2023 Metro Denver

GREEN HOMES TOUR

Saturday, October 7, 2023

Tour 9am–4pm • $10/adult
Electric Vehicle Roundup 3pm–5pm
Growing Dome Tours 3pm–5pm
Green Expo and Party 5–7pm

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Welcome to the 2023 Metro Denver Green Homes Tour!

Greetings, and welcome to the 2023 Metro Denver Green Homes Tour!

Thank you for coming to visit beautiful and energy-efficient homes that will help you learn how your neighbors are saving energy and water. We hope you will get ideas for improving your own home to make the air cleaner and the utility bills lower.

We are pleased that homeowners across metro Denver have been willing to open their houses to help you learn about technologies including electric-vehicle charging, solar energy and storage, heat pumps and water-wise landscaping. Please take this once-a-year opportunity to talk with these folks to learn what it is like to live with technologies you have probably read about. You'll see that energy efficient homes will not only save money but increase your comfort all year. And you'll see that beautiful yards don't have to waste water.

There are powerful new financial incentives to help make many of these improvements more affordable. Thanks to the Inflation Reduction Act, which just celebrated its first anniversary, there are powerful tax credits you can claim for work done this year. The tax credits will help cover the costs of appliances such as heat pumps, improvements to your building envelope, and renewable energy such as solar electric and battery storage systems. Along with incentives from utilities, the state of Colorado, and some local governments, you can layer together financial help for improvements in your home and for that electric vehicle you've been eyeing. Be sure and stop by our Tour After-Party and Green Expo where a variety of experts can help you learn more details.

The importance of being part of the solution continues to grow as the climate crisis intensifies. The earth's record hot summer brought misery around the globe from horrific wildfires in Maui to deadly flooding all over the world.

Sponsored by New Energy Colorado and the Colorado Renewable Energy Society, the tour is also part of the National Tour of Solar Homes.

In addition to the tour, we hope you will visit the Electric Vehicle Round-Up from 3-5 pm outside the Mountaineering Center and talk to a variety of EV owners about what it's like to ditch the high gas prices. Colorado now has the highest EV incentives in the nation so it's a great time to buy.

You can also visit a Tiny Home outside the AMC, and be sure to check out the Growing Dome passive solar greenhouse at 509 9th St. in Golden.

Then from 5-7pm, come to the Tour After-Party and Green Expo back at the American Mountaineering Center. A variety of experts on solar energy and energy efficient technologies will be happy to answer all the questions you gathered during your day of touring. Plus enjoy appetizers, drinks, live music and networking with fellow green home enthusiasts.

Don't forget that our online tour of sustainable homes continues at NewEnergyColorado.com anytime you want to visit. While you're there, check out our newsletters and other information about sustainable living.

Thanks to the people who have opened their homes to showcase energy smart improvements, thanks to the American Mountaineering Center for hosting our event, and thanks to the countless volunteers who have made this day possible.

And thanks again to you for choosing to spend your Saturday with us!

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ASES NATIONAL SOLAR TOUR

New Energy Colorado is an educational non-profit with deep roots in Colorado's solar and environmental communities. The Metro Denver Green Homes Tour is our signature event, and we are working to educate Coloradans in a variety of other ways as well.

We believe renewable energy and energy efficiency have a future in Colorado as unlimited as our blue skies and sunshine. Hundreds of thousands of Coloradans have installed solar on their homes and businesses. Making improvements to houses and other buildings to save energy is easier and more cost-effective by the day. Driving electric cars is growing more affordable.

With the climate crisis now upon us and wreaking havoc around the world, more action is needed. We need to band together and educate ourselves, then take action to encourage a rapid transformation to a clean energy economy. We are building what we call Solar CitiSuns into a powerful grass-roots movement.

It's easy and free to join us as a Solar CitiSun! Just sign up here: newenergycolorado.com/solarcitisuns

Solar CitiSuns are engaged in the following activities:

1. Educate our fellow Coloradans about how we can all save energy. Our biggest annual event is the Metro Denver Tour of Green Homes, which for 28 years has been showcasing homes that incorporate innovative energy and water- saving measures. We have added the Ark Valley Green Homes Tour, which just celebrated its fifth year, and with your help, we hope to spread the tours to other communities.

2. Amplify the voice of Coloradans who support renewables and energy efficiency and help deliver their message directly to lawmakers. There is no time to waste to stem the worst effects of climate change. We let Solar CitiSuns know about key opportunities to make their voices heard through our informative monthly newsletter (posted on our website at newenergycolorado.com

3. Invite broad participation in events and public forums that support clean energy and oppose polluting fossil fuels. We work with a variety of organizations including the Colorado Solar and Storage Association and the Colorado Renewable Energy Society. We seek to make clean energy accessible to all Coloradans, particularly those with limited incomes who have often borne the brunt of fossil fuel pollution.

4. Spread information about renewable energy and energy efficiency through media channels and public events. We have expert speakers who share their knowledge both virtually and in-person, and we publicize other educational events.

For more information, contact us:
newenergycolorado.com

Please help fund our work with a tax-deductible donation at link above or send checks to:

New Energy Colorado
P.O. Box 1154 Golden, CO 80402-1154

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TOUR PARTICIPANTS

TOUR ETIQUETTE

1. The residences on the Metro Denver Green Homes Tour are open Saturday, October 7, 9am–4pm ONLY.
2. Masks will be available and to be worn at the discretion of the homeowner.
3. Be mindful of your time in each home so as many people as possible can visit. Please join existing tours at the home to reduce confusion and congestion.
4. Respect the homeowners' boundaries for tour visitors.
5. Avoid handling homeowners' personal items.
6. Be aware of, and avoid, areas still under construction.
7. Follow all parking directions.
8. Please, no pets on the tour.
9. Bathrooms in the homes are not available for visitors' use on the tour – please plan accordingly.
10. Unless a homeowner requests otherwise, you may take a few photos for your own reference, but please ask permission before shooting video or taking extensive photos.

