- Non-profit organization staffed by volunteers
- Mission: To educate the public and promote the use of clean, healthy and low cost renewable energy, and energy efficiency.
- More information at cres-energy.org

  (select Chapters/SECRES)

Colorado Renewable Energy Society

Building Efficiency Basics: Selecting Appliances

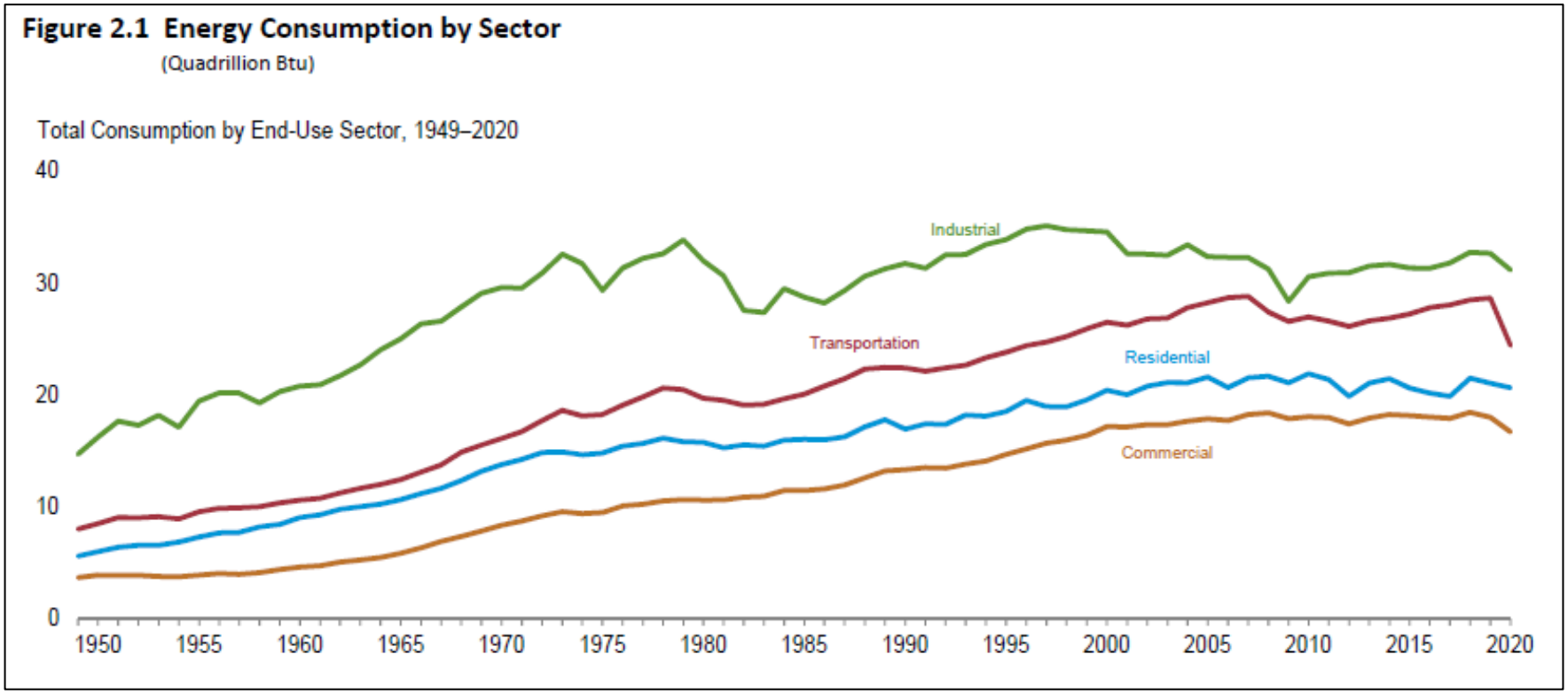
LEADING SOUTHEASTERN COLORADO AND ITS PEOPLE TO AN ENERGY-EFFICIENT (EE) AND RENEWABLE-ENERGY (RE) ECONOMY THROUGH EDUCATION, POLICY, AND ECONOMIC DEVELOPMENT.

CRES
Colorado Renewable Energy Society
SOUTHEASTERN CHAPTER

Presenter: Derek J. Law
Derek.J.Law@gmail.com

April 19, 2022

U.S. Energy Consumption by Sector

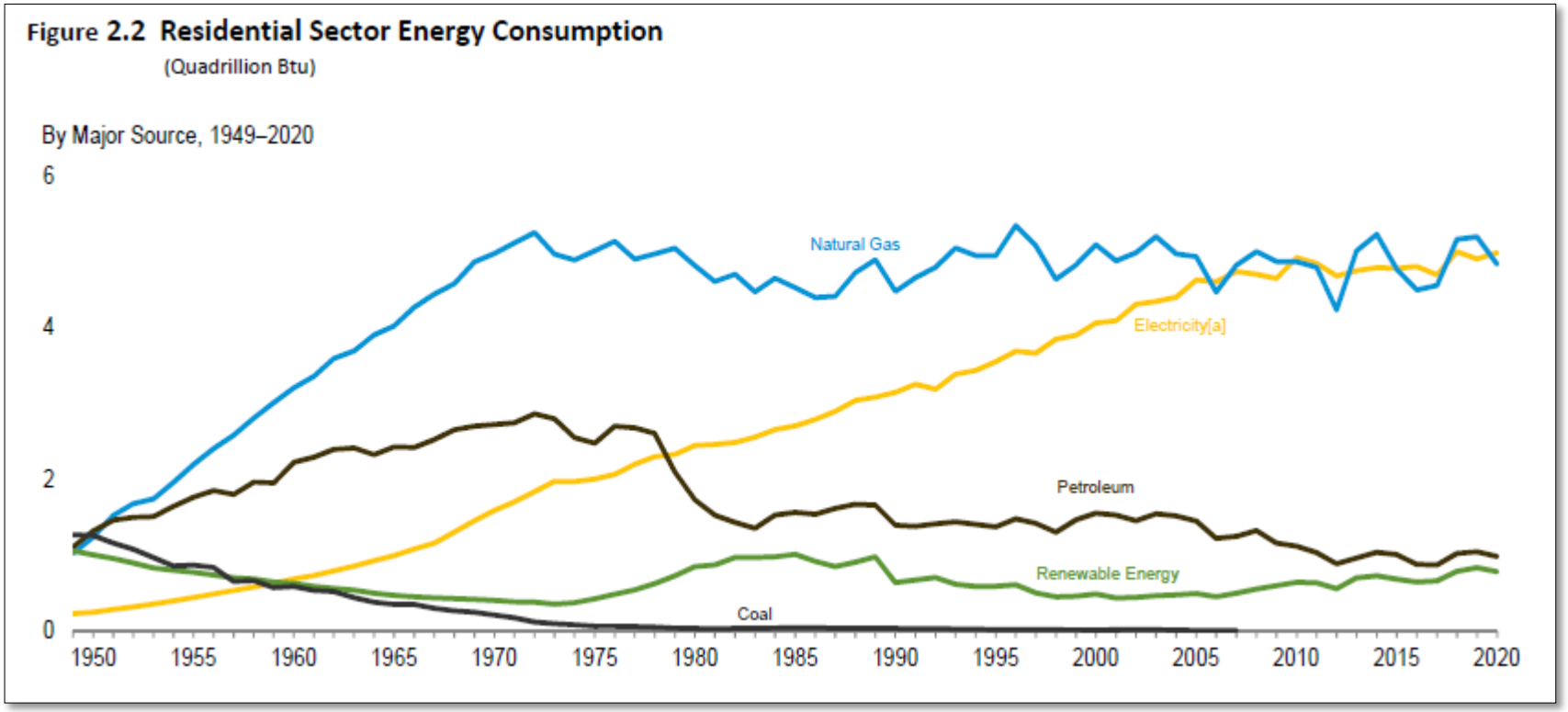


U. S. Energy Information Administration / Monthly Energy Review January 2022

U.S. Residential Energy Consumption

- Represents 22% of total U.S. consumption
- 20 Quadrillion BTU consumed annually

