

Energy Efficiency

Colorado's Most Underrated Clean Energy Source

Highlights

- Energy efficiency investments are a strategic step in making Colorado a leader in the transition to a clean energy future and climate change resiliency without breaking the bank. Without investments in efficiency, investments in renewable energy are less effective. To truly be a leader on climate change, Colorado needs to invest in both energy efficiency and renewable energy sources.
- Efficiency investments made between 1990 and today helped avoid the need to build the equivalent of 313 large power plants and resulted in savings of \$790 billion to customers nationwide.
- Carbon dioxide (CO₂) emissions for the U.S. electric power sector declined 28 percent between 2005 and 2017 and of this decline, 52 percent can be attributed to energy efficiency.
- Colorado's top three cost-effective energy efficiency investments are: LED light bulb, Smart thermostats, and high-efficiency heat pumps.
- In Colorado, installing LED light bulbs can help families save between \$70 and \$1,000 annually on utility bills.
- If a portion of single-family residential homes in Colorado upgrade to LED lightbulbs, it would reduce overall state energy usage by 6 percent and save over \$70 million annually.
- Cost-effective energy efficiency improvements reduce carbon dioxide emissions and other gases associated with climate change by as much as 500,000 tons annually which equal to 60,000 homes annual energy use.

Introduction

While the falling price of renewable energy sources like solar and wind has made them a much more appealing investment in recent years, another clean and cost-effective resource has been overlooked: energy efficiency.

Energy efficiency simply means making better use of existing energy sources. In addition to the environmental benefits of less energy consumption and less need to develop new resources, it has the economic benefit of saving families money. Efficiency investments made between [1990 and today](#) helped avoid the need to build the equivalent of [313 large power plants](#) and resulted in savings of \$790 billion to customers nationwide.¹ Investments in energy efficiency benefit Colorado families, boost Colorado's economy, protect our environment, reduce energy bills, and improve public health.

Colorado's top three cost-effective energy efficiency investments² are:

- 1. LED light bulbs*
- 2. Smart thermostats*
- 3. High-efficiency heat pumps*

By upgrading to LED light bulbs or installing insulation in a home, families can decrease overall energy use and save money. If even a portion of single-family residential homes in Colorado were upgraded to LED lightbulbs the state would reduce overall energy usage by 6 percent and save over \$70 million annually.

Cost-effective energy efficiency improvements also reduce carbon dioxide emissions and other gases associated with climate change by as much as 500,000 tons annually. This is equal to the annual energy use of over 60,000 homes. Energy efficiency investments can move Colorado towards climate change resiliency without breaking the bank.

Efficiency in Colorado

In 2007, the Colorado General Assembly passed [HB07-1037](#). That bill required public utilities to adopt minimum energy savings goals. The Colorado Public Utilities Commission (PUC) set the energy saving goals as 5 percent reduction in energy use below the utility's 2006 peak demand and electricity sales by 2018. The PUC set these goals to account for half of the expected increase in demand each year. Since 2007, Colorado's investments in energy efficiency have continued to expand. Currently, Colorado ranks 14th most-improved in energy efficiency.³ Ten years later, state lawmakers passed [HB17-1227](#), which directed the PUC to set energy saving goals through 2028. While Colorado offers a wide variety of incentives to meet these energy

¹ <https://aceee.org/research-report/u1604>

² The [National Renewable Energy Laboratory](#) (NREL) estimated the top ten cost-effective energy efficiency investments for the state of Colorado based on the average cost of energy efficiency improvements, payback periods, and annual dollar and energy savings.

³ <https://aceee.org/state-policy/scorecard>

savings goals, the state needs to make additional investments in energy efficiency in order to meet the new 2028 goals.⁴

An Affordable Solution

By looking at the up-front costs and program costs of energy efficiency investments and the corresponding dollar and energy savings, we can see just how much bang for the buck these investments give Colorado. The American Council for an Energy-Efficient Economy (ACEEE) estimates energy efficiency programs cost utilities on average 2.4 cents per kilowatt hour (kWh) saved nationally.⁵ To put this into context, the cost of energy efficiency is approximately 20 cents per month or \$2.43 per year less than the cost of a latte. These costs are substantially lower than both conventional resources like coal and renewable resources like wind or solar as shown in the figure below.