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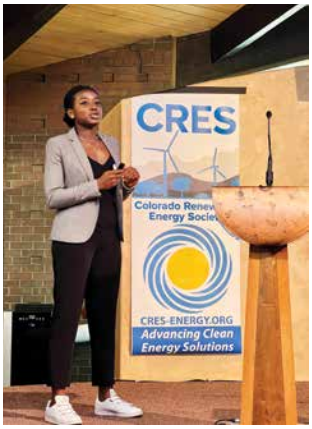
The **Colorado Renewable Energy Society (CRES)** drives environmental, social, and economic benefits for Colorado by promoting renewable energy and energy efficiency.



NREL's Sika Gandzaku presenting at Renewable Powering Forward CRES conference in 2022.

CRES is a statewide, non-partisan, non-profit, 501(c)3 membership organization. Its local chapters provide education, policy advocacy, and community engagement that accelerate the adoption of all forms of renewable energy, energy efficiency, high-performance building, energy storage, and emerging technologies that will help Colorado achieve 100% renewable energy.

Founded in May 1996, CRES reaches thousands of community members throughout Colorado and has established itself as the leading volunteer renewable energy professional and advocacy group in Colorado.

Five regional chapters in Denver, Colorado Springs/ Pueblo, Boulder, Golden, and Fort Collins organize their own events, listed at cres-energy.org. Sign up to register or to get involved. Event videos are hosted on the CRES Youtube channel at tinyurl.com/cresyoutube.

Contact: info@cres-energy.org, 430 North College Ave, Ste 400, Ft.Collins, CO 80524

cres-energy.org

Prof. Kyri Baker, CU Boulder, at the "Renewable Powering Forward" CRES conference in 2022.

Glossary

Accessory Dwelling Unit (ADU) – Small dwelling on the same grounds as a single-family house (e.g., in backyard, over garage, or in basement).

Air Change (ACH) – Exchange of the total volume of air in a house with outside air in a specific amount of time (measured in air changes per hour).

Air Stratification – Heated air rises so that the warmest air is at the top and cooler air is at the bottom.

Alternative Building Blocks – Like concrete blocks, but with recycled polystyrene, recycled wood fiber, or extra air to make them lighter.

Backup System – Provides heating for several consecutive cloudy days or when temperatures are exceptionally cold. Battery-backup solar PV systems also can run a house during power outages.

Berm – Earth mounded against walls or roof to help moderate temperature, redirect winds, reduce snow and ice buildup on the north side of buildings, or even dampen noise. Requires proper structural engineering.

BTU – British Thermal Unit is a measure of the quantity of energy, specifically, the heat required to raise one pound of water 1° F. It is equal to 252 calories (approximately the same as the heat emitted by a match). Example: A 9000 BTU heat pump.

Chimney Effect – Air rises when heated and sinks when cooled, thus a house can be cooled by opening windows at the top of the house, causing warm air to rise and creating a negative pressure that brings in cooler air from the bottom floors.

Clerestory – Windows placed high to let in light and heat. The earliest example of this is in the Ancient Egyptian temple complex of Luxor.

Conduction – Heat transfer between objects by direct contact (passed from molecule to molecule by rapid vibration).

Conductive Heat Loss – Heat passing through building materials from the inside to the outside.

Construction Waste Reduction – Using construction materials to create very little waste by efficient dimensioning and use of scrap materials. This practice also uses recycled materials.

Convection – Heat transmitted from a warmer surface to a cooler surface by air or liquid movement.

Daylighting – Using natural light wherever possible to reduce the use of electrical lighting.

Direct Gain – The basis of passive solar heating, with sunlight entering the building from a (usually) south-facing window and striking a high-density mass. Heat absorbed by the mass is released when the air temperature drops below the temperature of the mass.

Earth Sheltering – Use of earthen berms to the tops of walls, or even on the roof, to help moderate outside temperatures against the walls or the roof of habitable spaces.

Efficient Lighting – More cost-effective LED (light emitting diode) lighting has made CFL (compact fluorescent) technology obsolete. LED "color" is rated in Kelvins: 2800K = very warm white; 3000K = warm white, better color rendition; 5000K = blue-white/daylight. LEDs are available in lighting strips for under cabinet lighting. LEDs use 1/8 or less electricity than incandescent lights and are still improving.

Embodied Energy – Embodied energy is energy used by a building material from acquisition of the natural resource, to manufacturing and production, to product transportation and delivery. Indigenous building products like rock or wood harvested onsite have almost no additional energy costs in fuels, manufacturing, or building.

Engineered Composite Wood – Manufactured wood made from recycled or reconstituted wood that is laminated or "finger-jointed", creating a stronger, more consistent product. Also includes laminated veneer lumber (LVL), oriented strand board (OSB), and manufactured joists.

ERV, HRV, CERV – Energy recovery ventilator, heat recovery ventilator, conditioned energy recovery ventilator. Instead of opening a window in winter, fresh cold incoming air is warmed by extracting heat from the expelled stale air and adding that heat to the cold incoming air. A CERV can work both ways and also cools the fresh air in the summer.

Heat Pump Mini-Split – Electric heat pumps both heat and cool a house very efficiently. In cooling mode, heat pumps act like an air conditioner, moving heat from inside the home to outside; in heating mode, they pump heat from outside the home to inside. Heat is just energy, and there's energy in

the air all the way down to absolute zero (-465°F); therefore, heat pumps designed for cold climates can keep a home warm without backup even when outside temperatures are below -20°F. A heat pump's source can be air (more common, less expensive) or geothermal (more efficient, but more expensive) and they can take the form of either ductless "mini-split" or ducted systems. Ducted heat pumps use existing ductwork (or new ducts) to disperse heated or cooled air throughout the home. Mini-split ductless heat pumps are easier to install where there is no existing ductwork. A mini-split is named for its small form factor compared to a central air system. Mini-split systems have two main components: an outdoor compressor/condenser and an indoor air-handling unit(s) (evaporator), therefore a "split" in the hardware. Mini-splits have high SEER values from 33 to 42 (compared to air-conditioners at only 16). Heat transfer technology also is applied in heat pump water heaters (HPWHs). Similar to heat pumps for space heating, HPWHs produce hot water instead of hot air, using electricity to pull heat from the surrounding air and transfer it into a hot water tank. Like heat pumps, HPWHs are energy efficient because they transfer heat instead of creating it.