U.S. Residential Sector Energy Consumption by Source



*Does not illustrate 9 Quadrillion BTU in Electrical System Energy Losses

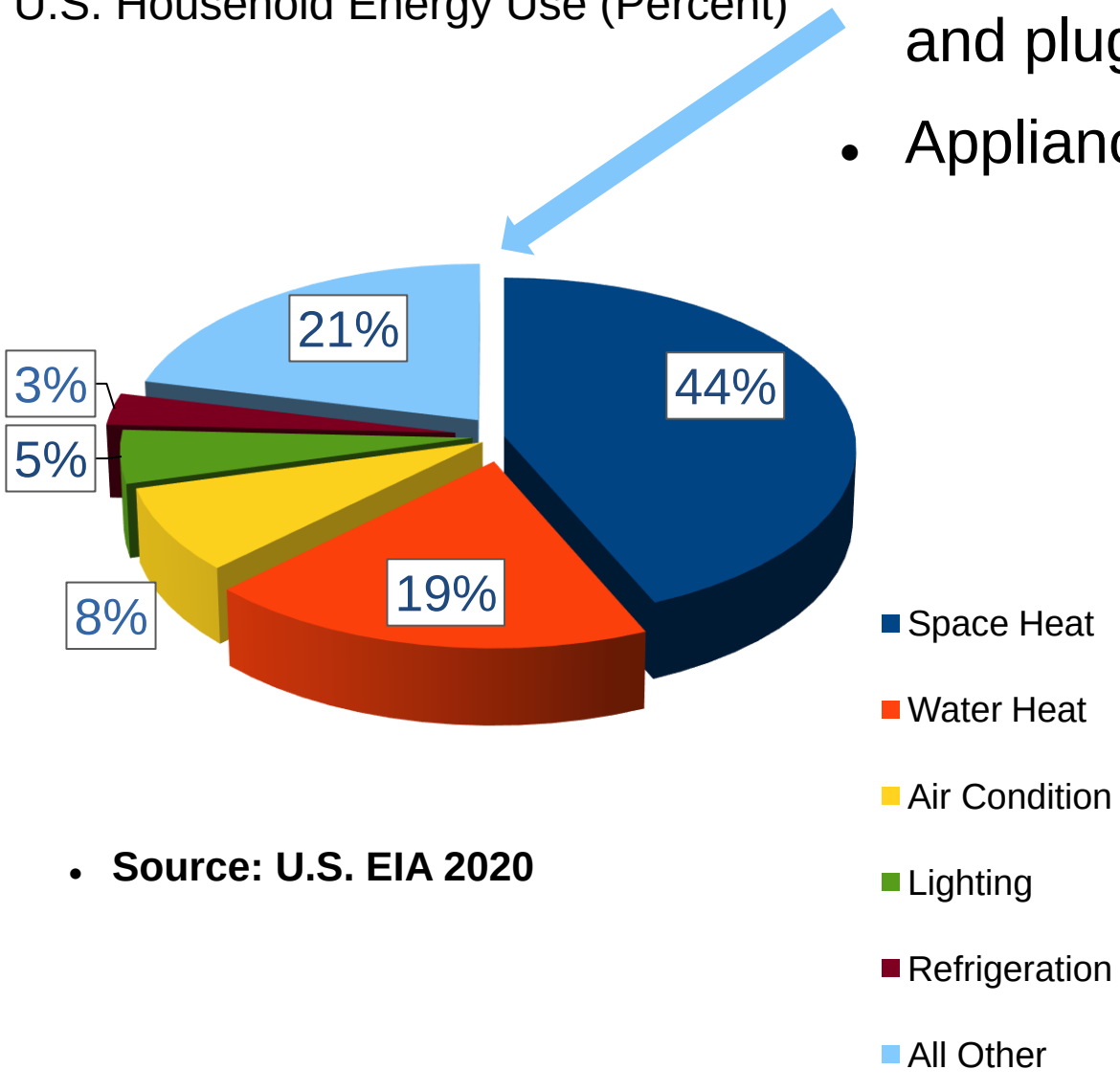
U. S. Energy Information Administration / Monthly Energy Review January 2022

Electricity is the Fastest Growing Residential Source of Energy

- 5 Quadrillion BTU consumed annually
- EnergyStar program aids in curbing accelerated growth
  - 500 billion kilowatt-hours of electricity saved annually
  - 390M tons of greenhouse gases ~5% of total U.S. greenhouse gas emissions

Home Energy Consumption
by Category

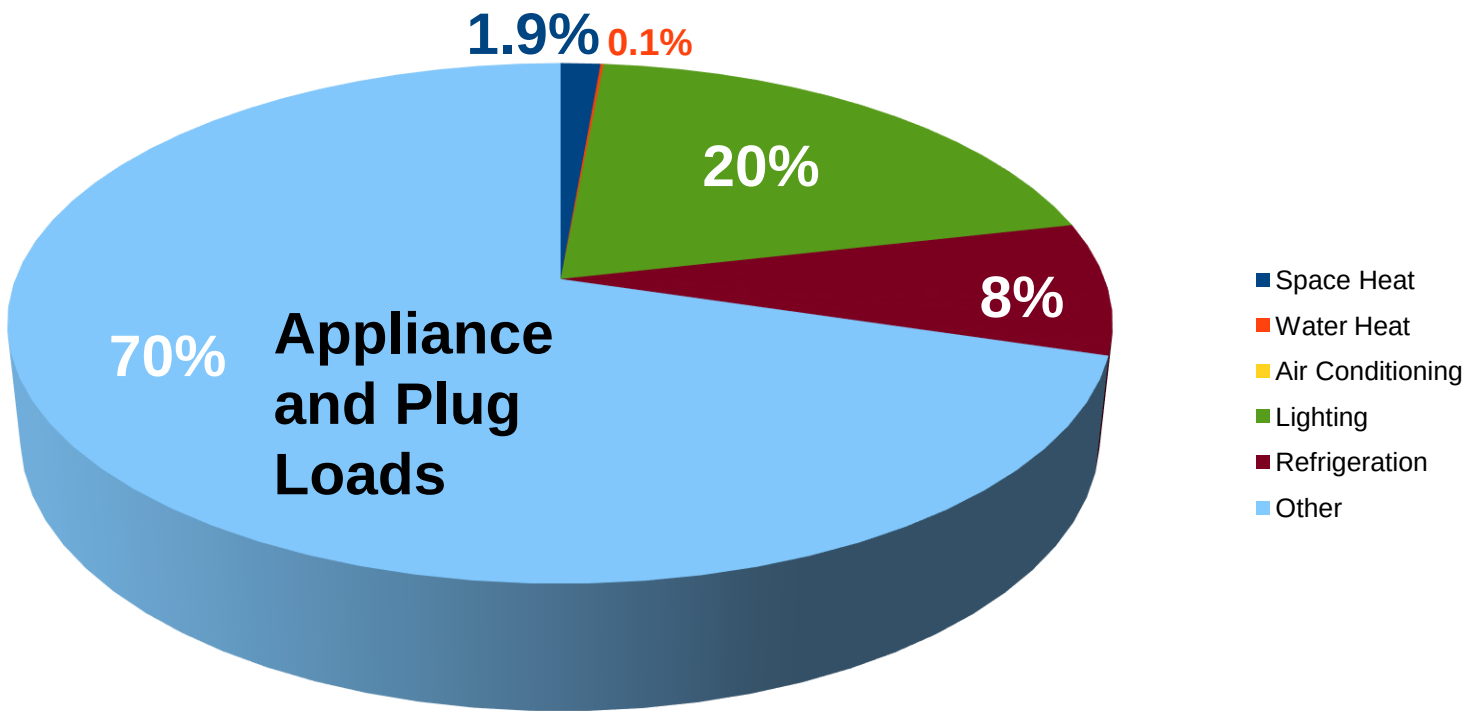
U.S. Household Energy Use (Percent)