Energy Programs Cost per kWh

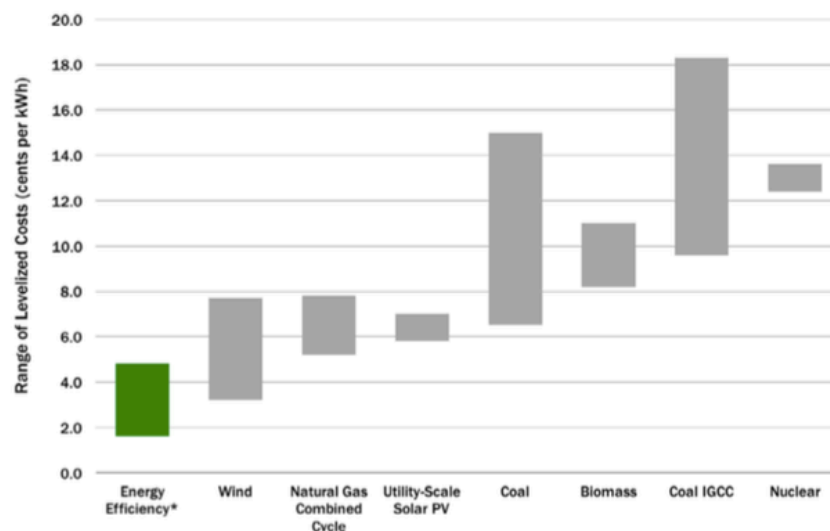


Figure 1: American Council for an Energy Efficient Economy

For consumers, the quickest and easiest return on their investment is upgrading to LED lighting, which would cost the average Colorado household \$258 to install in an entire home. A close second is installing a smart thermostat, which costs \$300 per home. The average payback period on these investments is between 26 and 51 months before families begin to see savings on energy bills and use.

⁴ <https://database.aceee.org/state/colorado>

⁵ <https://aceee.org/sites/default/files/cost-of-ee.pdf>

High-efficiency heat pumps, Colorado’s third-most cost-effective investments, have a higher average cost of \$2,144 per house, but those costs are recouped over a relatively quick 22-month payback period and have a high annual household savings of \$1,183. With high-efficiency heat pumps, families could see over \$1000 of savings on utility bills in as few as two years. See the table below for a full break down of the cost and return on investment of energy efficiency upgrades.

Improvement	Average improvement cost	Payback (Months)	Annual savings
LED Lighting	\$258	26	\$119
Smart thermostat	\$300	51	\$71
Duct sealing & insulating	\$1,081	118	\$110
Attic insulation	\$1,667	209	\$96
Insulated wall sheathing	\$1,704	118	\$174
High-efficiency heat pump	\$2,144	22	\$1,183
Crawlspace	\$2,645	143	\$222
Drill & fill wall cavity insulation	\$2,866	142	\$242
Basement wall insulaiton	\$3,778	275	\$165
Ductless heat pump	\$5,133	75	\$817

Figure 2

In Colorado, seemingly small investments like installing LED light bulbs can help families save between \$70 and \$1,000 annually on utility bills. In 2017, the [average monthly residential utility bill in Colorado was \\$82.47](#) which is about 27% below the U.S. average.⁶ This means the annual savings for LED light bulbs of \$119 dollars exceeds one month of a family’s utility costs. This can make a substantial difference for working families’ budgets, creating more room for other basic needs like health care, child care, and food.

