencing electricity outages during both the wildfire season and from winter storms. As climate change increases the frequency and severity of fires, storms, and other local hazards, the Truckee community will inevitably experience more frequent and severe outage events as well. An energy resilience plan would support the Town in determining the combination of strategies at the community level, building level, and household level that can best support the Truckee community through various outage scenarios based on scale, duration, season, and other factors.

Power outages have been identified by the local community as the biggest barrier (both real and perceived) to building electrification in the region, and a significant threat to the health and safety of the community, particularly in Truckee's cold winters. At the same time, traditional energy resilience strategies such as solar PV with integrated batter storage are more difficult to deploy locally due to snow load

and dense tree cover. This has contributed to community reluctance to move away from natural gas or propane appliances and a heavy reliance on backup power from diesel generators, which contributes to both GHG emissions and air pollution. Developing comprehensive energy resilience strategies will therefore be a key part of supporting building decarbonization and meeting Truckee's climate action goals.

Education & Engagement

Workforce Education & Training Program

Timeframe	Building Type	Staff Time	Cost
Short-term	SF, MF, NR	Low	Moderate

In collaboration with local and regional partners, support and expand local training and workshops for energy efficiency and electrification upgrades. (CAP-8.D)

One of the primary impediments to local building decarbonization in the Truckee-Tahoe region is a shortage of contractors skilled in performing electrification upgrades, particularly those familiar with cold-climate heat pump technologies. To address this barrier to building decarbonization, the Town partnered with the Sierra Business Council to secure private funding for a pilot workforce education and training program aimed at accelerating building electrification in the Truckee-Tahoe region.

Launched in 2024, the custom program provided by Sierra Business Council through the regional Climate Transformation Alliance goes beyond general electrification training modules to delve into the unique challenges faced with installing heat pumps in the Truckee-Tahoe region. The pilot program was designed to meet the training needs of local contractors by offering a multimodal approach layered with (1) on-demand, online courses, (2) in-person, hands-on classes, and (3) on-call mentorship. The current program will end in Spring 2025, and the Town can explore options to extend this program beyond this date to continue supporting the local workforce.

Technical Assistance Program

Timeframe	Building Type	Staff Time	Cost
Short-term	SF, NR	Low	Low

Work with local and regional partners to continue and expand technical assistance for residents and small businesses interested in electrification upgrades.

The Go Electric Truckee Tahoe Program, operated by Sierra Business Council on behalf of the Climate Transformation Alliance, provides a free one-stop coaching service for home and building owners looking to upgrade to heat pumps for space or water heating. The program provides an online resource guide for property owners to navigate the decarbonization process, as well as personalized coaching services including contractor referrals, help navigating available funding options, and support completing an online home assessment to develop a personalized electrification roadmap.

The Go Electric Truckee Tahoe Program was originally part of a privately funded pilot program to support building decarbonization in the Truckee-Tahoe region. To ensure

this support remains available to Truckee residents and businesses, the Town can work with Sierra Business Council and Climate Transformation Alliance members to extend this valuable program.

Induction Cooking Workshop & Lending Program

Timeframe	Building Type	Staff Time	Cost
Short-term	SF, MF	Low	Low

Support expanded induction cooking workshops and a cooktop lending program to provide residents with the opportunity for hands-on experience with induction.

TDPUD launched a series of induction cooking workshops in 2024 as a pilot program. Keep Truckee Green supported this program by providing reusable foodware and reusable takeout containers through the Town's green box program. The pilot program was extremely popular, with reservations reaching capacity shortly after the program was announced. TDPUD plans to eventually make the portable cooktops available through a lending program to allow residents to try them at home for a period of time. The Town can continue to support TDPUD in expanding this workshop program and creating a lending program.

Given high resistance to electrification of cooking equipment in the local community, this type of hands-on educational program is a great opportunity to help local residents feel more comfortable with induction cooking and experience the benefits firsthand. Small, portable induction cooktops like those used in this program are a great way for people to start using induction cooking at home without having to immediately replace their gas range cooktop. Similar programs in other jurisdictions have been very successful in encouraging more widespread use of induction cooking.

Building Energy Use Reduction Education

Timeframe	Building Type	Staff Time	Cost
Short-term	SF, MF, NR	Low	Low

Develop an educational campaign to promote the benefits of energy efficiency and electrification. (CAP-7.J)

In partnership with local utilities and other regional partners, develop an educational campaign about the multiple benefits of reducing energy usage and conversion to electric space and water heating. This campaign can be integrated with outreach about individual decarbonization programs and incentives. A regional campaign could be developed by the Climate Transformation Alliance that could then be leveraged by local jurisdictions, utilities, and community organizations. Unified regional messaging about building decarbonization would be a valuable resource in supporting local programs and decarbonization goals.

Retrofit Incentive Information & Promotion

Timeframe	Building Type	Staff Time	Cost
Short-term	SF, MF, NR	Low	Moderate

Develop a user-friendly online platform for residents and business owners to navigate available building decarbonization incentives. (CAP-7.I)

There are a wide variety of ever-changing rebate and incentive programs available for building decarbonization measures, offered by utilities as well as local, state, and federal agencies. Many residents and business owners struggle to find information on the available incentives that can support upgrade projects and often look to Keep Truckee Green for guidance, even though the Town does not directly operate any rebate programs. Website pages about building decarbonization rebates and upgrades are among the most visited on KeepTruckeeGreen.org. However, it is a challenge for Town staff to stay up-to-date on current incentive offerings and keep the website updated, and many residents require more technical support in navigating these programs than Town staff are able to provide.

To address these challenges and better support residents in identifying available incentives and submitting applications, the Town can work with a consultant to develop an improved online platform for building decarbonization rebates. Ideally, this platform would allow residents to easily search for all available incentives by project and building type, as well as support the application process for incentives. Developing this platform will also help support the Town in offering its own building decarbonization incentives, beginning with the heat pump air conditioning incentive program.

Showcase Local Electrification Projects

Timeframe	Building Type	Staff Time	Cost
Mid-term	SF, NR	Low	Low

Develop an outreach campaign to highlight successful examples of electrification by Truckee residents and businesses.

Many local residents and businesses are skeptical about electrifying key building systems, particularly in Truckee's cold climate. Building confidence in building decarbonization measures, particularly electrification, will be a key part of the Town's approach in encouraging voluntary implementation of building decarbonization in the short- and mid-term. Peer-to-peer education and knowledge sharing can be an effective mechanism to build confidence in these measures, showcasing success stories from Truckee community members. Local residents and business owners can be a more trusted source for information than government agencies or utilities for many in the community and can help combat hearsay and myths about the feasibility of building decarbonization in the Truckee-Tahoe region.

Once there are sufficient examples of successful electrification projects, the Town could work with community partners to develop a plan to showcase select projects to catalyze interest in decarbonization throughout Truckee. The goal would be to create a forum for building owners to share their experience, highlight the benefits, and provide honest feedback on the pros and cons of electrification upgrades. This campaign could include social media collateral, case studies that can be highlighted on the Keep Truckee Green website, in-person talks or workshops, or other methods as determined by Town staff and community partners.

Incentives & Financing

Heat Pump Air Conditioning Incentives

Timeframe	Building Type	Staff Time	Cost
Short-term	SF	Moderate	Moderate

Develop a residential incentive program to encourage installation of heat pumps instead of traditional air conditioning units.

Assess local incremental costs for heat pump air conditioning compared to traditional air conditioner units and propose an incentive program that will fully offset incremental costs for similarly-sized units, incentivize upsizing of heat pump air conditioners to cover a larger share of the heating load, and incentivize full heating system electrification. Include all related incremental costs including potential panel upgrades and control systems. Assess gaps in existing utility, state, and federal incentive programs and determine where the Town could best supplement these programs with additional incentive funds.