- All Other category includes appliances and plug loads (except refrigeration)
- Appliance consumption is growing

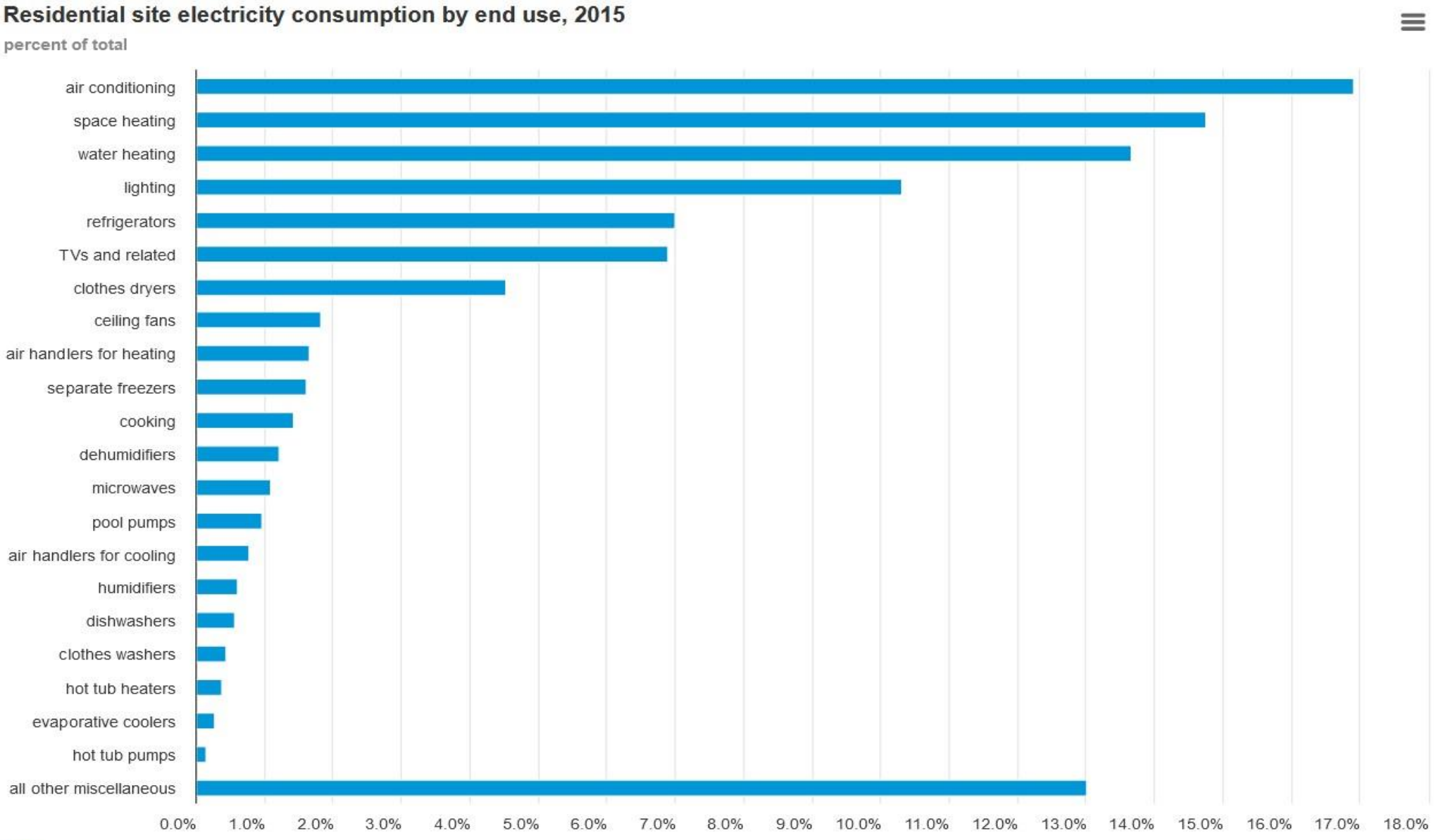
- **Source: U.S. EIA 2020**

Efficient Shell and Passive Solar
Shifts the Focus to Appliances & Plug Loads

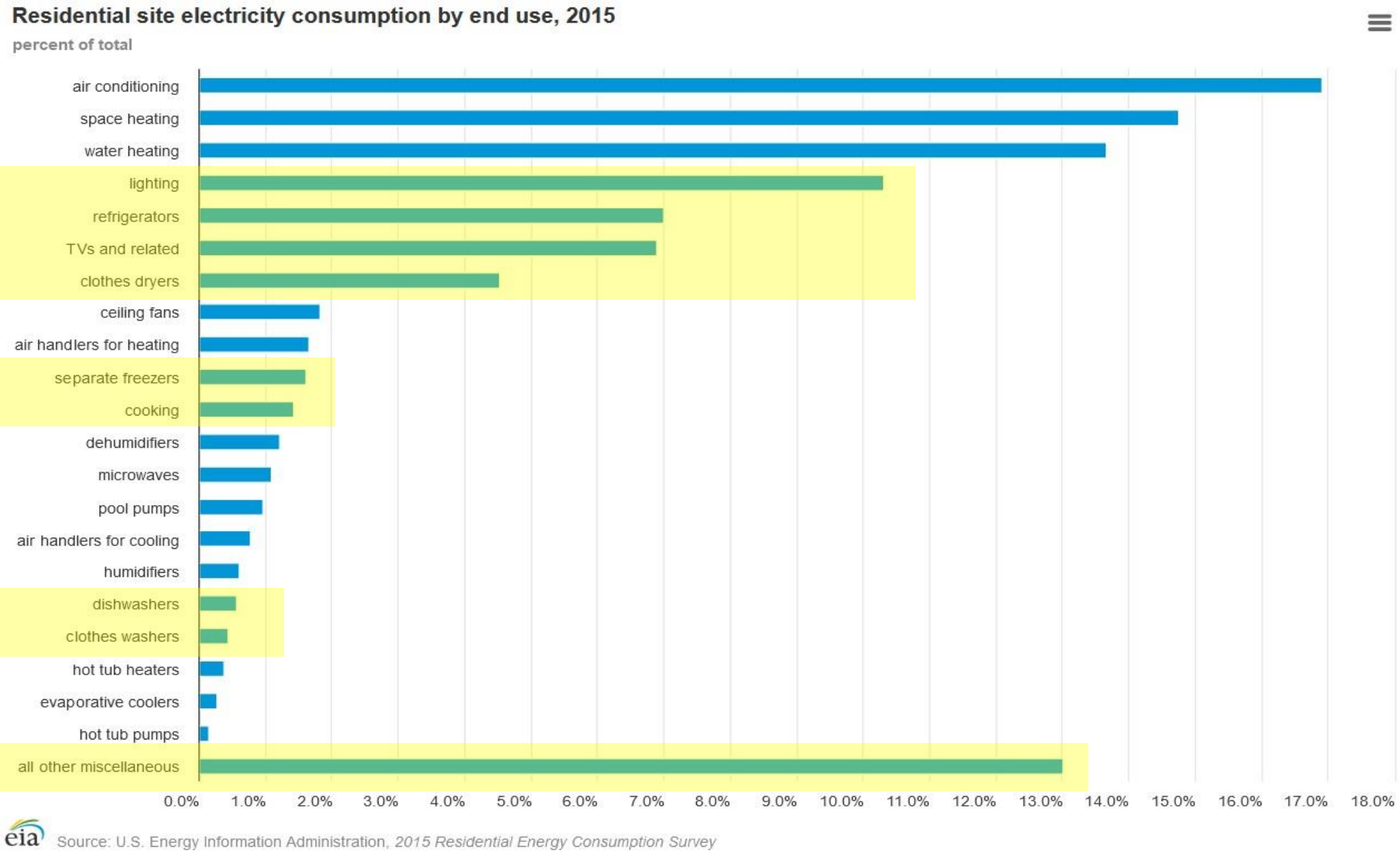


Modeled Loads of Net-Zero Energy House in Colorado

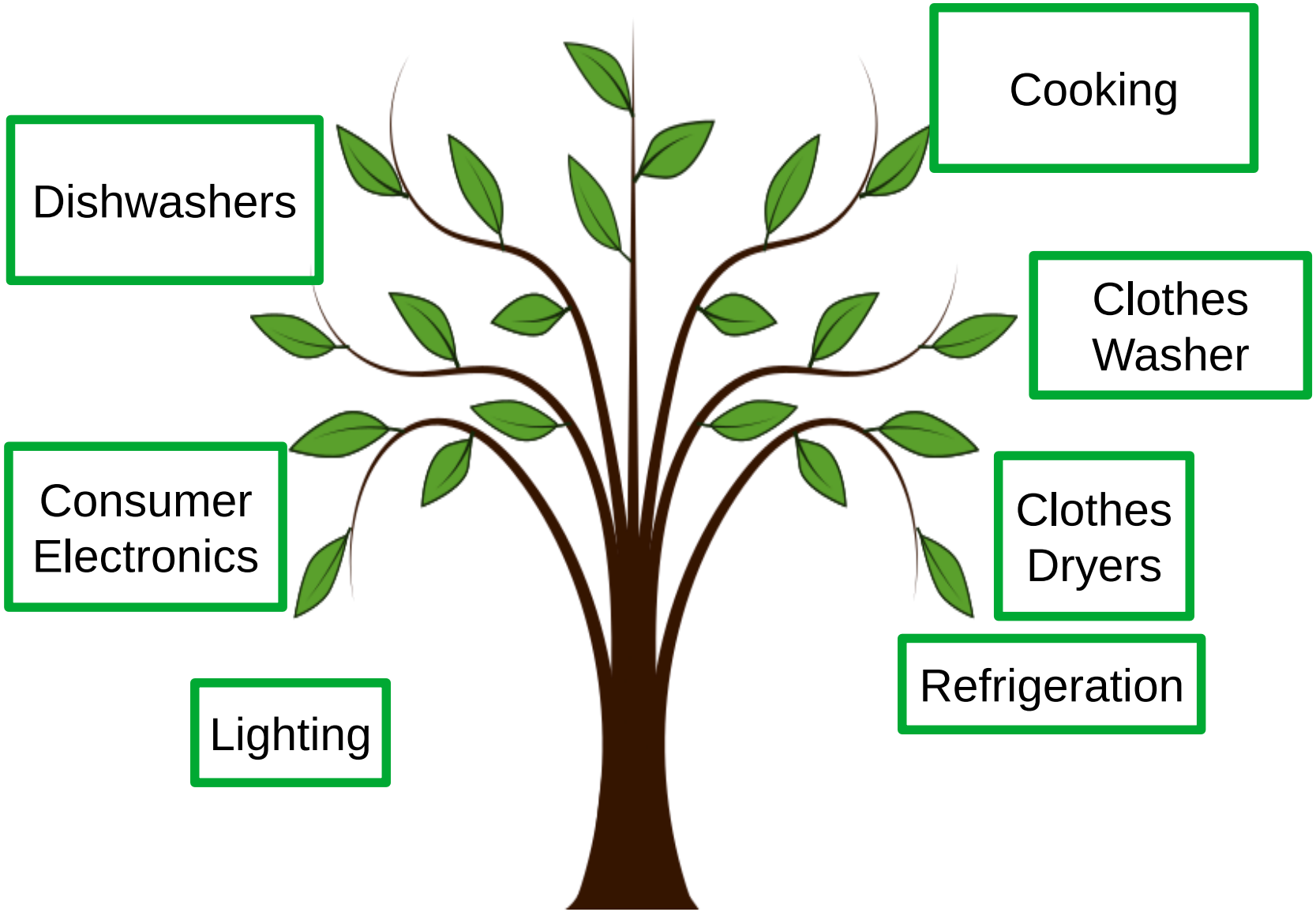
Electrical Consumption by Appliance



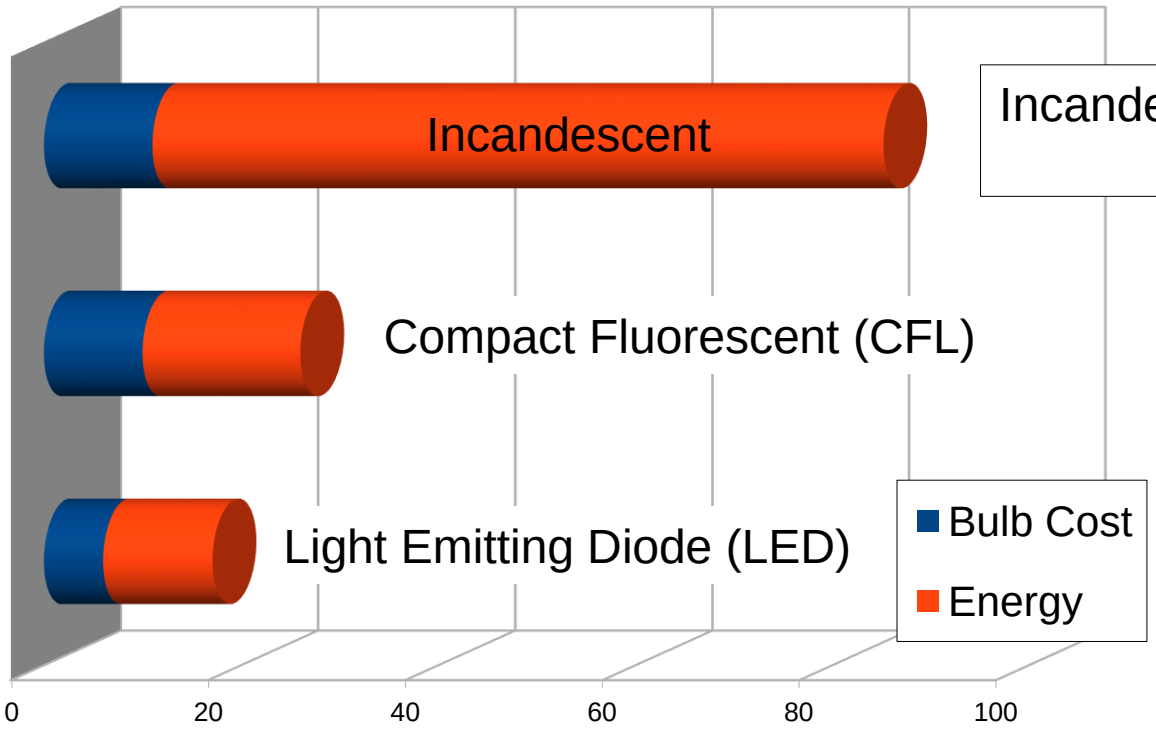
Electrical Consumption by Appliance



The Low Hanging Fruit