HERS Ratings – The Home Energy Rating System (HERS) index is the industry standard that measures a home's energy efficiency.

House Wrap – Material wrapped around the walls of a house to prevent air from passing through, thereby preventing a drafty house.

Indirect Gain System – Placing dense heat-absorbing material between a heat source and a space that needs heat is called indirect heating.

Indirect Mass – Materials like concrete, water, brick, stone, adobe, sheetrock, etc. absorb and store heat from warm air and release heat when the air temperature is cooler than the mass temperature.

Infiltration Heat Loss – Cracks around doors, windows, and outlets (among other places) allow cold outside air in and warm inside air to escape in winter, or the reverse in summer.

Insulation – Prevents heat loss or gain by using small air pockets or materials that don't conduct heat. Insulation conducts heat poorly and reduces heat loss by retarding the heat movement from warm to cold.

Insulating Concrete Forms (ICFs) – Lightweight blocks of concrete with polystyrene added for higher insulation values.

Internal Heat Gain – Heat generated by people, cooking, lights, hot water, etc. A person at rest produces 200 BTU or 130W.

Low-E glass windows – A thin metal coating lets in short wave solar energy but blocks long wave thermal energy, improving thermal performance by reducing the flow of heat from inside to outside or outside to inside. The "E" stands for emissivity.

Low Flow Toilets – A toilet using roughly 1½ gallons of water, or a dual-flush system using less water to flush liquid waste than solid waste.

Mass Wall – Generally a south-facing wall, and one made of a high-density material to store heat from the sun or surrounding air. When the air temperature drops below the wall temperature, the wall radiates heat back into the space.

Natural Convection – Movement of heat through the movement of air or water is called convection.

Net Zero Energy Home – A home that produces as much energy as it consumes.

Optimum Value Engineering (OVE) – Many homes are "overbuilt" with too much lumber. OVE techniques use less lumber without compromising structural elements of the house, saving material and labor costs, and providing more insulation because there is less wood and more insulation.

Passive Cooling – Using a "thermal chimney" to draw air from the lowest (generally cooler) point of a house to the highest point (generally warmer). Windows often are placed at the top of the thermal chimney to expel hot air, thereby pulling cool air up. An attic fan forces this action.

Passive Solar – Passive solar uses the sun to help heat the building. True passive solar heating requires a reasonable amount of thermal mass within the building, both indirect mass and sunstruck mass. No mechanical systems are used and the building itself is the heating system. Building orientation, site selection, materials, and design affect collection, storage and distribution of the sun's heat.

Payback – Time required to recoup the cost of an energy-saving improvement. If you spend $3,000 on insulation, weather stripping and caulking that reduces your energy bills by $600 a year, it will take five years to pay off your $3,000 investment.

Photovoltaics – Also known as PV or solar cells wherein light is converted to electricity to be used in the house, stored in a battery, or sold back to the utility company. PV systems can be "off-grid", meaning that they are not hooked up to a company that supplies electricity, or "grid-tied" where excess electricity can be sold back to the utility through net-metering.

R-Value vs. U-Value – "R" stands for resistance to heat loss. When referring to insulation, the HIGHER the value the better. Example: A typical 2x4 wall with fiberglass insulation = R9. A Passive-House building code wall may be R60 with an R100 ceiling/ attic to slow movement of heat from one side to the other. Windows (glass and frame) are rated as U-Value, where the "U" stands for unit value of many parts and is the inverse of R-value. The LOWER the U number the better. High-performance windows keep improving and range from U 0.17 down to U 0.045 (R21.7).

SEER – Seasonal Energy Efficiency Ratio is used to measure the efficiency of a heat pump when it is in cooling mode. The higher the SEER, the higher the efficiency rating.

Smart Home – A home with multiple sensors on walls and appliances to measure lumens, temperature, weather, humidity, watts used, motion, etc. The sensors create an active IF/THEN method of triggering energy conservation actions, such as motorized shades up/down, lights on/off, fans on/off etc.

Solar Thermal Heating System – Works similarly to domestic hot water with collector panels and a storage tank. The hot liquid can be sent directly through a hot-water baseboard in each room. A backup system for solar thermal would be a boiler.

South Orientation – The longest side of a house faces anywhere from 15˚ east to 15˚ west of true south, optimizing use of the sun's energy.

Straw Bale Construction – Straw bales made from waste products of harvested crops have an R-value of at least 45. Straw bale houses need very little backup heating. They are stuccoed on the outside, plastered on the inside, are fire resistant, and have very deep windowsills.

Structural Insulated Panel System (SIPS) – Sheets of OSB are the 'bread' of a sandwich of extruded or expanded polystyrene and are delivered on site in 4' x 8' pieces. The pieces are assembled in a factory and are labeled so that the house fits together in the style of "tab A goes into slot A". The house walls can typically be raised in under three days depending on the complexity of the floor plan.

Thermal Break – Foam or insulation between materials to stop the heat transmittance. The most common example is a foam panel layer between stick walls and house siding.

Thermal Mass – Use of very dense materials with high specific gravity, such as concrete, water, brick, stone, adobe, etc., that when struck by sunlight, absorb heat and later release heat when the air temperature is cooler than the temperature of the mass. In general, the more thermal mass in a house, the more stable the interior temperature.

Thermal Radiation – Heat transfer between objects by electromagnetic radiation. Example: Wearing a white shirt vs black. Infrared Cameras show Thermal Radiation in pictures.

Trombe-Michel Wall – Popularized by Felix Trombe and Pierre Michel, this type of wall consists of a wall of glass, an airspace of a few inches, and then a mass wall of concrete or filled concrete block. The wall can be vented, or non-vented. The 'outside' of this wall is painted a very dark color to help force the temperatures higher. Heat is absorbed into the thermal mass during daylight and released when the air temperature is lower than the wall temperature.

Vapor Barrier – In Colorado, this is usually a 6-mil layer of plastic attached by staples (minimum code) and tape (phius.org code DOE) to wall studs to prevent moisture from migrating from the interior to the exterior.

Xeriscaping – Landscaping with drought-tolerant native plants and vegetation which need very little water (though it might take a year or more of regular watering to establish the plants).

