Pathways to Energy Affordability in Colorado
Executive Summary

Prepared for the Colorado Energy Office by Physicians, Scientists, and Engineers for Healthy Energy and the Institute for Energy and Environmental Research

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Across Colorado, many households struggle to pay their energy bills. This study finds that energy cost burdens—the fraction of household income spent on electricity and fuel use—are particularly high for the state's rural communities, low-income households, renters, populations of color, mobile home residents, and propane users. These energy cost burdens can be alleviated over time by investing in key energy upgrades. In the near term, increased support from bill assistance programs—such as percentage of income payment plans—can help lower energy cost burdens. This assistance can be slowly reduced as home upgrades reach an increasing number of households statewide and lower their burdens below six percent of income. The expansion of energy efficiency, community solar, and demand response in heavily energy-burdened communities can simultaneously improve energy affordability for those who need it most while helping the state achieve its climate and clean energy targets.

MEASURING ENERGY AFFORDABILITY

Energy access and affordability have profound implications on quality of life, happiness, and welfare. When energy is unaffordable for vulnerable populations and access is limited, these burdens can lead to severe social harms and economic inequalities.

Typically, households that spend over six percent of their income on energy are considered to have high energy cost burdens (see **Box 1**). These households often face energy insecurity, defined as greater uncertainty that they can meet their energy needs. They may also experience fuel poverty, or the inability to afford essential energy services. Both energy insecurity and fuel poverty can result in adverse health outcomes, material deprivation, debt, and even homelessness.

The amount of energy a household uses per unit area, known as energy use intensity, can be helpful to identify homes where energy efficiency measures may be particularly effective (see **Box 1**). And all of these factors—energy cost burdens, insecurity, fuel poverty, and energy use intensity—interact in a complex dynamic with energy policy, housing infrastructure, socioeconomic factors, and historic inequities such as redlining. In this analysis, we assess energy affordability and energy use intensity across the state of Colorado and develop a suite of policy and program recommendations with the goal of lowering energy cost burdens below six percent.

BOX 1

Energy Cost Burden

Energy cost burden is defined as the percentage of household income spent meeting home energy needs. Typically, energy cost burdens over six percent are considered high.

Energy Use Intensity

Energy use intensity is the average energy consumed per square foot in a household or apartment. High energy use intensity typically indicates inefficient homes or appliances.

ENERGY COST BURDENS ACROSS COLORADO

A detailed analysis of existing energy cost burdens in Colorado is essential to identify which populations struggle to pay their energy bills. This analysis can also help develop policies and programs tailored to meet the needs of specific communities and regions. We use regression models based on geographic, demographic, climate, and housing-related variables to estimate census-tract level electricity and fuel use in residential buildings. Average census tract energy cost burdens are mapped in **Figure 1**.