The Town Council directed staff to develop this incentive program on December 10, 2024, and an RFP for consultant support was issued in early 2025. This program will also have moderate staff time needs to support both development and implementation phases of the rebate program. This program may require consultant support to operate due to the staff time requirements exceeding existing capacity.

Increase Local Contractor Enrollment in State Rebate Programs

Timeframe	Building Type	Staff Time	Cost
Short-term	SF, MF	Low	Low

Work with partners such as Sierra Business Council and the Contractors Association of Truckee Tahoe to support local contractor enrollment in state rebate programs such as TECH Clean California program.

The state of California has developed several building decarbonization rebates for single-family and multifamily residential buildings that can offset a substantial portion of the cost of installation of heat pumps. However, these rebates are only available through contractors that are enrolled in the TECH program, which can create a substantial barrier for local residents to access to these rebates. Currently, there is only one local contractor enrolled in the TECH program.

In November 2024, California launched Phase I of the new HEEHRA incentive program funded by the federal Inflation Reduction Act, with rebates of up to $8,000 for electrification measures to income-qualified residents of single-family and multifamily buildings. To be eligible for this new program, contractors were required to be enrolled in the TECH program and complete additional HEEHRA-specific training. There are no contractors in the Truckee-Tahoe region who completed the supplemental HEEHRA training. In January 2025, the State announced that the Phase I HEEHRA single-family rebates were fully subscribed in the Northern California region that includes Truckee, meaning local residents likely missed out on this funding opportunity unless the program is re-funded at some point in the future. The

Town had discussed opportunities to support broader contractor enrollment with Sierra Business Council, who operates the Climate Transformation Alliance's contractor training program. Unfortunately, a solution could not be proposed in time to get contractors enrolled before Phase I was closed to new applications.

With these incentive programs filling up quickly, Truckee residents and contractors will likely continue to miss out on this funding without a concerted effort to increase contractor enrollment. While existing contractor training programs provided by the Climate Transformation Alliance have provided participants with information on these programs and directed them to the necessary training, this has not been successful in getting more contractors enrolled. Working with local partners, the Town can explore options to better incentivize local contractors to complete the free training provided through TECH Clean California. Options include enhanced outreach and education as well as stipends or financial incentives to offset the cost of lost labor due to time spent completing the training.

Equitable Funding Strategy

Timeframe	Building Type	Staff Time	Cost
Short-term	SF, MF, NR	Low	Moderate

Develop an equitable funding strategy to support implementation of decarbonization measures identified in this Roadmap.

The equitable funding strategy will assess the costs for implementation of building decarbonization measures, assess funding gaps between measure costs and existing incentive or assistance programs, and identify funding strategies to allow for equitable implementation of measures for existing residential and commercial buildings. Many types of existing incentive programs such as rebates or tax credits are not equitable, as they require property owners to be able to cover the full cost of any upgrades and wait to be reimbursed. Additionally, funding programs must address the split incentive problem in order to be implemented successfully in renter-occupied housing.

This would be a consultant-led project to support implementation of this Roadmap by identifying appropriate cold-climate technologies, providing an in-depth cost and funding gap analysis, and developing an equitable funding strategy for priority upgrade measures. Targeted community engagement with specific groups such as low-income households, mobile home residents, and renters will be a key part of development of this strategy. This measure is expected to identify additional financing and incentive programs that the Town can offer in addition to the specific measures identified in this Roadmap.

Building Decarbonization "Token" Program

Timeframe	Building Type	Staff Time	Cost
Short-term	SF	Moderate	Low

Leverage short-term rental "Tokens" as an incentive to encourage voluntary building decarbonization, particularly high-priority electrification measures.

The Town Council adopted regulations on short-term rentals (STRs) in 2022 that cap the number of registration certificates at 1,255. This has resulted in a waiting list of approximately a year for property owners interested in registering their property as an STR. The adopted STR ordinance gives Town Council the authority to either withhold a certain number of registration certificates under the cap to use as workforce housing incentives ("Tokens") prior to releasing available registration certificates to the waitlist, or to issue additional Tokens *above the cap* for this purpose. These Tokens allow property owners to bypass the waiting list and register their property as an STR as long as it meets all other STR program requirements. The Town has explored using these Tokens as an incentive in the Short-Term Rental Workforce Housing Token Pilot Program ("Token Program"), which was approved by Council in early 2022.

The Town can explore utilizing these Tokens as an incentive for building decarbonization in addition to workforce housing by designing a Building Decarbonization Token Program for Town Council consideration. This program would award an STR Token to homes that complete certain energy upgrades. Property owners could choose from a list of eligible measures, which can be weighted based on relative GHG emissions reduction potential. This is a similar approach to a Flexible Pathway reach code, though it would not be subject to the same regulations as it is a voluntary program. If the program proves popular, the criteria for receiving a Token can become stricter over time, which could also encourage earlier participation in this program.

While this type of program is unlikely to result in a high number of homes implementing electrification measures, it is a highly cost-effective approach for the Town, as short-term rental "Tokens" are a cost-free incentive. Staff anticipates a Building Decarbonization Token Program may result in higher participation levels than the original Token Program, because it does not require property owners to have two different properties to participate, as the Token could be used to convert the same home that has been upgraded to an STR. This measure can be developed in the short term with supplemental staff capacity from a CivicSpark Fellow or similar program.

Forgivable Loans for Rental Improvements

Timeframe	Building Type	Staff Time	Cost
Mid-term	SF, MF	Moderate	Moderate

Develop a forgivable loan program to support energy efficiency and/or electrification upgrades in rental housing in exchange for affordability protections.

The Town can develop an incentive program that offers forgivable loans to owners of long-term workforce rental housing to implement energy efficiency and electrification upgrades (as well as supporting critical repairs or upgrades) in exchange for some guarantee of keeping rents affordable for a period of time. Cities such as Seattle and Tacoma, WA, have implemented similar programs to support energy efficiency and electrification upgrades in rental housing, with terms of 3-5

years. The affordability guarantees help mitigate the risk of displacement for tenants of upgraded properties. The forgivable loans would function as a grant as long as the homeowners meet the conditions of the program over the agreed term. Homeowners could still opt out of the program at any time, though if they choose to do so, they would be responsible for paying back some or all of the loan.

This type of program could be integrated with or supplement the Town's existing workforce housing programs like Lease to Locals and Rooted Renters, which offer incentives for homeowners to provide long-term leases to income-qualified local workers. The Lease to Locals program provides financial incentives to homeowners who shift from short-term renting their home or not renting at all to offering long-term leases to locally employed tenants. The Rooted Renters program was created in response to community interest in a program to support homeowners who had already been leasing to the local workforce in continuing to offer long-term, affordable leases. These programs have a built-in mechanism to maintain affordable rents over a term of at least three years, which provides a blueprint for the forgivable loan program.

Given the high demand for the Rooted Renters program, which was fully subscribed shortly after launch, this program could offer another path to support homeowners in continuing to make their homes available as long-term rentals for the local workforce while also supporting building decarbonization and climate action goals. The forgivable loan program would provide an added benefit of supporting upgrades to improve comfort and reduce energy costs for tenants, as well as addressing deferred maintenance issues that may otherwise be recovered through increases in rent. This program could support homeowners whose tenants don't qualify for the no-cost upgrades provided by the Truckee Weatherization Program (up to 80% of AMI).

Commercial On-Bill Financing

Timeframe	Building Type	Staff Time	Cost
Mid-term	NR	Low	Moderate

Develop a program to provide on-bill financing for energy efficiency and electrification retrofits of commercial buildings in partnership with a local utility or other organization.

Commercial building decarbonization can be challenging due to the variation of equipment and uses, greater technical complexity, and higher capital cost of retrofit measures compared to single-family residential buildings. In tenant-occupied commercial buildings, building owners are generally responsible for capital improvement cost of building envelope measures and major equipment, but cannot recoup their investment through energy savings if utility costs are paid by tenants. This "split incentive" exacerbates other barriers to decarbonizing commercial buildings and prevents many businesses from benefitting from energy retrofit measures.