Michel Jichlinski and Sara Gagneten Home

Ewers Architecture and builder Joe Ogg have transformed Michel and Sara's Golden property into their all-electric dream home. Exterior continuous insulation, SIPs (Structural Insulated Panels) on the roof, and electric design were applied to an almost ground-up rebuild of this 1960s home. An 8.14 kW solar PV system features Silfab 370W panels fitted with Enphase IQ8 Plus micro-inverters. A 10kW Enphase backup battery system will help the home achieve net zero energy.

Moisture, air, and thermal protection are integrated in all-in-one R-6 structural panels (ZIP System insulated R-sheathing) on 2 x 6 framing, contributing to a total wall insulating value of R-27. A metal roof covers R-29 SIPs; a partial attic with blown-in R-21 insulation adds to the package for a total R-50 insulation over half of the house. Beautiful low-e Alpen windows throughout have 0.14 to 0.15 U-values. The tilt-and-turn window design in the living area provides safe, flexible ventilation and easy maintenance. Electric shades enhance solar gain and screening.

HIGHLIGHTS

- Complete remodel toward net zero energy
- Solar PV + battery
- Roof SIPs
- Automated shutters and shades
- High-performance windows
- Heat pump space conditioning and water heating

A Mitsubishi air source heat pump conditions the home via two ducted air handlers for the upstairs area and 2 mini-split units downstairs. Cove heaters provide supplemental heat near entry areas. Hot water is provided by a hybrid heat pump water heater. The two-level home also includes a small kitchen on the lower level. The garage includes battery storage and a vehicle charging station to extend the home's all-electric design to the owner's transportation.

PARKING: Take care to park beyond the "Parking by Permit Only" signs.

Suzy Stutzman and Ken Lieb Home

At the base of South Table Mountain, this 2263 square-foot home is an excellent example of making the move from natural gas to all-electric, while improving both comfort and energy efficiency; the home has been completely disconnected from natural gas service. Electric consumption is reduced with added ceiling insulation and LED lighting, and electricity needs are met with two separate PV systems — a 4 kW system with another 6 kW system added to support the Tesla EV charging station in the garage. Gas appliances have been replaced with a hybrid heat pump water heater and heat pump for space heating, supplemented by electric resistance.

Upgrade costs were partially offset with rebates from both Xcel Energy and the City of Golden.

HIGHLIGHTS

- Transition to all-electric
- "Gen Vue" monitoring system tracks all electricity usage
- Two PV systems total 10 kW
- Tesla EV charging station
- Landscaping requires little to no irrigation

Jayne Aaron and Mike White Home

Ewers Architecture and DT Construct have helped make Jayne Aaron and Mike White's vision of a net-zero home in Golden's Pleasant View neighborhood a beautiful reality. The original 1940s ranch house with substandard construction and remodeling was removed (with much of the material salvaged and diverted from the landfill) to make way for a highly sustainable home built in a mid-century modern style.

The home has been carefully insulated with 2-inch R-10 rigid insulation panels plus R-13 batten insulation in the foundation, R-32 walls, R-77 roof, and R-25 floor over a conditioned crawl space. Aero seal technology reduces air changes (less conditioned air is lost to the outside), resulting in lower energy consumption, improved indoor air quality, and more consistent temperature control.

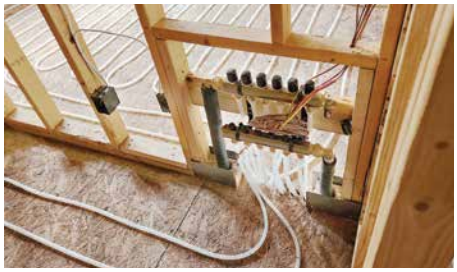
A 9.88 kW solar PV system and a 10-kW battery provides solar electricity to the home. The home features hot-water in-floor heat, mini-splits, and an EPA-rated built-in wood-burning stove for backup. Additional sustainable features include Alpen double-pane windows, low-flow water fixtures, and Energy Star-rated appliances. The house was designed and constructed to meet the LEED certification, including credits for sustainable sites, location and transportation, water efficiency, energy and atmosphere, materials and resources, and indoor environmental quality.

HIGHLIGHTS

- New build on former home site.
- All electric, net-zero energy home with solar PV
- Super insulated

Landscaping has been designed by Susan Saarinen, Landscape Architect, in collaboration with Ewers Architecture, to control runoff and feature native plants, low water use drip irrigation, and pervious porch, driveway, and path surfaces. Special touches will include a goldfish pond in a protected inset on the north side of the house, an outdoor kitchen, and even an area for an outdoor model train set up.

This home was in its last couple of months of construction when we took photos. Come and see the final product!



Kelsey Zabrusky Home

Kelsey Zabrusky has begun a mid-century modern restoration of her home in Golden's Applewood West neighborhood while steadily improving the home's sustainability. This home shows how much can be achieved by retrofits. She hired a contractor to help streamline her home electrification. First up was the installation of seventeen Enphase solar panels (made possible after a neighbor's cottonwood tree which formerly shaded part of her roof came down). A cold climate heat pump (hybrid ducted/ductless) and heat pump hot water heater replaced the home's failing furnace and water heater. These units were slightly oversized to compensate for deferring additional insulation and new doors. Electricity use is reduced with ceiling fans and indoor and outdoor clotheslines and Xcel Energy's time-of use metering helps save money. SoftLite double-pane, U-27, low-E vinyl windows have been installed on the home's first level and similar windows are planned for the basement.

Kelsey's approach to her home remodel is frugal and "future-proofing." She found reclaimed cabinets for her basement and kitchen and is replacing CFL lightbulbs with LEDs as the former expire. Kelsey expects to remove the home's natural gas connection and is looking forward to an EV when it's time to replace her current vehicle. Outdoors, the backyard has a small vegetable garden on drip irrigation and the front yard features a Xeriscape garden.