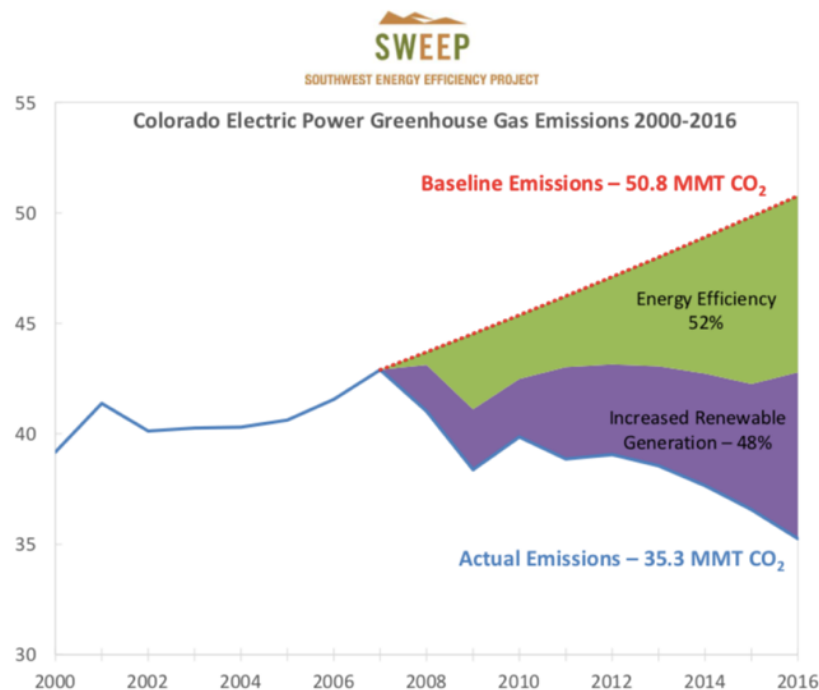
Energy efficiency investments also result in significant statewide savings. Both LED light bulbs and heat pumps save the Colorado consumers over \$70 million and smart thermostats save over \$50 million. Investments in energy efficiency help keep energy in Colorado families’ homes and dollars in families’ pockets.

Energy efficiency investments can save Colorado families \$70 million per year

⁶ https://www.eia.gov/electricity/sales_revenue_price/pdf/table5_a.pdf

Environmental Impact

The benefits of energy efficiency for Colorado families extend beyond lowering utility bills. [Energy efficiency reduces harmful greenhouse gas emissions](#) that contribute to climate change by reducing the amount of energy generation needed to meet customer demand.⁷ Figure 3 shows carbon dioxide (CO₂) emissions for the U.S. electric power sector [declined 28 percent between 2005 and 2017](#) and of this decline, 52 percent can be attributed to energy efficiency.⁸ In Colorado, greenhouse gas emissions from power plants fell by 18 percent between 2007 and 2016 from 50.8 million metric tons (MMT) of CO₂ to 35.3 MMT. This is equivalent to emissions from 1.9 billion smart phones being charged or 1.7 billion gallons of gasoline.



At the state level, the environmental impact from energy efficiency is seen in electricity savings and reductions in oil, gas, and propane consumption. When taking environmental impacts into consideration, as well as the cost-effective impact, the top energy efficiency investments change slightly. High efficiency heat pumps and LED light bulbs remain at the top, but ductless heat pumps move up, vying for position with basement wall insulation. Though basement wall insulation has a high average and repayment period cost at \$3,778 and 275 months, Colorado sees direct electricity savings of upwards of 170 Gigawatts annually or approximately enough electricity to power 800,000 homes.

⁷ <http://www.swenergy.org/electric-power-greenhouse-gas-emissions-reductions-in-the-southwest>

⁸ <https://www.eia.gov/todayinenergy/detail.php?id=37392>

These savings not only lower energy bills, they also reduce energy use, which reduces harmful air pollutants and other greenhouse gases, especially CO2 emissions. The graphic below shows Colorado's top energy efficiency investments, the electricity saved by each, and the corresponding reduction in CO2 emissions.

Environmental Impact		
Improvement	Electricity Savings (gWh)	Reduction CO2 Emissions (Tons)
LED Lighting	705.1	589,250
High-efficiency heat pump	613.7	512,970
Ductless heat pump	250.3	209,520
Basement wall insulation	177.6	148,800
Smart thermostat	154	129,040
Attic insulation	121.7	101,980
Drill & fill wall cavity insulation	101.4	84,980
Duct sealing & insulating	94.6	79,300
Crawlspace	65.6	55,030
Insulated wall sheathing	47.2	39,600

Figure 4

Reducing CO2 emissions and other harmful air pollutants is imperative to slowing climate change. Installing LED light bulbs will lead to over 700 gigawatt hours of electricity savings annually for the state, resulting in a 589,250-ton reduction in CO2 emissions. That's equal to the annual energy use for approximately 63,627 homes. Additionally, smart thermostats reduce CO2 emissions equal to the energy use of 13,934 homes. For high efficiency heat pumps, it's the equivalent of 55,390 homes.