This program could leverage the free technical assistance program for businesses to identify a cost-effective package of efficiency and electrification measures with a

reasonable payback period. Approved retrofit proposals could be eligible for zero-interest financing through an on-bill repayment program operated as a partnership between the Town of Truckee and a local utility and/or community-based organization.

In this on-bill repayment model, the Town of Truckee would provide seed funding to finance approved retrofit, to be repaid along with utility payments collected by the participating utility. The payments would be equal to or slightly less than the energy savings, so tenants would not see any increase in near-term utility costs (and likely have a small decrease in total costs) but would benefit from full energy savings once the repayment term is over. As initial loans are repaid, the funding provided by the Town would become available to finance additional retrofit projects, similar to a revolving loan fund. Since the seed funding will be repaid, the only cost to the Town not repaid would be if financial support is needed for a third party to operate the program.

By addressing the split incentive problem and supporting building owners with technical assistance, this program has the potential to facilitate greater adoption of efficiency measures such as lighting upgrades, weatherization, and other building envelope improvements that owners of tenant-occupied commercial buildings have less incentive to invest in. It can also enable more widespread electrification of commercial space and water heating equipment, which often have higher capital costs than natural gas equipment but can be cost-effective when paired with efficiency measures.

Upgrade Programs

Truckee Weatherization Program

Timeframe	Building Type	Staff Time	Cost
Short-term	SF	Moderate	High

Develop a 2-year pilot program to offer no-cost weatherization upgrades for income-qualified households making up to 80% of Area Median Income.

Many of Truckee's older buildings are in need of basic weatherization measures and critical repairs. Improving the resilience, safety, and comfort of these homes while reducing energy costs is critical to achieving equitable building decarbonization, but residents that need these measures most are least able to afford them. To address this need and fill gaps in existing utility and federal weatherization programs, Truckee can provide a centralized, no-cost weatherization program for households making up to 80% of Area Median Income.

This program will leverage existing weatherization programs to the fullest extent possible by addressing barriers to participation and increasing access to weatherization upgrades by (1) providing a centralized program to help residents access available assistance, (2) provide supplemental repair funds to enable greater participation in existing programs, (3) expanding weatherization assistance to homes with all heating fuels, and (4) increasing household income limits for eligibility.

Greater participation in weatherization programs will immediately reduce GHG emissions by reducing energy use, especially from natural gas and propane heating, while providing residents with cost savings. In the long term, this program could help accelerate adoption of clean energy technologies like heat pumps by conducting the necessary building envelope upgrades to more efficiently implement electrification measures.

Similar to existing weatherization programs, the Truckee Weatherization program will be managed by a program administrator. The program administrator will oversee program outreach and implementation, manage customer intake and communication, and be responsible for overseeing implementation of upgrades. Providing a "turnkey," no-cost program helps improve access for lower-income households.

The Town Council approved a pilot program in November 2023, and an RFP was issued to select a program administrator. The program is currently under development and expected to launch in late FY 24/25.

Expanded Building Retrofit Program

Timeframe	Building Type	Staff Time	Cost
Mid-term	SF	Moderate	High

Based on the results of the Truckee Weatherization Program pilot, develop an expanded building retrofit program that includes electrification measures. (CAP-7.A)

Truckee's Climate Action Plan includes action CAP-7.A, a comprehensive building electrification and energy efficiency retrofit program. The Town began an initial phase of developing a retrofit program in 2024 with a two-year pilot of the Truckee Weatherization Program. After completion of the two-year pilot program, staff can assess the success of the program and evaluate options for an expanded upgrade program. Part of the purpose of the pilot program is to better assess local costs and existing conditions in the building stock that may create barriers for building decarbonization measures.

Options to expand measures covered by the retrofit program include packaging electrification measures with weatherization upgrades, as well as resilience measures identified in the Energy Resilience Plan. In addition, the program could be expanded to make certain services available to households with incomes above 80% AMI. While staff do not recommend expanding the no-cost installation portion of the program to higher-income households, the program could still provide significant benefits to these households. The Town could still work with the program administrator to provide contractor vetting and upgrades at pre-negotiated prices per measure to streamline the process for higher-income households interested in upgrades. This type of program is widely utilized in other mountain communities to provide home energy audits, weatherization, and electrification upgrades to residents at a reasonable upfront price. One example is the REenergizeCO program in Colorado, a utility-funded program operated by Xcel Energy.

While this is a high-priority item, there is insufficient existing staff capacity to support this project in the short-term. With additional staff capacity, this measure could potentially be started in the short-term timeframe, after completion of the Truckee Weatherization Program.

Commercial Energy Audit Program

Timeframe	Building Type	Staff Time	Cost
Mid-term	NR	Low	Moderate

Offer low- or no-cost energy audits for commercial buildings, prioritizing small businesses.

A simple energy audit would assess the wide variety of energy uses in commercial buildings, including heating and cooling systems, water heating, other equipment, lighting, ductwork, and the building envelope. Audits result in a list of no-cost and low-cost recommendations to improve energy efficiency and comfort as well as reducing energy costs. The end result is a road map for building owners, including (1) no-cost operational or maintenance adjustments that will save energy, (2) short-term, low-cost energy efficiency retrofit recommendations, (3) action plans for energy efficiency capital investments, (4) comfort and code issues that can be addressed immediately, and (5) opportunities for better adherence to lighting and comfort standards.

Energy audits are a powerful tool to provide building owners with information to improve their building and reduce operating costs. By prioritizing small businesses, this measure can best support both local economic development and decarbonization of the smaller commercial buildings that comprise the majority of the Town's non-residential building stock. This would be a voluntary program offered at low- or no-cost to Truckee businesses, and could be offered in coordination with local utility programs for commercial customers.

The success of commercial building benchmarking ordinances in reducing energy use and GHG emissions is largely due to the periodic requirements for an audit. While building benchmarking ordinances require a significant amount of staff time to develop and implement, the Town can more easily offer a free or low-cost audit program for commercial businesses to provide the same benefit.

Solar Installation Program

Timeframe	Building Type	Staff Time	Cost
Mid-term	SF	Moderate	Moderate

Develop a discounted solar and battery storage installation program in collaboration with regional partners.

While heavy snow load, tree shading, and roof orientation make rooftop solar systems infeasible or impractical on the majority of existing residential properties in Truckee, there are still many residential properties that can benefit from on-site solar PV systems. To meet local climate action goals and improve community resilience, Truckee will need to maximize use of distributed energy resources such as solar PV

wherever feasible. To facilitate this, the Town can develop a discounted solar installation program. This would be a good candidate for a regionally coordinated program through a partner such as the Climate Transformation Alliance.

Many mountain communities in Summit County, Colorado, have partnered together to implement a coordinated solar incentive and installation program for residents. The program contracts with an installer to provide discounted solar installation for a certain number of residents each year. Interested residents are eligible for a free assessment to determine viability of solar on their home, as well as discounted energy assessments to advise them on opportunities to implement energy efficiency and electrification upgrades in their home. Residents who choose to move forward with solar installation sign a contract directly with the program's installer and are eligible for the discounted rate. Participating jurisdictions also offer a limited number of additional rebates for residents who sign installation contracts through the program, which can be stacked with other federal, state, or utility rebates for solar. A similar program could be developed for Truckee by the Town and/or the Climate Transformation Alliance.

The program can also include installation of battery storage systems to provide additional benefits. Including energy storage with solar PV systems adds additional GHG emission reduction benefits, as it allows residents to use the power generated by their solar panels later in the day during peak demand. This can provide additional cost savings benefits for households on a time-of-use rate for electricity, as well as reducing peak demand on the electrical grid. Since peak demand is when Truckee's electricity sources have the highest GHG emissions due to heavier reliance on fossil fuel generation sources, this type of demand reduction measure has high GHG emissions reduction potential especially at the community scale.