HIGHLIGHTS

- Retrofit and electrification of 1960 home
- Hybrid ducted and mini-split air source heat pump
- Heat pump water heater
- 17 solar PV panels
- Water-saving landscape

Michele Merritt Home

HIGHLIGHTS

- All-electric interior
- 44 solar PV panels
- Natural flooring materials
- Induction stove
- Water-efficient landscape, food production

Michele Merritt began her quest for cleaner, greener living like many of us, inspired by the magazines Organic Gardening and Mother Earth News. After auditing levels 1-3 green design classes at Rocky Mountain College of Art and Design and years of research, she manifested her "green living dream" in this demonstration of a sustainable living environment.

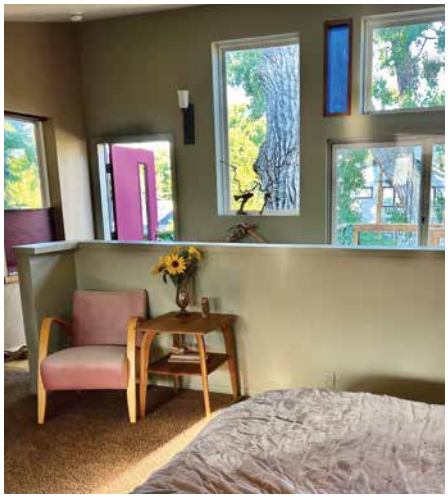
This modular home was situated on the property for maximum solar exposure, with deliberate intention for an energy efficient, healthy interior. Appliances, like induction cooking and a geothermal heat pump, are electric, eliminating natural gas to the home. Indoor air quality is a priority, with a combination of bamboo, cork, and linoleum flooring. Two ethanol fireplaces provide aesthetics without interior or exterior air pollution. Natural lighting is encouraged with the building's interior and exterior design. Triple-pane windows — placed to promote air circulation — and LED lighting help reduce the energy requirement from twenty-four solar panels, plus another twenty panels recently added, covering 93% of the home's requirement. Reversible ceiling fans provide comfort without high electrical consumption.

In addition to water-efficient interior fixtures, rainwater collection and compost complement the gardens, and water-efficient sprinklers include a rain sensor to avoid waste. The surrounding landscape features fresh food production with enough volume to preserve for later consumption. Permeable driveway pavers were negotiated with the City as an alternative to a hard-surface cul-de-sac, reducing rainwater runoff.

Jana Mohrman Home

HIGHLIGHTS

- Transition to all-electric
- 9.72 kW PV
- Gas-filled double-pane windows
- Flood control landscape
- Attractive “tree-house deck”



This Mid-Century Modern Lakewood home meets the challenge of installing photovoltaic (PV) panels on a flat roof, optimized to take full advantage of the Colorado sun’s energy for heating, lighting, and other electrical needs in the home. Three large evergreens were removed to accommodate a 9.72 kW PV array. The recently completed wood shop and upstairs master suite — doubling the size of the 1957 home — are both heated and cooled by a mini-split (ductless heat pump). Cellular blinds provide added insulation. A heat pump hot water heater further contributes to an effort to move to an all-electric home; kitchen appliances include an induction stove top and convection oven.

Sprayed insulation was added by Bestway over the three downstairs bedrooms when the soffits were removed to attach the carport, and eight windows were replaced with neon-gas-filled double pane windows. Additional green upgrades have been done over the years. To address flooding issues exacerbated by Lakewood infrastructure improvements and a high water table, a water feature was added to catch any flood waters.

Note: This home is not handicap accessible; touring this home requires going up and down stairs.

Sehkar Paladugu and Jim Burgess Home

HIGHLIGHTS

- 16.8 kW Solar PV (42 Qcells panels) system + LG 16 kWh battery
- SolarEdge integrated EV charger with Nissan Leaf
- Cold climate air source heat pump (furnace and A/C replacement)
- 80-gallon heat pump water heater
- SPAN 200-amp smart electrical panel
- Induction cooktop
- Whole-home ERV
- Garden and chickens

In 2016, the 1950s home of Sekhar Paladugu and Jim Burgess got a major (80%) rebuild. Last year they took it to the next level, working with a cotractor on a sustainability makeover to fully electrify their 3,700 square-foot, 4-bedroom, 4-bath home.

The home previously had a dual-zone HVAC system with two inefficient air conditioners and two gas furnaces; the couple wanted to replace with an energy-efficient heat pump. Every contractor they talked to wanted to include a gas furnace backup until Sekhar connected with their contractor.

The contractor coordinated trade partners to install a dual-zone air-source heat pump condenser with two air handlers (one each for the attic and basement). The units meet all the home's heating and cooling needs in Denver's widely variable temperatures (-13° to 100°+ so far!). Before the new system was sized and installed, Sekhar and Jim had their home fully sealed and insulated to reduce energy demands. A 16.8 kW solar PV system combined with a 16-kWh battery and Xcel Energy's time-of-use billing means the home doesn't need to take energy from the grid during peak (expensive) periods. The home's solar system produces more than 20,000 kWh of electricity annually, which fully meets the couple's energy needs and effectively eliminates their utility bill.

Federal tax credits and rebates from the City of Denver and Xcel Energy reduced the cost of such a big project by about 40%. The couple financed the remainder through a 20-year, low-interest Colorado Residential Energy Upgrade (RENU) loan. They were able to apply pre-tax funds from their Flexible Spending Account for their induction stove and ERV (Energy Recovery Ventilator). With what they now save on energy and gasoline costs plus the expense of replacing an aging air conditioner, this big project was almost revenue neutral.

Jim added finishing touches to the home's outdoor areas with Xeriscaping, a vegetable garden, and chickens with their own special "Eglu."

redT Homes

HIGHLIGHTS

- New home with exemplary energy package
- LEED Platinum rating
- 2:1 Tree-planting to offset material use
- Solar powered all-electric home, EV charging
- Anticipated 100% offset with PV

This new Denver LiteHome by redT was designed and registered with the certification goal of LEED Platinum, with an eye toward earning certification as LEED Zero (verification after a year). A HERS rating of 3 puts this home in the range of superior efficiency. The home's envelope is insulated to R-23 in the walls, R-51 in the ceiling, and R-19 in the basement; a Tyvek wrap minimizes unwanted air infiltration; low-e, triple-pane windows complete the package with a u-value of 0.3 and SHGC of 0.3. Duct air leakage is minimized with sealed ducts. Interior air quality is enhanced by all low-VOC/no-formaldehyde materials and finishes.