Lighting: 10-Year Cost



Incandescent Bulbs: 85-95% Heat
16 Lumens / watt

CFL: ~40% Heat
60 Lumens / watt

EnergyStar LED: ~20-30% Heat
up to 145 Lumens / watt

Savings from LED Bulbs

- Up to 50,000 hours of life (10x more than conventional)
- 9 watt consumption for 60 watt light output equivalency
- Less cooling energy needed in summer

Refrigeration

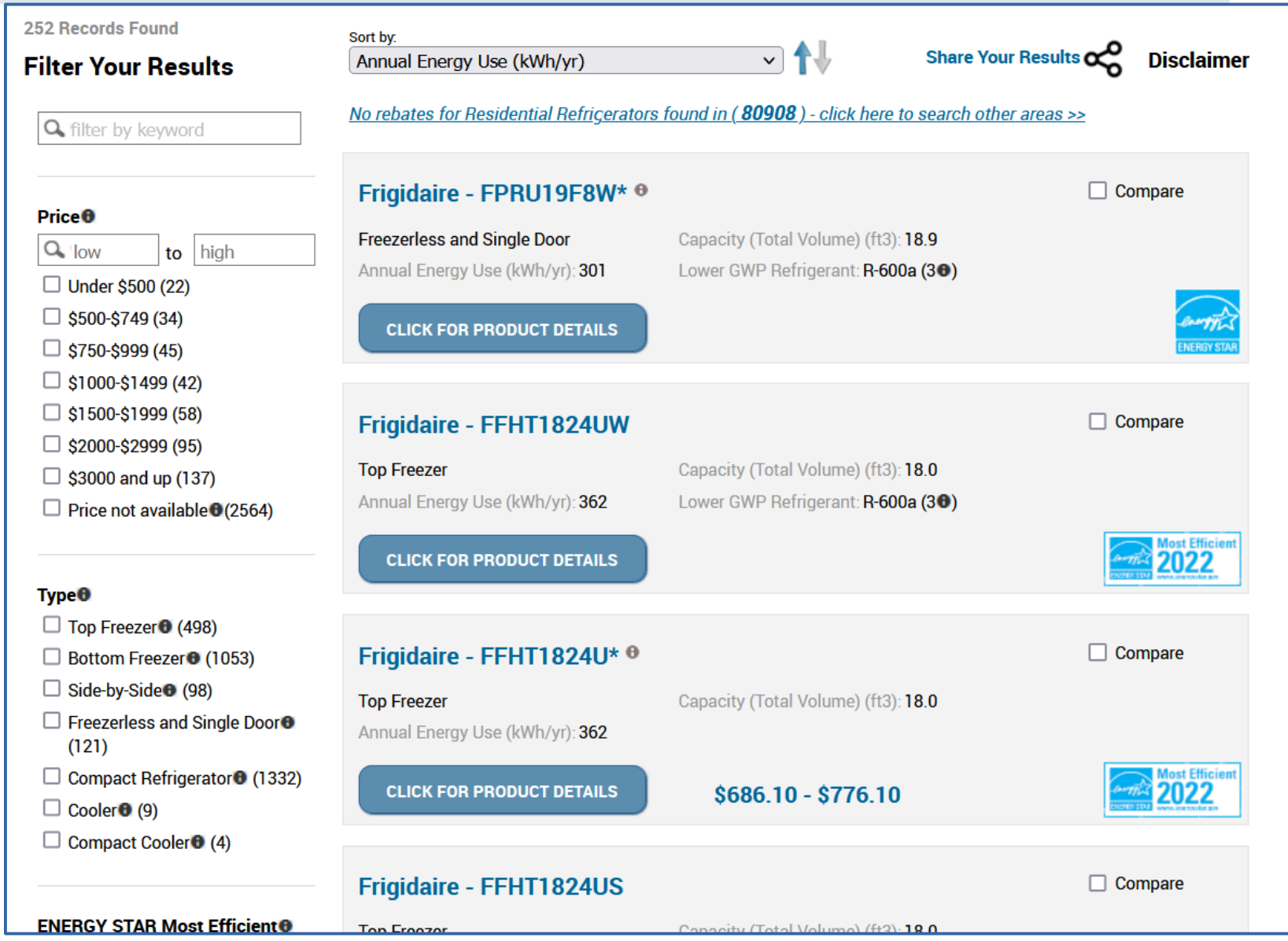
Start Here:
https://www.energystar.gov

Filters:

- Price
- Type
- Brand
- Volume
- Dimensions
- Features

Typical annual energy use dropped

1200 kWh in 1980
to
550 kWh today



Note: Fridge in unheated garage loses 15% efficiency

Clothes Washers

Start Here:
https://www.energystar.gov

$$IMEF = \frac{C}{M + E + D + L}$$

Higher IMEF = more energy efficient washer

- **Integrated Modified Energy Factor (IMEF):** measure of energy efficiency that factors:
  - Capacity (C)
  - Energy used by the washer during the cycle and standby (M)
  - Hot water energy consumption (E)
  - Energy needed to dry remaining water (wringing efficiency) (D)
  - Combined low power mode energy consumption (L)