Building Permit Prioritization Program

Timeframe	Building Type	Staff Time	Cost
Mid-term	SF, MF, NR	High	Moderate

Explore the creation of a building permit prioritization program to support building decarbonization in existing buildings. (CAP-7.K)

Climate Action Plan action CAP-7.K: Explore the creation of a building permit prioritization program, through stakeholder engagement and/or a stakeholder committee, for building decarbonization projects, that considers:

- Prioritization for most impact (i.e. highest cost-benefit ratio)
- Creation of a Town staff navigator position/staff technical support
- The financial implications to the Town Building Division, an enterprise fund, and any fee schedule adjustments necessary to support the program, or possible General Fund subsidies
- An educational program
- Decarbonization funding (e.g. loans, public-private partnerships, incentives)

Policy & Regulation

Heat Pump Air Conditioning Reach Code

Timeframe	Building Type	Staff Time	Cost
Short-term	SF	Moderate	Moderate

Consider a heat pump air conditioning reach code for existing single-family homes in Truckee.

Heat pump air conditioning reach codes can incentivize and/or require that a heat pump be installed instead of an air conditioning-only unit whenever cooling equipment is added to a single-family home. Heat pump air conditioning can provide the same cooling benefits as a traditional air conditioner, but also provides heating, either as a primary heat source or alongside an existing gas furnace as a dual-fuel heating system. This is a high-impact GHG emissions reduction measure that has minimal incremental costs and does not require full heating system electrification.

While air conditioning is still relatively uncommon in Truckee, the rate of installation is increasing rapidly, with 85% of air conditioning units installed in the last three years. As Truckee continues to experience the impacts of climate change, demand for air conditioning is expected to continue to increase. Air conditioners and heat pumps are essentially the same type of equipment, which move heat from one place to another rather than generating it through combustion. Heat pumps have a reversing valve that allows them to transfer heat in both directions, providing either heating or cooling, while air conditioner units can only provide cooling. Heat pump air conditioning can also reduce energy bills and improve home comfort compared to traditional air conditioning units; 87% of homes that replace existing air conditioners with heat pumps reduce their total energy costs.[44]

Heat pump air conditioning is an emerging area of focus for California's building decarbonization efforts with the 2025 Building Standards Code updates. The 2025 California Green Building Code (CALGreen) will include a heat pump air conditioning requirement in the residential voluntary measures. The draft CALGreen languages includes an alternative compliance pathway of energy efficiency measures (ducts and insulation). The Town can evaluate the CALGreen language and adapt to Truckee's local conditions.

Interest in electrification is low in Truckee, with only 20% of survey respondents willing to consider fully electrifying their heating system, and many of these respondents being deterred by incremental costs and other factors. This limits the potential near-term impact of voluntary and incentive-based measures focused on heating systems. Heat pump air conditioning provides an important alternative to full heating system electrification that still supports community-wide building decarbonization efforts. A heat pump air conditioning reach code would be a high-

[44] Mahone, A., C. Li, Z. Subin, M. Sontag, G. Mantegna, A. Karolides, A. German, and P. Morris. 2019. "Residential Building Electrification in California: Consumer Economics, Greenhouse Gases, and Grid Impacts." Energy and Environmental Economics, Inc. Available at: https://www.ethree.com/wp-content/uploads/2019/04/E3_Residential_Building_Electrification_in_California_April_2019.pdf.

impact method of catalyzing heat pump installation in Truckee, likely resulting in 5-10 times as many heat pump installations as an incentive-based program.

Focusing on cooling equipment rather than heating equipment allows residents to keep their existing furnace units if desired, while gaining high-efficiency supplemental heating at minimal incremental cost (which can be fully offset with incentives). A heat pump air conditioning reach code would not regulate the installation or replacement of gas furnaces in existing buildings, allowing homeowners to continue to utilize their existing gas furnaces while experiencing the benefits of supplemental heat pump heating. This provides a way to substantially increase the number of heat pumps in Truckee without regulating heating equipment.

On December 10, 2024, the Town Council directed staff to engage a consultant to analyze potential policy options for a heat pump air conditioning requirement for single-family homes in Truckee and present recommendations to the Town Council for consideration. This project began in FY 24-25 and is expected to continue in FY 25-26.

Renewable Energy Mitigation Program

Timeframe	Building Type	Staff Time	Cost
Mid-term	SF	High	Low

Explore options for a Renewable Energy Mitigation Program to address energy-intensive outdoor systems that are not covered by existing codes or programs.

A Renewable Energy Mitigation Program is an initiative implemented in several jurisdictions in Colorado, including Breckenridge, Aspen, and Pitkin County, to promote renewable energy and reduce GHG emissions from outdoor energy uses on a property. While these jurisdictions have adopted building codes that support building decarbonization, there are many outdoor uses of energy that are not covered by the energy standards in the building code such as outdoor spas, pools, gas fire pits, or snowmelt systems. A Renewable Energy Mitigation Program addresses these outdoor energy uses by requiring property owners to either mitigate the GHG emissions from these energy uses with an on-site renewable energy measure or pay a mitigation fee.

These requirements are triggered when a new permit is pulled that includes one of the covered uses, which means that a Renewable Energy Mitigation Program applies to both new construction and existing buildings if they pull a relevant permit. Examples of mitigation measures include installing renewable energy systems such as solar photovoltaic panels, solar water heating, or geothermal heat pumps. Property owners can also choose to pay a mitigation fee calculated based on the relative GHG emissions of covered outdoor systems.

A Renewable Energy Mitigation Program could address a key gap in California's building energy codes, which do not generally cover outdoor uses of energy. This includes many energy-intensive systems such as snowmelt systems, outdoor pools, large spas, and gas fire pits. While some of these outdoor systems like pools and

large spas are not very common in Truckee, they are extremely energy-intensive.[45] By requiring mitigation or fees for these systems, a Renewable Energy Mitigation Program encourages property owners to consider their energy consumption and its environmental impact. Some common outdoor energy uses that do not require a permit, such as small hot tubs, are not covered by the Colorado programs. The Town could tailor a Renewable Energy Mitigation Program to Truckee's unique needs and determine the recommended covered systems based on local priorities.

While development of this program would have some costs, it can also be a source of revenue to support other building decarbonization initiatives. Since its inception in 2000, Renewable Energy Mitigation Programs in Aspen and Pitkin County have generated $12 million that funds energy efficiency and renewable energy programs. While these programs have been successful in Colorado, it will be important to assess the feasibility of such a program in California and locally through further research.

Time-of-Sale Requirements

Timeframe	Building Type	Staff Time	Cost
Mid-term	SF	Moderate	Low

Explore time-of-sale requirements for energy use disclosure or assessments for single-family residential homes, with flexible compliance pathways and appropriate exemptions.

Time-of-sale policies impose requirements on a building when it is listed for sale. These types of policies can be very flexible, allowing sellers to choose from a variety of compliance pathways. For example, the City of Berkeley's Building Energy Savings Ordinance allows sellers to choose from five compliance options: (1) complete an energy assessment, (2) complete an energy efficiency or electrification upgrade from a list of eligible measures, (3) apply to defer the requirements to the buyer, (4) apply for a new construction exemption if the building was constructed or fully renovated within the past 10 years, or (5) apply for another eligible exemption.