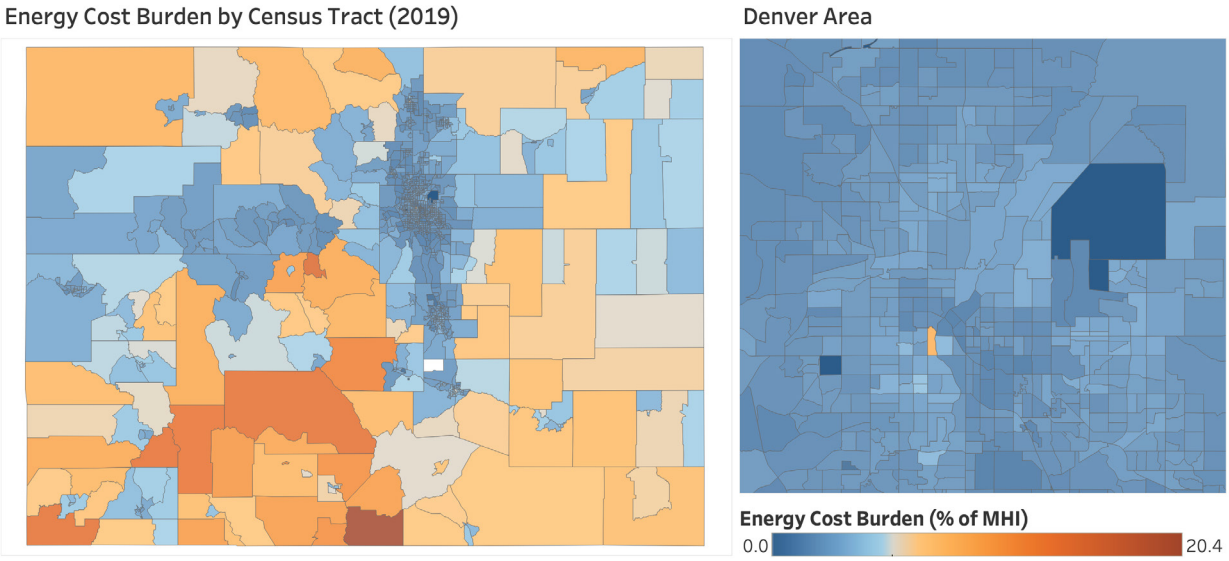

Figure 1. Colorado Energy Cost Burden Landscape. Average energy cost burdens by census tract shown on a blue-to-orange color divergent map, with orange color indicating high energy cost burdens. The blue-to-orange color transition point is set at six percent.

> ***Across Colorado, we find that about 17 percent of households face energy cost burdens over six percent.***

Energy affordability is a particularly acute issue among specific populations such as low-income households and those in rural areas (see **Figure 2**). By identifying communities and households with high energy burdens, we can develop policies and programs to target the state's most needy populations. A few of the trends we identified include:

Urban and rural areas. Rural areas across Colorado typically have higher energy cost burdens and higher energy use intensity than urban areas. Rural homes are also more likely to use propane, which is expensive, and wood, which is associated with higher indoor air pollution. Rural households are largely served by rural co-ops, some of which have the highest electricity rates. Homes in urban areas typically use less energy and pay lower average energy prices than rural areas.

Population characteristics. Lower-income households have the greatest energy cost burdens (see **Figure 3**). Due to household income disparities these burdens fall disproportionately on populations of color. Even so, when controlling for the effects of income, we find that communities of color in urban areas, renters, and tracts with lower educational attainment are still subject to higher energy cost burdens than Whiter and more educated communities with the same income. In rural areas, populations tend to be more low-income, White, and in some regions Indigenous, and these areas also face high energy cost burdens.

Climate. Energy use intensity is higher in colder climates due to increased space heating needs. When controlling for climate and differences between urban and rural areas, we find that higher-income households are more efficient despite using more energy overall—mainly to power larger homes and more appliances. This disparity in energy use intensity may be due in part to 1) limited funds in low-income households for efficiency upgrades and 2) the "split incentive" problem, where renters pay the energy bill but landlords are responsible for investments in efficiency.

Tenure and housing type. Despite lower average energy use among renters, urban communities with a larger portion of renters face higher energy cost burdens than those with high rates of homeownership. Although apartments tend to be more energy efficient, they are also less owner occupied, which correlates strongly with income and therefore with energy cost burden.