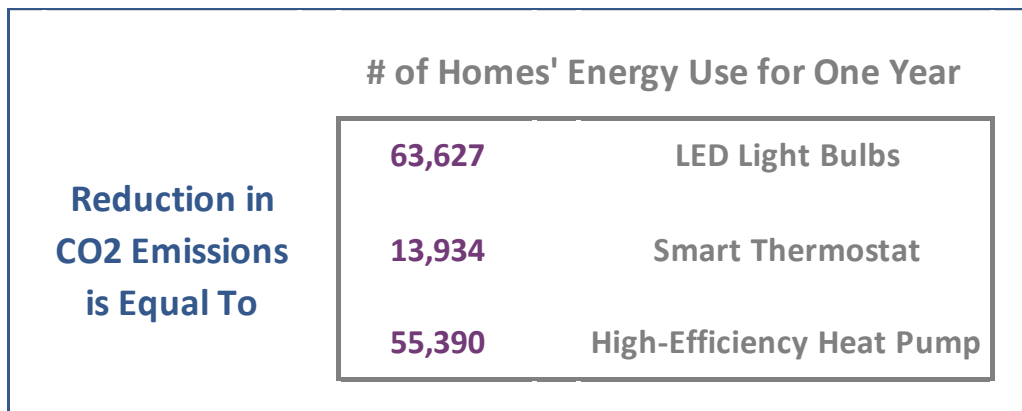


Figure 5

Energy efficiency investments are a strategic step in making Colorado a leader in the transition to a clean energy future and climate change resiliency without breaking the bank. Without investments in efficiency, investments in renewable energy are less effective. To truly be a leader on climate change, Colorado needs to invest in both energy efficiency and renewable energy sources. These cost-effective investments provide Colorado families with both utility bill and energy savings, while also protecting the outdoors that make Colorado a great place to live, work, and play.

Methodology

The National Renewable Laboratory's ResStock Analysis Tool helps states, municipalities, utilities, and manufacturers identify which home improvements save the most energy and money. The tool calculates average cost of energy efficiency improvements, annual dollar savings, payback periods, and energy savings. ResStock determines the cost-effective aspect of an improvement based on a positive net present value (NPV), evaluated using costs and benefits from the building owner's perspective instead of a utility or society perspective. The full ResStock methodology can be found [here](#). These cost-effective investments were used as a baseline to estimate monthly utility bill savings for working family budgets and the environmental benefits from reducing energy use.

The U.S. Energy Information Administration (EIA) estimates the average monthly utility bill by state. These were as a baseline to compare utility bill savings resulting from investments in energy efficiency in Colorado.

The Environmental Protection Agency's (EPA) Avoided Emissions and Generation Tool (AVERT model) was to calculate the reduction in Carbon Dioxide (CO₂) emissions that result from the electricity and energy savings. AVERT uses EPA reported emissions data to quantify the particulate matter (PM_{2.5}), nitrogen oxides (NO_x), sulfur dioxide (SO₂), and carbon dioxide (CO₂) emissions benefits of state and multi-state energy efficiency policies and programs. Because NREL estimates focus on electricity savings, the calculations for emissions reductions focused on carbon dioxide. AVERT was used to calculate the CO₂ emissions avoided by reducing electricity use. The EPA's Greenhouse Gas Equivalencies calculator was then used to determine the annual energy use of a home that would be avoided by reducing CO₂ emissions.

Sources

https://www.coloradopolitics.com/opinion/the-key-to-combating-climate-change-is-greater-energy-efficiency/article_84ef7440-1874-11e9-87bb-0b4c0ba9b8f8.html

<https://rhg.com/research/preliminary-us-emissions-estimates-for-2018/>

<https://www.lazard.com/perspective/levelized-cost-of-energy-and-levelized-cost-of-storage-2018/>