Time-of-sale policies are often centered around home energy use assessment and disclosure. This creates critical transparency for potential buyers around otherwise "hidden" costs from energy use, helps buyers understand what key energy efficiency upgrades may be needed, and allows buyers to make more informed decisions when looking for a home. The Town could consider options ranging from energy use benchmarking, which is as simple as uploading a few years of utility data to a platform like Energy Star Portfolio Manager (many utilities offer integration with this platform to streamline the process), to requiring a professional to conduct a full home energy assessment. Similar to the Berkeley ordinance, the Town could offer property owners a wide variety of compliance pathways to provide as much flexibility as possible.

[45] California Air Resources Board. (December 2022). Final 2022 Scoping Plan, Appendix F: Building Decarbonization. https://ww2.arb.ca.gov/our-work/programs/ab-32-climate-change-scoping-plan/2022-scoping-plan-documents.

A time-of-sale policy for single-family residential buildings has the potential to be highly effective in Truckee due to an active housing market, potentially impacting up to 20-30% of all single-family homes within a 5-year timeframe. Accordingly, it could be one of the most effective ways to impact existing single-family homes in Truckee. However, this policy would require the Town to develop a new type of regulatory framework, so it would not be feasible in the short-term, and would likely require the Town to have additional staff capacity compared to current levels.

Flexible Pathway Reach Code

Timeframe	Building Type	Staff Time	Cost
Long-term	SF	High	Moderate

If voluntary measures are unsuccessful in achieving energy efficiency and weatherization measures in existing buildings, consider developing a flexible pathway reach code for residential retrofits.

While a near-term approach focused on incentives and voluntary measures is recommended, the Town can explore long-term options for regulatory measures if voluntary measures have not achieved building decarbonization and GHG emissions reduction targets. This includes considering a reach code requiring owners of single-family residential buildings to implement building decarbonization measures when they conduct large renovation projects. A "flexible pathway" approach to existing building reach codes allows homeowners to choose from various compliance pathways, allowing for more flexibility than a purely prescriptive approach.

Flexible pathway reach codes generally apply to retrofits of existing single-family residential buildings above a minimum square footage or permit valuation threshold. Covered renovations must implement energy efficiency and/or electrification measures, which is enforced through the permitting process. Homeowners can choose from a set of eligible measures with a weighted value based on energy savings to achieve a target score, which varies by building vintage. Measures such as installation of highly efficient heat pumps are higher value, while minor energy efficiency improvements have a lower value, incentivizing (but not requiring) highly efficient electrification. At least eight California jurisdictions adopted these types of reach codes for the 2022 building code cycle.

Existing building reach codes must demonstrate cost-effectiveness, meaning the cost savings from reduced energy use must offset any additional upfront costs within a reasonable period of time. The list of measures in a flexible pathway reach codes are structured around at least one cost-effective pathway for each building vintage range. Measures that are not cost-effective, as well as electrification measures, can still be included as optional pathways as long as there is at least one cost-effective, fuel-neutral compliance option available. This allows the Town to include a wider variety of eligible measures, providing homeowners with flexibility to choose the energy upgrades best suited to their project. Due to the legal restrictions on reach codes, the Town cannot mandate electrification measures for existing buildings, but can use this type of flexible pathway reach code to incentivize these upgrades.

The Town convened a Reach Code Stakeholder Committee from 2022-2024 to explore options While the Committee recommended incentivizing rather than mandating retrofit measures for existing single-family homes, a flexible pathway reach code was the most popular approach among Committee members if the Town did decide to move forward with this type of measure in the future.

Flexible pathway reach codes are complex to develop and implement and complicate the permitting process and add cost for renovations of single-family homes by imposing new requirements. Due to these factors and the high staff time needs for both development and implementation, staff recommends considering this type of measure only if other options are not effective in the short- and mid-term.

Minimum Energy Performance Standards for STRs

Timeframe	Building Type	Staff Time	Cost
Long-term	SF	High	Moderate

Explore minimum energy performance standards for short-term rentals (STRs) if voluntary programs do not achieve sufficient uptake in these homes.

Several cities in the U.S. have adopted policies setting minimum efficiency standards for rental housing. This type of policy sets a minimum energy efficiency level that buildings must meet to ensure that energy bills are affordable for renters. For example, Burlington, Vermont, requires larger multifamily buildings of 50,000 square feet or more to meet a specific energy efficiency level or implement basic weatherization measures.

While these types of policies generally apply to long-term rental housing, staff recommends considering them only for short-term rentals in Truckee. In addition to not having any existing mechanism to regulate long-term rentals, staff is concerned that any regulations would discourage property owners from long-term renting their property, exacerbating the shortage of workforce housing and working against existing rental incentive programs. Given the extremely small number of renter-occupied multifamily properties in Truckee overall, particularly larger buildings, this would not be an impactful policy in Truckee if applied to multifamily buildings.

Energy efficiency is particularly important in STRs, as neither property owners nor the Town have significant influence over occupant behavior and energy use. The Town could develop minimum energy performance standards for STRs to ensure they are as efficient as possible, resulting in lower operating costs for owners. This could include setting a performance-based target or requiring owners to demonstrate certain weatherization or efficiency measures have been implemented. Most similar types of regulations make the energy performance standards stricter over time, to give owners of older buildings more time to bring their properties up to modern efficiency standards.

The hope is that owners of short-term rentals, like other Truckee property owners, will take advantage of rebates and other voluntary programs encouraging energy upgrades. Because property owners pay the energy bills for short-term rentals, they

have a financial incentive to invest in energy efficiency measures. If voluntary measures are insufficient to meet decarbonization targets in STRs, the Town can consider adopting regulatory measures. However, this would take significant staff time to both develop and implement and would require a mechanism for compliance verification of all 1,255 STRs.

While Truckee's short-term rental ordinance provides a strong control point and enforcement standard for any regulations that apply to STRs, these buildings are not the highest priority to target for decarbonization measures. Short-term rentals are a relatively small percentage of the overall residential housing stock (approximately 9% of residential units) and an even smaller percentage of overall energy use and GHG emissions. Accordingly, this is recommended for consideration as a long-term measure only if voluntary programs for single-family homes are not successfully adopted in STRs.

Building Benchmarking Ordinance

Timeframe	Building Type	Staff Time	Cost
Long-term	NR	High	High

Consider development of a building benchmarking ordinance for larger commercial buildings if voluntary measures are not effective.

Building benchmarking ordinances can be an effective way to reduce GHG emissions from commercial buildings but work best for larger commercial buildings. Benchmarking is a mechanism to compare energy performance of a building to buildings of similar use and size. Property owners can benchmark their buildings using easy-to-use platforms such as EnergyStar Portfolio Manager by providing just a few key pieces of information about their property and uploading energy use data. By benchmarking against similar buildings, property owners can better understand if there is an opportunity for energy efficiency improvements. Many benchmarking ordinances also require a periodic energy audit to identify cost-saving energy efficiency measures that could be implemented.

Most jurisdictions that have adopted this type of requirement only require buildings above 25,000 square feet to comply, with some applying it to buildings as small as 10,000 square feet. Aspen, Colorado, adopted a building benchmarking ordinance that phased in over several years to cover commercial buildings as small as 5,000 square feet. Because Truckee has so few large commercial buildings (only 39% of Truckee's commercial buildings are over 5,000 square feet, and only 16% are over 10,000 square feet), this type of strategy is less of a priority. Benchmarking alone does not reduce GHG emissions; the success of these types of ordinances in reducing emissions is primarily due to their energy audit requirements, as building owners often choose to implement cost-effective efficiency measures identified in the audit report. The Town can offer these types of audits as a voluntary program to achieve many of the same results, including with smaller commercial building types.

Adoption of building benchmarking ordinances in California is also complicated by the statewide building benchmarking regulations created by Assembly Bill 802. Any

jurisdiction that adopts a local benchmarking ordinance must take on the reporting and enforcement requirements for the state's requirements, which apply to both commercial and multifamily residential buildings of 50,000 square feet or more. This would require the Town to take on a much more active compliance and enforcement role compared to most of its current sustainability regulations. It would also require the Town to develop a new reporting platform, forms, guidance for covered buildings, and conduct extensive annual outreach to ensure compliance.