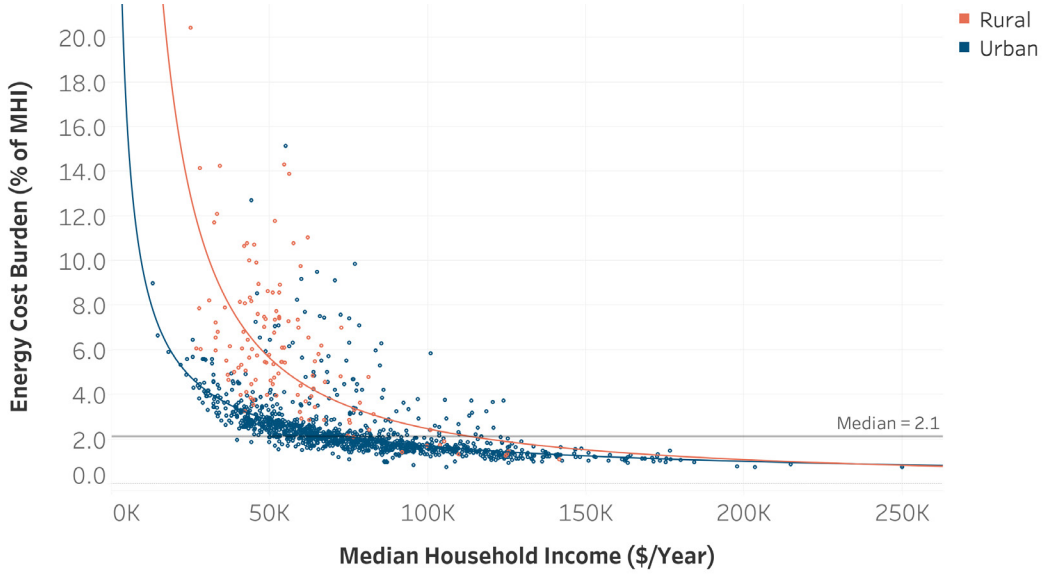

Figure 2. Energy Cost Burden and Income. Average energy cost burdens by census tract as function of median household income (MHI). Lower-income census tracts tend to spend a much greater proportion of their income on energy bills. Rural areas generally have higher energy cost burdens than urban areas.

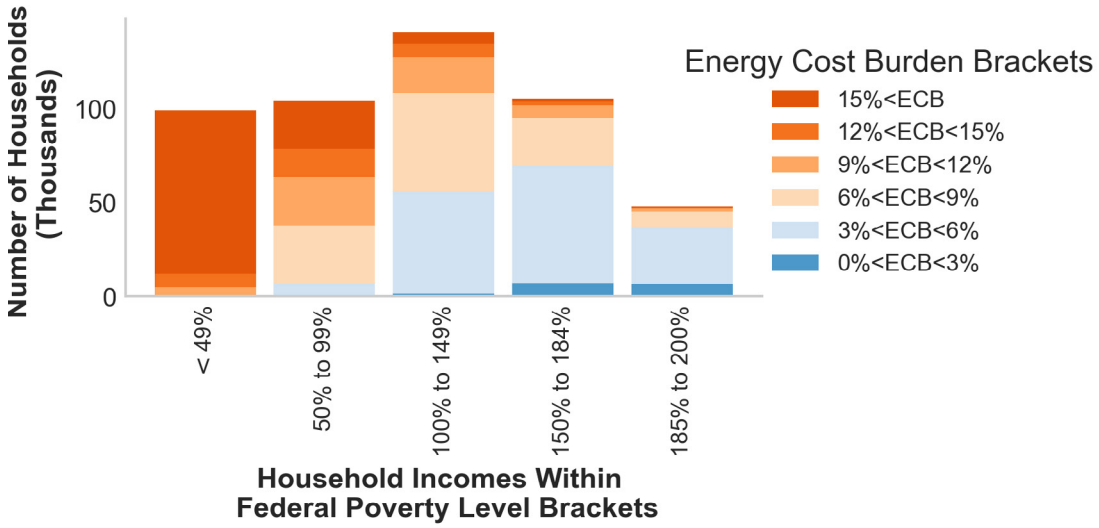

Figure 3. Energy Cost Burden by Income Bracket. Total number of households in income brackets with energy cost burdens less than or equal to (blue) and greater than (orange) six percent.

POLICY RECOMMENDATIONS

Our approach to policy solutions is to recommend options that would reduce energy cost burdens for all low- and moderate-income households to six percent of their income or less, mainly through investments such as weatherization and community solar, and using bill assistance as a supplement rather than a mainstay. Colorado has a suite of existing programs designed to improve energy affordability (see **Box 2**). Colorado has also established the Colorado Clean Energy Fund, a green bank that can finance many of these energy investments with low-interest loans. By expanding existing programs and developing new complementary programs, Colorado can help all households reduce their energy cost burdens to under six percent. Below, we provide a policy strategy to help achieve energy affordability for all Colorado households over the next two decades, while also supporting the state's decarbonization goals.