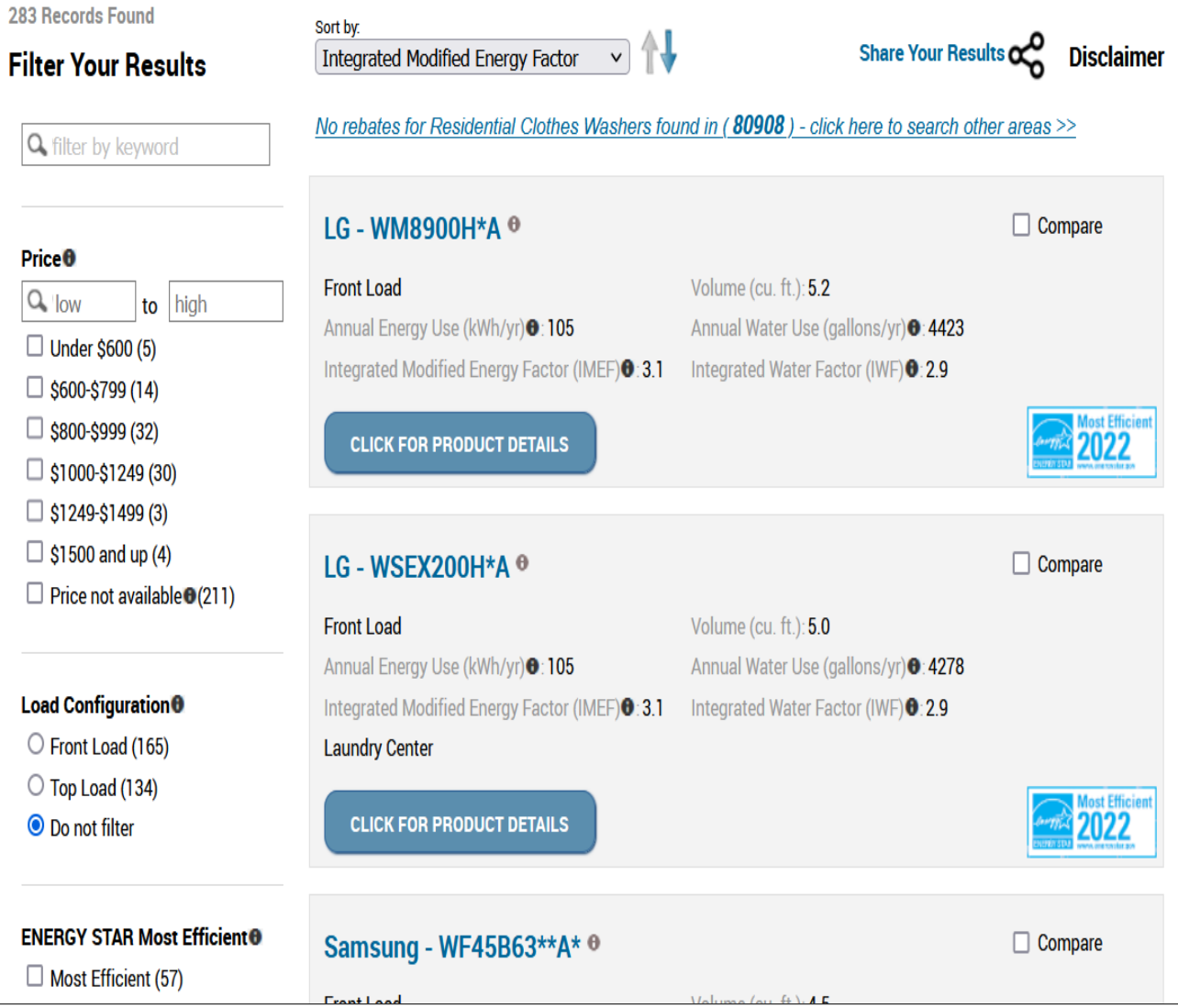
$$IWF = \frac{Q_A}{C}$$

Lower IWF = more water efficient washer

Integrated Water Factor (IWF): measure of water efficiency that factors:

- Gallons of water consumed for all wash cycles (Qa)
- Cubic foot of capacity (C)

Clothes Washer Notes



- In general, <u>Front Load</u> washers are more efficient
  - Typical EnergyStar Front Load: 100 kWh/yr; 4200 gal/yr
  - Typical EnergyStar Top Load: 130 kWh/yr; 5100 gal/yr

Clothes Dryers

- Clothes dryers consume more energy than any other home appliance
- Relatively new EnergyStar category (est. 19 May 2014)

$$CEF = \frac{C\ (lbs)}{E_{on} + E_{standby}}$$

Higher CEF = more energy efficient dryer

- **Combined Energy Factor (CEF)**: measure of energy efficiency that factors:
  - Load size (C)
  - Energy use during operational and standby cycles (E)
- Select capacity that meets your needs
  - Drying too large or too small both waste energy
- Types: traditional vented; ventless (condensing); heat pump
  - Most efficient is the ventless heat pump
- Example of the difference between EnergyStar-rated models:
  - Most efficient 299 kWh/yr vs least efficient: 640 kWh/yr ($33 vs $70 per yr)
- Non-EnergyStar vented dryers: approx 900 kWh/yr ($99/yr)

Sample Dryer Search by Efficiency (> 7 cuft capacity)

Fuel Type
- (•) Electric Clothes Dryer (351)
- ( ) Gas Clothes Dryer (154)
- ( ) Do not filter

ENERGY STAR Most Efficient
- [x] Most Efficient (27)

Other Features and Characteristics
- [ ] Connected (11)
- [ ] Paired with ENERGY STAR Clothes Washer (285)
- [ ] Vented (441)
- [ ] Ventless (64)
- [ ] Heat Pump Technology (36)

Show more

Refrigerant Type
- [ ] Lower impact on global warming (1)

Brand Name
- [ ] Almison (2)
- [ ] Amana (3)
- [ ] Asko (2)

Whirlpool - WHD560CH**

[ ] Compare

Electric Standard Ventless
Combined Energy Factor (CEF): 5.2
Drum Capacity (cu-ft): 7.4
Estimated Annual Energy Use (kWh/yr): 460

Paired with ENERGY STAR Clothes Washer, Heat Pump

CLICK FOR PRODUCT DETAILS

Most Efficient 2022

Whirlpool - WHD862CH**

[ ] Compare

Electric Standard Ventless
Combined Energy Factor (CEF): 5.2
Drum Capacity (cu-ft): 7.4
Estimated Annual Energy Use (kWh/yr): 460

Heat Pump

CLICK FOR PRODUCT DETAILS

Most Efficient 2022

Whirlpool - WED9290FW*

[ ] Compare

Electric Standard Ventless
Combined Energy Factor (CEF): 4.5
Drum Capacity (cu-ft): 7.4
Estimated Annual Energy Use (kWh/yr): 531