Staff does not believe this type of ordinance would be feasible in the near-term due to the high staff time required to support both development and implementation, as well as the other challenges noted above. Instead, staff recommend focusing on other strategies outlined in this document in the near- and mid-term and leaving this item for consideration in the long term if voluntary measures and other commercial strategies have failed to achieve building decarbonization goals.

Implementing the Roadmap

This Roadmap represents a recommended pathway for the Town to follow as it begins the journey towards efficient, comfortable, and healthier carbon-free buildings. Course correction is necessary and anticipated on this road to account for changing conditions, and to adjust and improve based on lessons learned from early adopters and pilot programs.

While rough implementation timeframes have been included for each measure in the Roadmap, the inclusion of a measure in this Roadmap is not a guarantee that it will be implemented. Successful decarbonization of Truckee's existing building stock is contingent on continued commitment to climate action from both the Town and the Truckee community. The timeframes of short-term, mid-term, and long-term included in this document are intended primarily as an indication of relative priority of the recommended measures, and not necessarily as a realistic schedule for implementation based on current resource levels; the feasibility of implementation in the suggested timeframe will depend on the Town having adequate staff capacity and funding to support each of these programs.

Funding is another important component of Roadmap implementation. Many of the recommended measures are identified as having moderate or high costs to the Town and will be dependent on the availability of general fund revenues or external funding sources. While it is important to prioritize smart investment of Town funds and efficient use of public resources, there is an inherent tradeoff between cost-effectiveness and equity. Simply pursuing a lowest-cost approach that seeks the "biggest bang for the buck" in achieving GHG emissions reduction will inevitably result in Town programs primarily serving those who already have the most resources. The community members with the least resources need the most support, including financial support, to share in the benefits of building decarbonization.

Most importantly, the Town cannot achieve climate action targets, including building decarbonization goals, on its own. Continued close collaboration with local utilities,

other public agencies, community-based organizations and regional partners, both directly and through the Climate Transformation Alliance, will be critical to success.

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Appendix A: Glossary and Acronyms

Term and Acronym (if applicable)	Definition
Area Median Income (AMI)	Area median income, or AMI, is the median household income in a region. AMI is generally assessed at the county level.
Building envelope	The exterior of a building that encloses conditioned space. The envelope is a combination of building components that include the foundations, floors, walls, roofs, windows, and doors.
Building Standards Code (California)	Also known as Title 24, it is a set of regulations that govern the construction and planning of buildings in California.
Building stock	The collection of buildings that exist within a region.
CALGreen	California's first green building code and first in the nation state-mandated green building code. It is formally known as the California Green Building Standards Code.
California Air Resources Board (CARB)	State agency tasked with protecting the public from air pollution and developing programs and policies to fight climate change.
California Energy Commission (CEC)	California's primary energy policy and planning agency.
California Public Utilities Commission (CPUC)	State agency responsible for regulating services and utilities, protecting consumers, safeguarding the environment, and assuring access to safe and reliable utility infrastructure and services.
Carbon neutrality	Refers to achieving net-zero emissions of carbon dioxide.
Climate Action Plan (CAP)	Element in the Town of Truckee's adopted 2040 General Plan update that outlines a strategy to meet the Town's adopted GHG reduction goals.
Climate Transformation Alliance (CTA)	Regional public-private partnership of local governments, special districts, community organizations, businesses, and individuals committed to collaboration, innovation, and accountability through a governing body and shared vision for the North Tahoe-Truckee community to achieve carbon neutrality by 2045.
Commercial buildings	Building sector that includes a wide variety of nonresidential building types such as high-rise

	multifamily, offices, retail, restaurants, campuses, and hospitals.
Community-based organization (CBO)	An organization, most often a non-profit, that provides a beneficial service to and is based in the local community.
Control point	An existing regulatory framework, such as building permits.
Cooling degree days	Heating or cooling degree days measure relative demand for heating or cooling in a building. They are the difference between the daily temperature mean (high temperature plus low temperature divided by two) and 65 degrees Fahrenheit. If the temperature mean is above 65F, the difference between the mean and 65 is the number of cooling degree days.
Decarbonization	Activities that reduce greenhouse gas emissions such as reducing or removing fossil gas use in buildings or replacing fossil fuel generated electricity with renewable sources like solar or wind.
Demand response	Changes in electric usage by demand-side resources from normal consumption patterns in response to changes in the price of electricity over time, or to incentive payments designed to induce lower electricity use at times of high wholesale market prices or when system reliability is jeopardized.
Displacement	When tenants must involuntarily leave the property where they are living.
Distributed energy resource (DER)	Electricity-producing or controllable loads that are directly connected to a local distribution system. It includes, but is not limited to, demand response, rooftop solar, energy efficiency, and battery storage.
Electrification	Converting end uses from a combustible fuel source (typically a fossil gas) to electricity.
Energy Audit	Assessment of the wide variety of energy uses in buildings, including heating and cooling systems, water heating, other equipment, lighting, ductwork, and the building envelope.
Energy Star	An energy efficiency program developed by the Environmental Protection Agency (EPA).
Flexible pathway	Approach to existing building reach codes allows homeowners to choose from various compliance pathways, allowing for more flexibility than a purely prescriptive approach.
Fossil gas	A gas, such as methane or propane, derived from nonrenewable sources.

Full-time equivalent (FTE)	A measure of workload based on the equivalent of one full-time employee working a 40-hour work week.
Grant	A set amount of money that is given to an applicant for meeting the qualifications of a program that does not need to be paid back.
Greenhouse gas (GHG)	Gases in Earth's atmosphere that trap heat and contribute to climate change.
Heating, ventilation, and air conditioning (HVAC)	Mechanical systems that provide thermal comfort and air quality to indoor spaces.
Heat Pump	Electric device that moves heat from one place to another rather than generating it through combustion. Heat pumps have a reversing valve that allows them to transfer heat in both directions, providing either heating or cooling.
HEEHRA	A home electrification and appliance rebate program managed by the California Energy Commission and funded by the Inflation Reduction Act.
Investor-owned utility (IOU)	IOU. Privately owned electricity and gas providers.
Keep Truckee Green (KTG)	The Town of Truckee's sustainability, solid waste, and resiliency program.
Median family income	The median (middle) income for a family in a region.
Metric tons of carbon dioxide equivalent ($MTCO_2e$)	Unit of measurement for the amount of greenhouse gas emissions produced by an activity.
Multi-Family Residential (MF)	Building type that includes apartment buildings and condos.
New Construction	The construction of new buildings or significant renovation of a building.
Non-Residential (NR)	Building type that includes commercial buildings.
On-bill financing	Alternative energy financing tool that allows a utility to recover the cost of an upgrade on the utility bill.
Photovoltaic (PV)	Solar panels use photovoltaic technology to generate electricity.
Reach code	A law adopted by a local government that creates higher building energy performance standards than those in the State code.
Rebate	An amount of reimbursed money that an applicant receives after complying with the qualifications of a program.
Renewable natural gas (RNG)	Methane that is produced from biological sources such as landfills, wastewater treatment plants, food waste, or livestock farms