We focus on the following key measures:

1. **Efficiency and electrification investments:** These measures include investments in building envelopes; increasing the efficiency of electric appliances, such as lighting and water heaters; and the conversion of gas and propane-heated homes to efficient electric heat pump systems (see **Box 3**).
2. **Community solar gardens:** The build-out of sufficient community solar can ultimately ensure subscriptions can meet 100 percent of low- and moderate-income electricity requirements, including the increase in electricity demand from electrification.
3. **Demand response:** Residential demand response programs, enabled through the adoption of smart appliances and build-out of broadband infrastructure, can help reduce energy costs through payments to customers for avoiding energy use at peak times.
4. **Energy assistance:** Enrollment in programs such as LEAP and PIPP is expanded to all households meeting eligibility requirements.
5. **Green bank:** Increasing the capitalization of the Colorado Clean Energy Fund would enable low- to no-interest financing with a mix of loans to weatherize homes and electrify space and water heating.
6. **Grants for weatherization:** Households in the lowest income bracket (less than 50 percent of the Federal Poverty Level) would be given as grants (rather than loans) for weatherization.

While we did not model their impacts, measures such as building energy efficiency codes (regulated at the county level in Colorado) and appliance efficiency standards can help facilitate decarbonization and reduce energy use intensity for households of all income levels across the state. New building codes, in particular, can help mitigate the need for expensive retrofits.

BOX 2

Key Existing Programs for Low-Income Households

- **Weatherization Assistance Program (WAP):** Provides energy efficiency, electrification, and rooftop solar upgrades.
- **Low-Income Energy Assistance Program (LEAP):** Funding to pay heating bills.
- **Percentage-of-Income Payment Plans (PIPP):** Energy assistance to cap utility bills to six percent.
- **Colorado's Affordable Residential Energy Program (CARE):** Energy efficiency upgrades.
- **Crisis Intervention Program:** Repair and replacement of broken heating systems.
- **Bill Payment Assistance:** Support for households behind on energy bills.
- **Community Solar Gardens:** Carve-out for low-income households.

BOX 3

Heat Pumps

Heat pumps are an efficient electricity-powered technology to heat and cool buildings. They transfer heat from the outside air or ground to the interior of the building. Heat pumps provide an efficient option to replace the gas or propane typically burned to heat homes and water, and they provide cooling in the summers as well. *Air-source heat pumps* extract heat from the ambient air, while *ground-source heat pumps* transfer heat from the ground; the latter are more expensive but more efficient. In Colorado's mountainous regions, the adoption of *cold-climate heat pumps* can enable heating even when outdoor temperatures are very low. In Colorado, heat pumps produce two to four times the amount of heating using the same amount of energy as fossil fuel or radiant electric heating. Heat pumps not only improve overall efficiency, but also reduce carbon emissions and indoor air pollution attributable to fuel combustion. Heat pump replacement of propane heating systems, in particular, is likely to provide heating bill savings.