The home is all-electric, with an air-source heat pump for space heating, electric water heating, LED lighting, and an induction stove. After envelope and interior efficiency treatments, a 7.6 kW PV system is expected to cover all the home's electricity needs, including an EV charging station in the garage.

The team at redT Homes is dedicated to being "part of the solution" by producing healthy, zero-net-energy homes. More information on the redT portfolio is available at https://redthomes.com/portfolios/mississippi/.

Note: Booties will be provided for visitors during the tour. Street parking is available; no driveway parking.

Tom Abood Home

The first thing visitors to the Abood home notice is the magnificent landscaping. About eight years ago, the Aboods converted their whole yard into a permaculture sanctuary of native, edible, and xeric plants (significantly reducing their water bills in the process). As part of their pursuit of sustainable living, Tom and his wife wanted to be able to walk anywhere in their yard and pick something edible. They've planted apples, currants, lovage, gooseberries, grapes, strawberries, sour cherries, Nanking cherries, plums, peaches, rhubarb, have raised garden beds for vegetables, and more. Embedded downspouts deliver drip irrigation to the low water use plants. Their garden hosts the hives of a local beekeeper, so they have plenty of pollinators. Compostable waste is collected by a local composting company, Wompost (for which the Abood home also serves as neighborhood pickup site).

HIGHLIGHTS

- Permaculture, with native and edible low-water-use landscaping
- Beehives
- Air source heat pump
- Hybrid heat pump water heater
- 10 kW PV system

Understanding that all we do impacts the world around us, the Aboods have long sought ways to reduce their consumption and carbon footprint. Beginning more than two decades ago, they installed all double-pane windows throughout their home, followed not long after by an air-source heat pump, additional insulation, and a new stucco exterior. Twelve years ago, they had Namaste install a 10 kW solar PV system which provides much of their home's and their Tesla's electricity needs.

After an energy audit of the home this year, the Aboods are currently adding additional insulation in the attic and crawlspaces and air sealing, installing an electric hybrid heat pump water heater and are reviewing their possible next steps to electrify their home and to optimize energy efficiency, including a new cold climate heat pump that would eliminate the need for gas furnace backup, an ERV, an electric clothes dryer, and an induction cooktop.

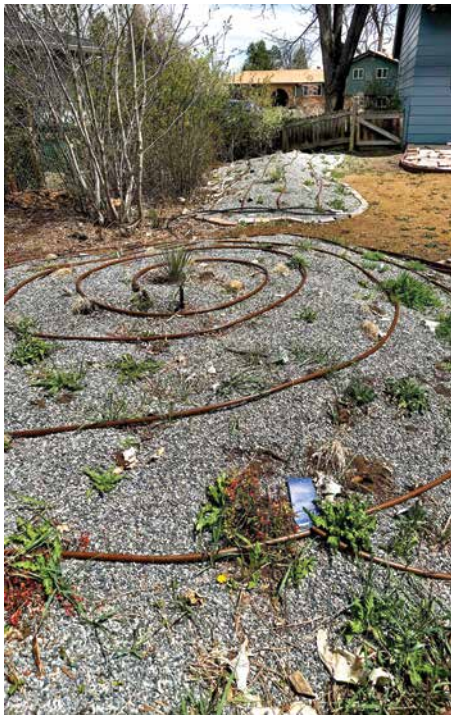
HIGHLIGHTS

- Ground source heat pump
- Ground source HP pre-heats electric water heater
- 9.8 kW PV system
- Native and xeric landscaping

Milt Hetrick Home

Milt Hetrick has shown how a 1974 home can be retrofitted for sustainable living. An engineer and physicist by training, Milt has thought deeply about burning ancient hydrocarbons and how we can transition to solar and geothermal energy (see his book Living Without Fire: Just the Sun & Earth).

In 1981, Milt added a solar air thermal system to his house. Then more affordable than solar PV, the thermal solar reduced the home's natural gas use for space and water heating by about 30%. After 15 years, the system's control unit failed, and the company had gone out of business. In 2011, after added efficiency improvements (windows, insulation, and sealing), Milt had Golden Solar install a 40-panel, 9.8 kW, remotely monitored rooftop solar PV system. Milt's ground source heat system was installed that same year. Two 300'- deep, 4"-diameter vertical boreholes house 1200' of plastic tubing exchange thermal energy with the earth to heat and cool the house via a GeoComfort ground-source heat pump, and also pre-heat water for an electric water heater. The ample solar PV provides all the electricity for this system and for Milt's hybrid Chevy Volt. The home now generates more electricity than it uses over the year. The impact of his improvements is an annual reduction of an estimated 22 metric tons of CO_2.



Recently, Milt has turned his attention to landscaping with native plants, saving water and attracting pollinators and birds. Mounded grow areas display plants native to the plains and foothills of Colorado. The front yard Kentucky Bluegrass was removed in 2022 (remaining grassy areas have low-water-use buffalo grass). The back yard is nearing completion this year with more native plantings and flagstone replacing former areas of concrete.

Matthew and Kylee Duff Home

HIGHLIGHTS

- All electric
- Landscaping for water retention (future)
- Certified Passive House
- Heat pump heating and cooling

This all-electric home was built in 2021, and is a Certified Passive House (www.passive house.com). Matt and Kylee wanted their family with four young children to grow up in the most energy efficient home possible while also having plenty of space for their family to grow. Their home's design/build team is Shape Architecture, B-Line Construction, and EMU Systems, which ensured coordination from design to post-building data collection.

The 2400 sq-ft, two story house has a full basement. The home's envelope is an all-inclusive system that includes: double-wall construction with fiberglass batts and rockwool to create R-50 walls; R-34 basement walls and R-34 basement floor; triple-sealed doors; R-65 ceiling insulated to R-65 with air venting; triple-sealed, U-0.15 Alpen windows with a solar heat gain coefficient (SHGC) of 0.55. The AeroBarrier process sealed virtually all leaks, and the result is a total air exchange of only 0.50 (ACH50) after everything was completed.

One of Kylee and Matt's goals for their home was to have large common areas and smaller, efficient bedroom space. Even with six people and two dogs, the house feels spacious. The house features a living room with a lofted net area and second-story bedrooms for the kids.