Renewables Portfolio Standard (RPS)	A California state regulation that requires utilities to increase procurement of electricity from renewable sources.
Residential	A building sector that includes single-family homes, multifamily units, townhouses, and condominiums.
Retrofit	To add a new component to a structure or facility that wasn't installed initially or to improve an existing structure or facility.
Short-term rental (STR)	Residential units rented for periods of 30 days or less, typically advertised as vacation rentals.
Scoping Plan	A document created and updated by the California Air Resources Board. The 2022 Scoping Plan for Achieving Carbon Neutrality (2022 Scoping Plan) lays out a path to achieve targets for carbon neutrality and reduce anthropogenic greenhouse gas emissions by 85 percent below 1990 levels no later than 2045, as directed by Assembly Bill 1279.
Sierra Business Council	A nonprofit with the goal to improve the economic, environmental, and social needs of the Sierra Nevada region.
Single-Family Residential (SF)	Building type that includes both detached single-family homes and attached single-family homes like townhomes.
Split incentive	Term used to indicate a barrier between owners and tenants of buildings when deciding if an energy upgrade should be done.
Synthetic gas	Gaseous fuel alternative to fossil gas when produced using renewable resources.
Tax credits	Help reduce the amount of tax someone may owe.
TECH Clean California	A statewide initiative to accelerate the adoption of clean space and water heating technology across California homes to help create an equitable pathway to carbon-free homes by 2045 and install six million heat pumps by 2030.
Time-of-use (TOU)	Electricity rate that varies by the time of day and/or season.
Truckee Donner Public Utility District (TDPUD)	A public utility providing electricity and water to customers in the Truckee area.
Weatherization	The process of installing better insulation, higher-performance windows and doors, and weatherstripping and other air sealing measures to make a building more resilient against changes in weather and temperature, and large fluctuations in energy use.

Appendix B: Building Decarbonization Myths & Realities

There are many common misconceptions about building decarbonization, particularly electrification. While there are valid concerns about how the transition might unfold in Truckee, many commonly held beliefs are either only partially accurate or untrue. This section aims to separate myth from reality, addressing common questions to provide Truckee community members with clear and accurate information about building decarbonization.

Is building electrification feasible in Truckee's cold climate?

While building decarbonization work may be more common in milder climates, electric appliances have been shown to work well in cold climates. Heat pumps can achieve an efficiency of up to 400%, although their performance may decrease as temperatures drop. However, some models are designed to operate effectively even in extreme cold, maintaining 100% efficiency at temperatures as low as -20°F[46]. There are several examples of successful building electrification in even colder climates, including other mountain towns, some of which are listed below:

- **Crested Butte, CO:** As of January 2023, this small mountain town (elevation 8,900 feet) requires all-electric new construction for residential and commercial buildings, with exceptions for commercial cooking. Crested Butte experiences heavier snowfall and colder winters than Truckee.[47]
- **Denver, CO:** For new commercial buildings and additions, Denver mandates one or more green building measures, such as green roofs, solar panels, renewable energy purchases, achieving 12% energy cost savings, or green certifications like LEED. Additionally, all new buildings must begin partially electrifying space and water heating systems as they are replaced. The requirements phase in gradually, with systems that are easier to electrify required by 2025, and harder-to-electrify systems by 2027.[48]
- **Maine:** In a study of 10 Maine households with heat pumps installed and operational from February to June, seven relied on the heat pumps as their primary heating source, while the remaining three occasionally used a backup heat source in case of power outages. The study found that air

[46] *Heat Pumps in Cold Climates: 2024 Edition*. (n.d.). BlocPower. https://www.blocpower.io/posts/cold-climate-heat-pumps

[47] Crested Butte, Colorado. (2022, August 22). *Ordinance No. 13*. https://www.crestedbutte-co.gov/vertical/sites/%7B6058FFBB-CB06-4864-B42F-B476F794BE07%7D/uploads/Ordinance_No._13_Series_2022.pdf

[48] *Existing building electrification*. (n.d.). City and County of Denver. https://www.denvergov.org/Government/Agencies-Departments-Offices/Agencies-Departments-Offices-Directory/Climate-Action-Sustainability-and-Resiliency/Cutting-Denvers-Carbon-Pollution/High-Performance-Buildings-and-Homes/Existing-Building-Electrification.

source heat pumps were able to effectively and efficiently keep homes a comfortable temperature, even when outdoor temperatures reach -5 degrees Fahrenheit.[49]

- **Ithaca, NY:** Ithaca has adopted progressively stricter requirements for new construction. In 2021, all new buildings were required to produce 40% fewer GHG emissions than state code standards. By 2023, this increased to 80% fewer emissions, and by 2026, all new construction must produce net-zero GHG emissions and be all-electric, with some exceptions.[50]
- **Sweden, Norway, and Finland:** More than 40% of households in the three coldest countries in Europe – Sweden, Norway, and Finland – have heat pumps.[51]

These examples demonstrate that even in colder climates, states and municipalities are adopting innovative approaches to reduce GHG emissions and transition toward electrified buildings.

Truckee produces so few greenhouse gas emissions compared to other cities, do we really need to decarbonize our buildings?

While it's true that Truckee is just one town producing a small amount of greenhouse gas emission compared to the rest of California, collective action is essential. If every town and city in California adopted a passive approach, GHG emissions would never be meaningfully reduced. The California Air Resources Board Scoping Plan outlines the emissions reductions that are necessary to reach statewide climate action targets and highlights the critical role of local government in implementing these GHG reduction measures.[52] This includes decarbonizing buildings throughout the state, including those in Truckee.

The Town of Truckee is committed to reducing emissions locally in the most equitable way possible with the support of residents who are passionate about making Truckee a sustainability leader among mountain towns. One of the most significant opportunities for Truckee to contribute to combat climate change is by addressing greenhouse gas emissions from existing residential and commercial

[49] Brutkoski, D. (2024, May 9). *Cold-Climate Heat Pumps Pass the Ultimate Test: a Maine Winter*. Regulatory Assistance Project. https://www.raponline.org/blog/cold-climate-heat-pumps-pass-the-ultimate-test-a-maine-winter/

[50] *The building decarbonization big idea: BlocPower in Ithaca | U.S. Green Building Council*. (2022, July 22). https://www.usgbc.org/articles/building-decarb-big-idea-blocpower-program-ithaca

[51] Resilience. (2023, October 3). *How heat pumps became a Nordic success story*. Resilience. https://www.resilience.org/stories/2023-10-03/how-heat-pumps-became-a-nordic-success-story/

[52] California Air Resources Board. (December 2022). Final 2022 Scoping Plan, Appendix D: Local Action. https://ww2.arb.ca.gov/our-work/programs/ab-32-climate-change-scoping-plan/2022-scoping-plan-documents.

buildings. Statewide, these buildings account for 25% of California's total emissions, with transportation being the largest contributor.[53]

It's worth noting that while there have been concerns about the emissions that the Truckee Tahoe Airport produces, the airport lies outside the town's boundaries and is not included in Truckee's emissions calculations. However, Truckee's efforts to decarbonize buildings and transition to more sustainable practices can set an example for neighboring communities and contribute to broader climate goals. The Truckee Tahoe Airport has also committed to reducing its GHG emissions footprint and, like the Town, is a founding partner of the Climate Transformation Alliance, which is committed to region-wide carbon neutrality by 2045.

Is electricity really better for the environment than natural gas? Doesn't electricity also come from fossil fuels?

Truckee's electricity has a high percentage of renewable electricity, and produces fewer GHG emissions than natural gas. Most of Truckee's electricity is provided by the Truckee Donner Public Utility District (TDPUD), a community-owned, not-for-profit, locally governed public power and water utility. Their electricity is transmitted through NV Energy's infrastructure but is not sourced from NV Energy. In 2023, TDPUD's power mix was 60% renewable, which was higher than average for California.[54] Liberty Utilities, which supplies electricity to a portion of Truckee's Glenshire neighborhood, had a renewable portfolio of 37% as of 2022. Since 2008, Liberty Utilities has reduced the GHG emissions from its electricity by more than 50%, and TDPUD has reduced their GHG emissions by over 70%. The State of California adopted legislation (Senate Bill 100) requiring all electric utilities to source 100% of their electricity from renewable or zero-carbon sources by 2045.[55]

Using Truckee Donner Public Utility District's (TDPUD) grid emissions and accounting for grid inefficiencies, a 90% efficient gas furnace produces about 2.3 times the emissions of a heat pump. Even under the more conservative emissions profile of NV Energy's power mix, a gas furnace is still responsible for 1.8 times the emissions of a heat pump.[56] As the electricity grid continues to incorporate more renewable energy sources, the emissions advantage of heat pumps over natural gas systems will only grow, making them an even more sustainable choice over time.