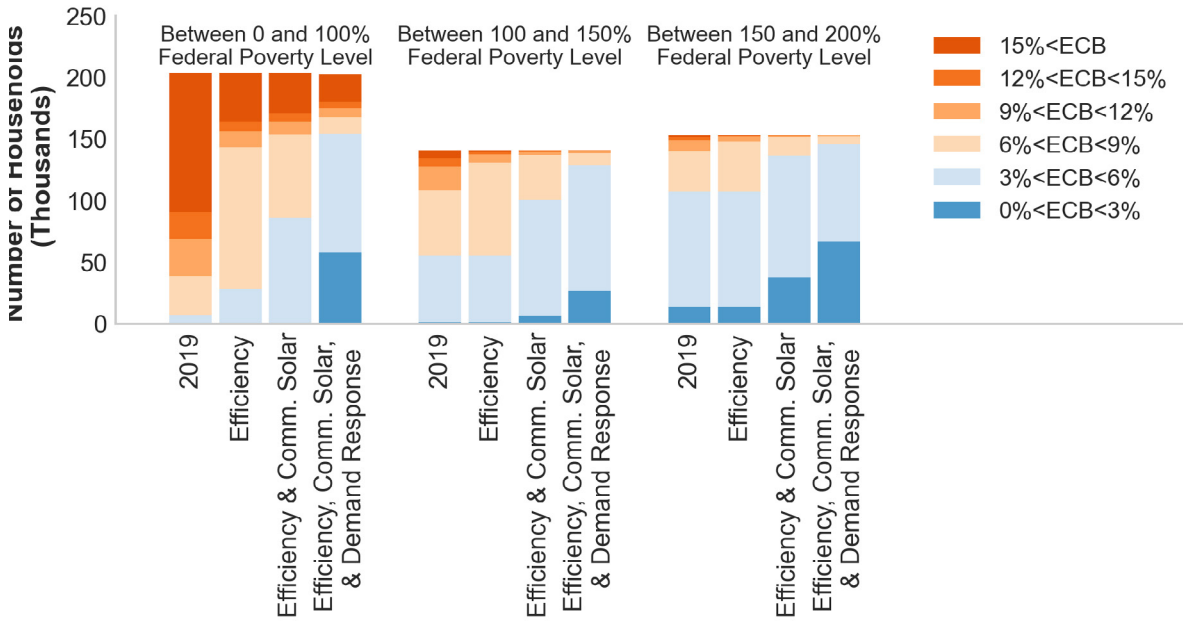

Figure 4. Cumulative Impact to Energy Cost Burden (ECB) of Each Intervention. Illustration of the sequential impact of the various investment components on reducing energy cost burdens within income brackets.

Our recommended approach (illustrated in Figure 4) includes the following steps:

1. Increase funding and enrollment levels to expand the PIPP program[1] and alleviate energy cost burdens for as many eligible households as soon as possible.
2. Provide weatherization grants to the lowest-income households.
3. Use funds from the Colorado Clean Energy Fund to finance weatherization and electrification for low-to-moderate income households. Loans should be paid through on-bill financing and the total number of low-income houses weatherized per year more than quadrupled.
4. Expand access to community solar gardens to provide electricity at discounted rates for low- and moderate-income households. The Colorado Clean Energy Fund would create a loan-loss reserve to enable high enrollment.
5. Support the adoption of smart appliances in low-income households, including incentives for landlords, to expand demand response rebate programs, which reduce energy costs.
6. Reduce reliance on PIPP and other energy assistance programs over time as overall energy cost burdens decline due to investments in efficiency and access to discounted community solar.

1 Currently, only eight percent of eligible households are enrolled in PIPP.

A number of key considerations are important for enabling these programs and policies to be effective. Central among these include:

- **Community engagement:** Conduct up-front and continuous engagement with communities to identify enrollment barriers, design programs, and increase participation.
- **Capitalization of the Colorado Clean Energy Fund:** Capitalize the Fund adequately to enable it to finance the energy transition, including loans for low- and moderate-income households.
- **Prioritization of propane-heated households:** Prioritizing propane-heated households for weatherization and electrification would target areas that have the highest energy burdens while complementing a policy of not expanding gas infrastructure where it does not exist.
- **Elimination of enrollment barriers:** Decoupling LEAP and PIPP, allowing self-attestation of income, and conducting multilingual outreach can help increase enrollment levels. Recent legislation in Colorado (HB21-1105) has begun the process of increasing enrollment by automatic inclusion of households receiving supplemental nutrition benefits.
- **Expansion of broadband:** Broadband access can enable households to participate in time-of-use rates and demand response.
- **Data collection, sharing, and transparency:** Regular data collection on measures such as weatherization investments and bill savings, the impact of rate structures, electrification, and demand response is essential for improving program effectiveness. The data can be anonymized for consistency with regulatory privacy rules, and shared with agencies, energy providers, and researchers.
- **Workforce development:** Broad expansion of weatherization and electrification efforts will require trained auditors and retrofit contractors in all parts of the state. Expansion of technologies such as geothermal heating and underground seasonal thermal storage may provide pathways to transition the oil and gas drilling industry to the renewable energy future.
- **Pilot projects:** A variety of pilot projects such as renewable microgrids, solar+storage, seasonal thermal storage, and whole house demand response with time-of-use rates for low to moderate income households aimed at 1) resiliency in the context of the energy transition, 2) minimizing winter heating peaks, particularly in the coldest areas, and 3) reducing electricity storage requirements while making full use of spring and fall variable energy surpluses.
- **Strengthening the grid in rural areas:** Electrification of heating in rural areas may require investments in strengthening the grid; this would help avoid expansions in gas infrastructure, a policy necessary to minimize stranded costs in the energy transition.
- **Coordination with rural co-ops:** Increasing capacity for weatherization and electrification will be needed in rural areas, especially those not on the interstate highway corridors. Coordination with co-ops (both distribution and wholesale electricity suppliers) and incentives to set targets and build capacity will be important to achieving the needed increase.

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