Paired with ENERGY STAR Clothes Washer, Heat Pump

CLICK FOR PRODUCT DETAILS

Most Efficient 2022

Whirlpool - WED7990FW*

[ ] Compare

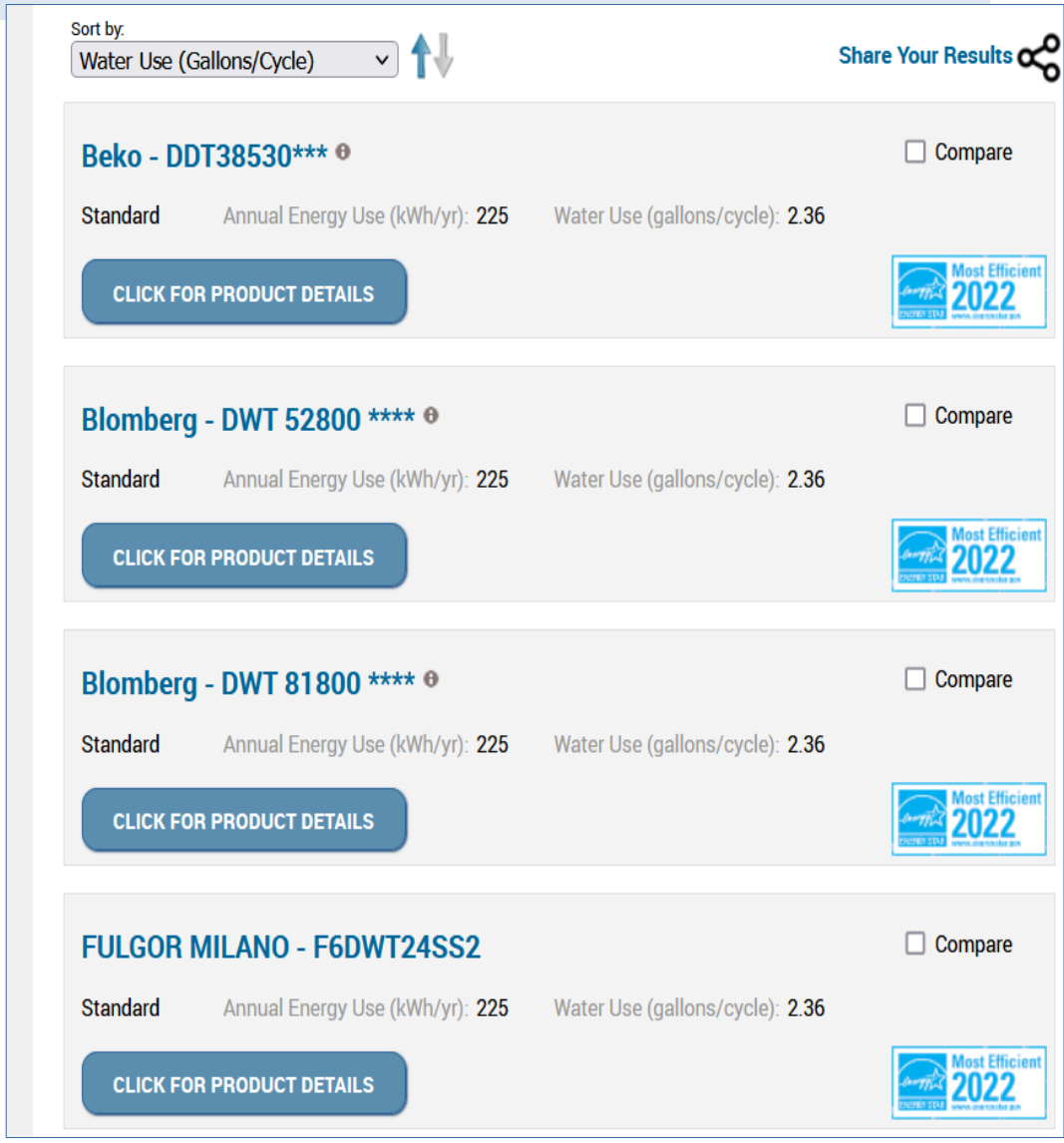
Electric Standard Ventless
Combined Energy Factor (CEF): 4.5
Drum Capacity (cu-ft): 7.4
Estimated Annual Energy Use (kWh/yr): 531

Dishwashers

- Using an EnergyStar certified dishwasher compared to handwashing will save you:
  - $130 per year or $1,500 in total lifetime operating costs
  - 8,000 gallons of water per year
- Most EnergyStar models employ soil-sensing to control amount of water needed
- Boost water temperatures to 140 degrees which improves disinfection compared to handwashing
- Scrape don't rinse, for caked on food, use the rinse feature

Sample of Full Size Dishwashers- EnergyStar Rated

Sort by energy use



Sort by water consumption

Ensure it has an auto-sensing cycle with soil-sensor

Consumer Electronics / Phantom Loads

- Look for the EnergyStar label 

- Set up power-saving modes for computers, monitors, printers, modems, and routers
- When able, turn off electronics rather than use standby
- Phantom Loads: Energy consumption when an appliance or device is not in use (“off” or “standby”)
  - AC to DC transformers
  - Cable and satellite TV boxes are notorious offenders
- Check out a Kill-A-Watt power and energy meter from Pikes Peak Library District
- Connect devices to a power strip that is turned off nightly
- Use automatic timers – do not exceed the timer’s rated value

Phantom Loads
Real World Examples

Real world examples:

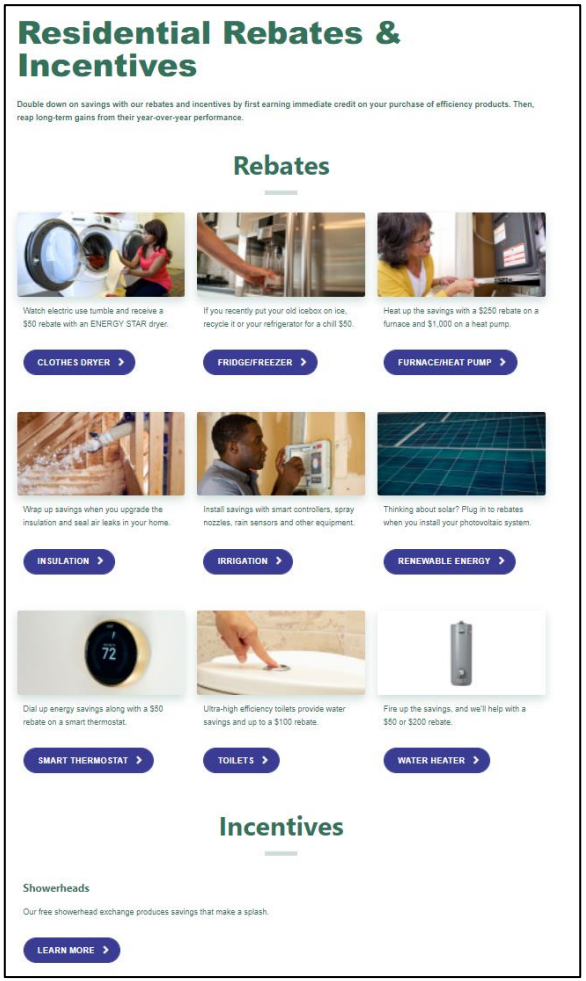
- Entertainment Center w/ DirectTV box (Off): 70 watts, $61 per yr
- TV + Wii Console (Off): 17 W, $16 per yr
- Empty Garage Fridge: $73 per yr
- Comcast TV box (Off): 29 W, $23 per yr
- Elliptical Trainer (Off): 5 W, $4.70 per yr
- Well Pump Controller (Standby): 60 W, $53/yr

These examples add to $230 per year or $19.23 per month

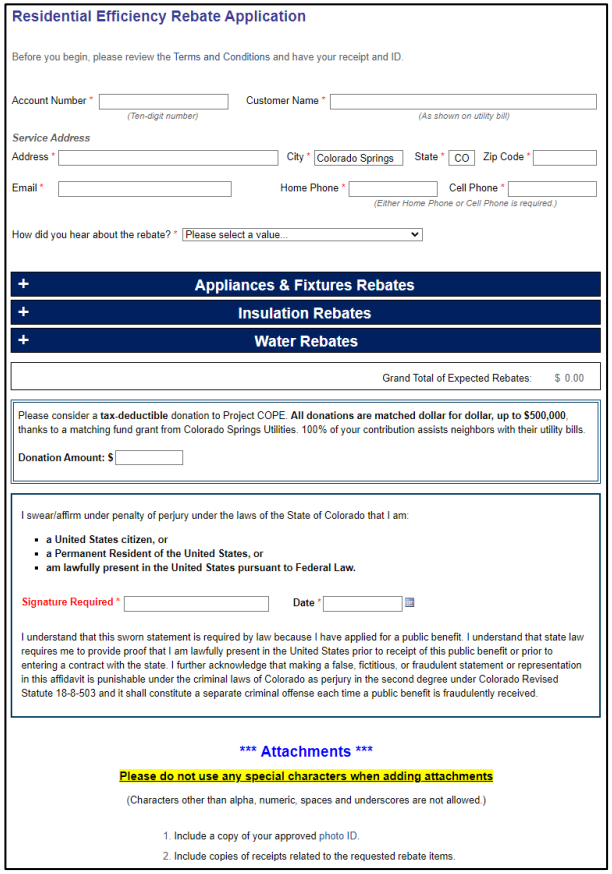
Miscellaneous Considerations

- Cooking: induction stovetop most efficient (with no CO emissions), but requires ferrous (stainless, iron) cookware
- Electric Vehicle Supply Equipment (EVSE)
  - Home charging stations are now in the EnergyStar program
- Great tips for efficient use of appliances: www.energy.gov/energysaver/appliances-and-electronics
- Understand your electricity consumption
  - Utility smart meters allow hour-by-hour consumption
  - Consider buying a circuit panel energy monitor ($50 to $350)
  - Look for monitors that can ID devices using machine learning