Computer modeling estimated a winter heating load requiring only a 10,000 BTU system.The house is cooled and heated using a Pioneer 4-head heat pump capable of 36,000 BTU at SEER 19. Domestic hot water is produced by a SANCO2 high-efficiency heat pump using CO2 as the refrigerant instead of R410a or R134A. A Zehnder ERV provides filtered fresh air to all rooms.

The house has performed incredibly well in the winter. During below-zero temperatures, with no heating (running an experiment), the house temperature fell only to the mid to high 50s. As soon as the sun rose, the house temperature climbed back to the high 60s.

Matt is experimenting with permaculture water retention principles. Tiered landscaping will facilitate a future gravity-fed watering system. Meanwhile, much of the rainwater from the roof is directed to garden areas.

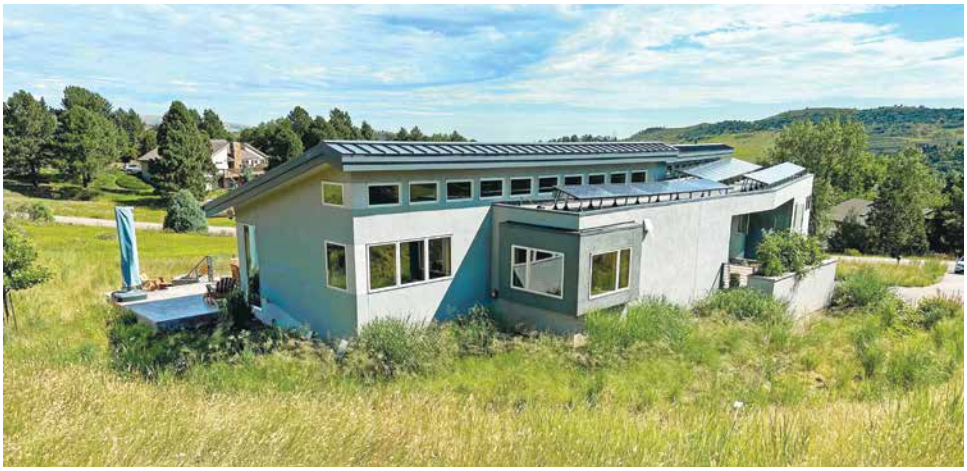
Jack and Cynthia Dekker Home

HIGHLIGHTS

- Double-stud wall construction with R-30 blown insulation.
- Furred-down roof framing to create larger cavity for R-80 insulation.
- Clerestory windows bring south sunlight into the major living spaces
- Ground source heat pump with vertical loops for heating and cooling
- Energy Recovery Ventilator
- All-LED lighting, including creative strip lighting
- 8kw PV system
- Elevator to provide handicap access to entire house for aging in place

This beautiful home has the backdrop of rock formations from the Red Rocks formations that run along the Front Range. But the hidden features make this home an energy winner. Double stud wall construction and roof framing allow high insulation in the walls (R-30) and the ceiling (R-80). Sunlight enters the main living areas through operable clerestory windows that also allow great air flow to exhaust warm air during summer nights. Tight construction is complemented with an Energy Recovery Ventilator for conditioned fresh air. The 8 kW PV system provides all the electricity needed for summer air conditioning and charging the homeowners' Tesla. The home is heated and cooled with a ground source heat pump system (vertical wells). The solar array provides about 2/3 of the home's energy requirement over a full year. Supplemental electricity from the grid comes from CORE Electric Cooperative, which currently provides ~40% renewable energy, bumping the Dekker's overall sustainable energy to ~80%.

The exterior materials for this home are non-combustible, with powder-coated steel, and even a metal grate at the entrance to eliminate a combustible door mat. This home was designed to be multi-generational, and is equipped with an elevator for handicap access for aging in place.



Mike and Ann Moore Home

Mike and Ann Moore's home in Evergreen is a sprawling, must-see combination of beauty, low-impact living and eco-friendly design. Inspired by the architecture of the Pueblo Indians, the 3,550 square foot residence was designed by Doerr Architecture to be a net-zero energy home, creating more energy than it uses. With a property at an elevation of almost 8,000 feet in the Rocky Mountains of Colorado, Ann and Mike wanted a home that reflected elements of adobe architecture, provided ample space to show off their art collection, and offered views of the continental divide, all while treading lightly on the earth.

The walls of 7-inch spray foam insulation plus 1-inch rigid insulation for a thermal break combine to achieve an insulation value of R-30 and greatly minimize air infiltration. Also, Alpen quadruple glazed windows were installed to allow loads of natural light without sacrificing too much heat loss. An insulated, 2,000 gallon, reclaimed, stainless steel milk tank is fed by solar thermal collectors: 180-evacuated tubes. This system is used both to heat the domestic water and to provide supplemental heat for the home through radiant floors and the hot water coil in the forced air furnace. The grid-tied PV system generates more carbon-free electricity (14,400 kWh/year) than the house requires. Fresh air is brought in via an Energy Recovery Ventilator (ERV), through a 300-foot "earth tube." Coupled with thermal mass and proper orientation to stabilize indoor temperatures, windows are electronically opened and closed in the summer to provide "free" cooling. To capture this view and the western heat, the western windows were fine-tuned with double heat-reflective glass. The resulting energy performance, validated by an impressively low HERS score of minus-3, makes this home one of the more efficient homes in the country.

Numerous green building features, including beetle-kill lumber and low-toxicity materials round out this home's appeal.

NOTE: The narrow mountain driveway does not allow easy access to this home. Visitors will have to park downhill at their office parking lot and walk or shuttle about 150 yards uphill to the home.