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[53] California Energy Commission. (n.d.). California climate policy fact sheet: building energy efficiency. In *California Climate Policy Fact Sheet*. https://www.law.berkeley.edu/wp-content/uploads/2019/12/Fact-Sheet-Building-Energy-Efficiency.pdf

[54] TDPUD Power Content Label, available at: https://www.tdpud.org/departments/electric/rates-renewable-reliability

[55] Senate Bill 100 – California Renewables Portfolio Standard Program: emissions of greenhouse gases (2017-2018): https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201720180SB100

[56] This information was confirmed directly from TDPUD

Is the electric grid inefficient?

While it's true that the electric grid experiences some energy loss—about 5% between power generation and end-use—this figure represents a relatively small fraction of the total electricity produced. These losses occur due to resistance in power lines and other inefficiencies inherent to transmission systems. When electricity is generated from fossil fuels, there are additional inefficiencies compared to renewable energy generation, as the fossil fuel combustion process is only about 45% efficient.[57]

The transportation of natural gas via pipelines has even higher losses of around 9%.[58] These inefficiencies have a much higher impact on GHG emissions than electrical grid transmission and distribution losses, as they release methane, a greenhouse gas approximately 28 times more potent than CO_2 at trapping heat in the atmosphere.[59]

Are electric appliances as efficient as gas appliances? Won't switching to electric equipment increase utility costs?

New natural gas appliances, such as a gas furnace, may have efficiencies around 90% or higher (meaning that for every one unit of energy in, you get 0.9 out). Because they rely on combustion to generate energy, natural gas appliances cannot reach 100% efficiency. However, because heat pumps transfer heat from one place to another instead of generating it, they can reach 300-400% efficiency (i.e. for every unit of energy in, you get 3-4 out), making them three or more times as efficient as gas technology.[60]

However, older electric resistance space and water heating equipment is not as efficient as heat pumps. It is also important to acknowledge that currently electricity tends to be more expensive than gas. Simply switching from gas appliances to electric appliances alone won't save people money on their energy bills unless they choose high-efficiency electric equipment such as heat pumps or pair electrification with weatherization or other efficiency improvements.

Even in areas with high electricity costs, natural gas also may not be cheaper than electricity forever. As more buildings become electrified, the cost per remaining

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[57] *More than 60% of energy used for electricity generation is lost in conversion - U.S. Energy Information Administration (EIA)*. (n.d.). https://www.eia.gov/todayinenergy/detail.php?id=44436

[58] *Climate change commitment - American Gas Association*. (2023, May 12). American Gas Association. https://www.aga.org/natural-gas/environment/climate-change-commitment/#:~:text=The%20natural%20gas%20delivery%20system,the%20delivery%20of%20natural%20gas.

[59] *Importance of methane | US EPA*. (2024, October 21). US EPA. https://www.epa.gov/gmi/importance-methane#:~:text=Methane%20is%20the%20second%20most,trapping%20heat%20in%20the%20atmosphere.

[60] https://www.technologyreview.com/2023/02/14/1068582/everything-you-need-to-know-about-heat-pumps/#:~:text=Heat%20pumps%20today%20can%20reach,today%20reach%20around%2095%25%20efficiency.

natural gas customer will increase as the financial burden to maintain the natural gas system infrastructure falls on the shoulders of fewer and fewer people.[61]

Are gas appliances more resilient in power outages than electric ones?

In most cases, neither natural gas nor electric appliances will work in a power outage without a source of backup power. However, it is important to acknowledge that natural gas appliances generally need less backup power to function than electric ones. Listed below are explanations of what gas appliances may or may not work during a power outage. This information was provided by ID360, a consultant that the Town of Truckee worked with during the Town's reach code consideration process in 2024.

- **Gas Furnace:** During a power outage, a gas furnace will generally not function without backup power because it relies on electricity to operate certain components. This includes the fans that circulate the heated air through ducts into your living spaces. While gas wall furnaces can typically operate during a power outage, they are generally not effective as primary heating sources and are not common in Truckee.
- **Gas range and oven:** A gas range will typically function during a power outage, but a gas oven will not. When you turn on a gas stove, the clicking sound comes from the electric ignition, which sparks the flame for cooking. During a power outage, this ignition system won't work, but you can often light the stove manually with a match or lighter. However, some newer models are designed to prevent manual ignition.

  Modern gas ovens, on the other hand, require an electric ignition to light the pilot and start the flame needed to heat the oven. Unlike gas stoves, most ovens cannot be lit manually. Additionally, the fans used to exhaust fumes from both stoves and ovens require electricity to operate.
- **Water heaters:** Tank-type water heaters are the most common type in Truckee and will generally not work during a power outage, though already-heated water in the tank will be available. Modern gas tank-type water heaters typically use electronic ignition systems, which rely on electricity to operate. However, older models with continuously burning pilot lights or some types of direct-vent water heaters can continue to function without power. Tankless gas water heaters, while highly efficient, also fail to operate during power outages. These systems heat water on demand using gas but require electronic controls to function, which makes them dependent on electricity.

[61] Klivans, L. (2024, September 30). Newsom signs bill to help California neighborhoods ditch gas and go all electric. *KQED*. https://www.kqed.org/news/12006711/newsom-signs-bill-to-help-california-neighborhoods-ditch-gas-and-go-all-electric

Is the Town of Truckee considering banning natural gas?

The Town of Truckee is not currently considering measures for either new construction or existing buildings that would prohibit the use of natural gas. Based on the 2023 Ninth Circuit Court of Appeals decision in the *California Restaurant Association v. City of Berkeley*, reach codes and other building code amendments that prohibit the use of natural gas are no longer considered legally viable pathways for local jurisdictions in California or elsewhere in the territory covered by the Ninth Circuit Court of Appeals.[62]

Does the electrical grid have enough capacity to keep up with more demand from increased electrification?

According to the TDPUD, the district's power lines and substations are designed to handle significantly higher electrical loads than we currently use. This means that we have more than enough spare capacity for electrification in the foreseeable future and plenty of time to expand our infrastructure where necessary to prepare for longer term forecasts of electrification load growth. Installing energy efficient appliances, making building envelopes as efficient as possible, and implementing demand reduction measures will help to reduce this load.[63]

Isn't mining to get the minerals needed for building decarbonization and electrification related technologies just as bad for the environment as fossil fuels?

It is true that green technologies need minerals such as copper and lithium to be produced and the method of extracting these minerals often come from mining practices that are harmful to the environment. However, the amount of emissions produced from mining these minerals is still significantly less than the emissions created from our current fossil fuel infrastructure. Once green technology has been created, it uses and produces little to no emissions. For example, for every gigawatt of clean energy technology used, millions of tons of CO_2 emissions are prevented. [64] Ultimately, the investment and creation of green technology will reduce greenhouse gas emission produced, not add to them.

[62] Building Decarbonization Coalition. (2024, March 1). *Implications of California Restaurant Association v. City of Berkeley Ninth Circuit Decision - BDC*. BDC. https://buildingdecarb.org/resource/implications-of-california-restaurant-association-v-city-of-berkeley-ninth-circuit-decision

[63] This information was obtained directly from TDPUD

[64] *How does the environmental impact of mining for clean energy metals compare to mining for coal, oil and gas? | MIT Climate Portal*. (n.d.). MIT Climate Portal. https://climate.mit.edu/ask-mit/how-does-environmental-impact-mining-clean-energy-metals-compare-mining-coal-oil-and-gas