Rebates



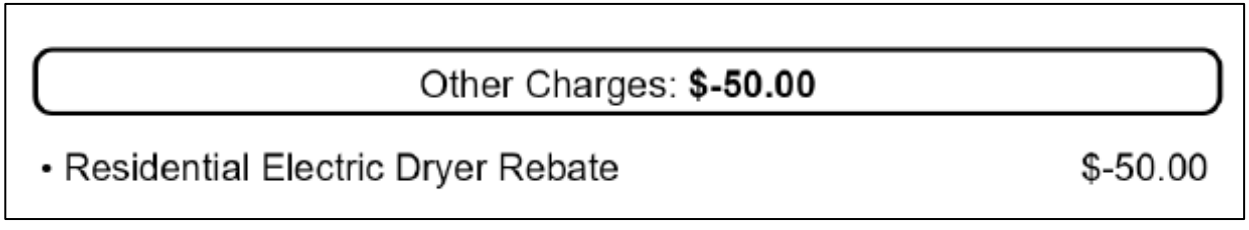
https://www.csu.org/Pages/ResidentialRebates.aspx



My rebates since July 2020:

- $50 Energy Star Dryer
- $50 Smart Thermostat
- $50 Rain sensor for Sprinkler
- $50 WiFi Sprinkler Controller
- $200 Insulation
- $580 Solar Panels ($.10/Watt)

$980 in total rebates to-date



Black Hills Energy
https://tinyurl.com/BHERebate

Mountain View Electric Association
https://tinyurl.com/MVEARebate

https://www.energysmartcolorado.com/wp-content/uploads/2022/03/2022-Rebates-by-Utility.pdf

apply for rebates: https://www.energysmartcolorado.com/for-my-home/home-rebates/

Utility Rebates

	EFFICIENCY MEASURE	CITY OF ASPEN ELECTRIC	ATMOS ENERGY	BLACK HILLS ENERGY (gas)	EMPIRE ELECTRIC	CITY OF GUNNISON ELECTRIC	GUNNISON COUNTY ELECTRIC	HOLY CROSS ENERGY	LA PLATA ELECTRIC	MOUNTAIN PARKS ELECTRIC	SAN ISABEL ELECTRIC	SAN MIGUEL POWER	SDCEA	XCEL ENERGY	YAMPA VALLEY ELECTRIC
ENVELOPE	Air Sealing	25% up to $500 (electric only)	30% up to $300					25% up to $500						30% up to $200	
	Insulation	25% up to $500 (electric only)	30% up to $300	$0.25/sq.ft up to $890		$0.15/sq ft up to $300 (attic)		25% up to $500			60% up to $450			30% up to $400	
HEATING & COOLING	Programmable Thermostat	25% up to $500	$20 - $75 (Energy Star)	$25 - $100	$25 - $50	up to $100		25% up to $300	$25 - $75	$25 - $50	$25	$25		visit Xcel Energy store	up to $50 (limit 2)
	Gas Furnace		$400 (95% AFUE)	$300 (95% AFUE) $350 (97% AFUE)										$300 (95% AFUE)	
	Boiler		$300 (95% AFUE)	$35 (84% AFUE)										$250 - $350 (95% AFUE)	
	HVAC Equipment Maintenance & Tune Up		$50												
	Evaporative Cooler (Swamp Cooler)	25% up to $500						25% up to $200						$300 - $1,200	
	Balanced Ventilation (HRV/ERV)	25% up to $500													
	Cold Climate Air Source Heat Pump	25% up to $500 -->$2,500		$1500 (gas fired absorption)	50% up to $2,400	$400 to $1,000	$675 - $4,800	25% up to $4,000	$1,000 - $3,500	$675 - $1,000	$875 - $2,900	$900 - $2,000	$675 - $2,400	$1,000 - $2,000	
HOT WATER	Indirect Hot Water Heater			$85											
	Standard Tank Hot Water Heater			$50 (min 0.64 EF)	$60		$50 - $70 (electric)			$180 (fuel switch from gas)	$50 - $250	$150	$30 - $50	$50 (min 0.64 UEF)	up to $200 fuel switch from gas
	Tankless Hot Water Heater		$200 (min 0.86 EF)	$80 (min 0.92 EF)										$100 (min .87 UEF)	
	Heat Pump (Hybrid) Hot Water Heater	25% up to $500			$350		$740	25% up to $1,000 (Energy Star)	$550 - $700	$350	$350	$700		$600 - $800	
RENEWABLES	Solar Photovoltaic (PV)	$0.75/watt up to 3kW up to $2,250						$100 to $250 per kW for up to 25kW installed		$1,000 (2kW+)		$0.10/watt up to 3kW or $300		Solar Rewards Program	
	Storage System	25% up to $2,250 -->$2,500						$500 per kW for up to 25kW installed or Tesla Powerwall-2s							
ELECTRIC	EV Charger (Level II)	25% up to $500			50% up to $1,000		50% up to $1,250	Free level 2 ChargePoint Charger	Free level 2 ChargePoint Charger	Match up to $500	50% up to $1,000	50% up to $500		$50 annual bill credit	$250
	Electric Bike				25% up to $150			25% up to $50 (up to 2 per household)	25% up to $150		25% up to $150	$150			25% up to $150
	Lighting (LEDs)	25% up to $500			50% up to $8 per LED	commercial program only	50% up to $8 per LED	25% up to $100	50% up to $8 per LED	50% up to $8 per LED		50% up to $8 per LED	50% up to $8 per LED	visit Xcel Energy store	up to $10/bulb max 10 LEDs/yr
	Induction Cooktop/Range						$100 - $350	25% up to $100 (replace gas stove)	$100 - $350	$100 - $350		$150 - $450	$100 - $350		
	Heat Tape Controls/Timers	25% up to $200 -->$500						25% up to $200 (must be hard-wired)							$100 (hard-wired) $15 (plug-in)
APPLIANCES	Heat Pump Clothes Dryer				$60 (Energy Star) $120 (electric hybrid heat pump)		$30 (Energy Star) $90 (electric hybrid heat pump)	25% up to $100	$30 (Energy Star) $90 (electric hybrid heat pump)	$30 (Energy Star) $90 (electric hybrid heat pump)	$80 (Energy Star) $90 (electric hybrid heat pump)	$60 (Energy Star) $180 (electric hybrid heat pump)	$30 (Energy Star) $90 (electric hybrid heat pump)	$30	$100 (fuel switch from gas)
	Clothes Washer (Energy Star)			$25 (top loading)	$60 - $80		$50 - $60		$30 - $40	$30 - $40	$70 - $80	$60 - $80	$30 - $40	$30	
	Dishwasher (Energy Star)				$40						$30				
	Refrigerator or Freezer (Energy Star)				$60		$50 $60 for recycling		$30 $60 for recycling	$30 $60 for recycling	$80 $60 for recycling	$80 $100 for recycling	$30 $60 for recycling	$50 for recycling	
OTHER	Window Replacement			up to $700 (storm windows)											
	Cellular Shades													variable	

Questions?