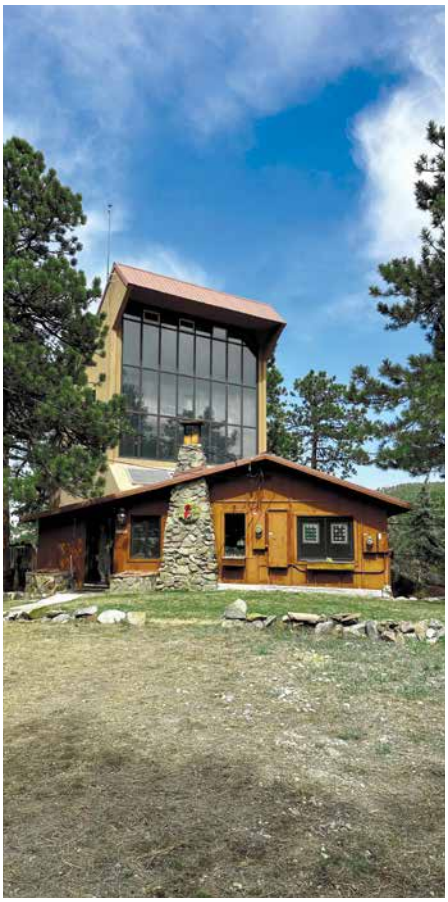
HIGHLIGHTS

- Net-zero energy design
- Super-insulation (R-30+ walls)
- Quadruple-glazed windows
- 2000 gallon thermal storage, augments water and space-heating
- 10kW PV, grid-tied
- HERS rating of -3
- Spectacular views

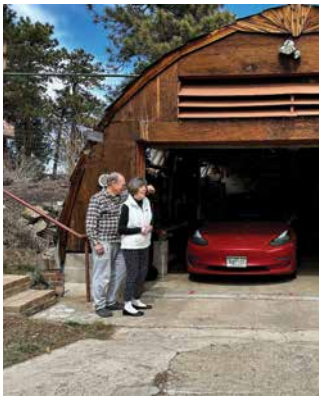
Mark Miller and Elaine Sponsler Home "Hummingbird Hill"

HIGHLIGHTS

- Older mountain cabin made all electric, net zero
- 480 square-foot solar heat collector
- 14.3 kW solar PV system



Mark Miller and Elaine Sponsler began their sustainability journey early, specifically looking for good solar exposure when they went searching for their home in the foothills above Golden in 1982. Mark found a Jimmy Carter era solar hot water system which they incorporated into the eye-catching addition they built (themselves!) on the home from 1988-1990. For hot water, three thermal panels preheat well water for an 80-gallon holding tank. When needed, the water is further heated by an electric 40-gallon Energy Star-rated water tank. For heating the home, the solar collector has a 790-cubic-foot rock box with 25 tons of rock bed for thermal mass, thus the home needs no furnace, just an electric blower to distribute the warm air. Substantial insulation and sealing improve the efficiency of these systems.



In 2010, the couple added a 14.3 kW ground-mounted solar PV system which paid for itself in 11 years. It covers all their electricity needs (including charging their Tesla) and then some, so Xcel Energy pays them between $10-$50/month.

All the home's windows are double-paned and nearly all lighting is LED. A separate greenhouse used primarily for composting and starting cacti has its own solar heat collection and distribution system.

Ron and Gretchen Larson Home

HIGHLIGHTS

- Passive solar design
- High-efficiency windows (R-9)
- Pottery studio, PV-powered
- Water efficiency inside and out
- Double-wall construction
- Electric vehicle charging
- 7.0 kW PV
- Radiant floor heat
- Heat recovery ventilation
- Evacuated tube thermal collectors
- 10,000 gal water storage for annual cycle heat collection and storage
- Frequent wildlife sightings (deer, wild turkeys, elk in winter)

This unique, award-winning home is owned by Ron and Gretchen Larson. Ron is one of the founders of New Energy Colorado, formerly Golden Earth Days. He was founder of Colorado Renewable Energy Society and Chair of the Board of the American Solar Energy Society, and also helped draft the legislation that created the National Renewable Energy Laboratory (NREL, formerly called the Solar Energy Research Institute). In 2004 the Larsons purchased the winning entry in the first Solar Decathlon home competition – a 650 sq. ft. prototype solar home designed and built by students and faculty at the University of Colorado – and converted it to a remarkably efficient 2,800 sq. ft. residence on Lookout Mountain.

The south-facing lot allows excellent annual solar benefit with a view of Pikes Peak (on a clear day), and makes possible ample use of active and passive heating and generation of electricity from the original 7.0 kilowatt photovoltaic (PV) system. Solar heated water feeds a radiant floor heating system as well as domestic hot water. Optimum efficiency from the renewable energy systems is ensured with heavily insulated walls and ceiling and thermal mass built into the home's interior. Unique features include a "green roof" and a small third floor greenhouse for gardening. Material reuse/recycling rounds out the green building aspects of this home, and the pottery studio is fully powered by the home's PV system. In addition to the recycled materials in the home, they have literally recycled an entire house!

Growing Spaces / GoFarm Greenhouse

This year's tour offers a convenient "last stop," from 3 PM to 5 PM, to visit the Growing Dome® greenhouse. In 2019, Growing Spaces (a Colorado-based geodesic greenhouse company headquartered in Pagosa Springs) and GoFarm (a local agriculture non-profit) partnered in a 26 ft Growing Dome® organic greenhouse located in Golden's historic Goosetown district. The dome is most easily accessed from the American Mountaineering Center via the pedestrian bridge across Tucker Gulch.

Growing Spaces owners Lem and Liz Tingley promote Growing Dome® greenhouse kits in sizes from 15 ft to 42 ft for year-round food production to enhance a sustainable lifestyle. The dome in Golden supports the work of local non-profit GoFarm to increase the supply of local food, provide fresh produce to the community, and support sustainable farming through training and mentorship. The dome is managed by an apprentice farmer in GoFarm's Incubator program. The dome also serves as a learning center to showcase geodesic technology as a strong, effective, year-round growing solution for northern climates.

Growing Domes® are constructed on a Douglas fir frame covered with 100% recyclable 16mm 5-wall polycarbonate (R-value 2.8) sealed with aerospace-grade tape to prevent leakage, They have a 24-inch insulated foundation wall, a Reflectix north wall, and a solar-powered undersoil heating and cooling "climate battery."

Inside the dome, you'll find an eco-circle of life with a misting system, drip irrigation fed by a 1000-gallon thermal mass above-ground pond with aquatic plants and goldfish, PV solar panels to run fans, and temperature-activated automatic venting. Bio Ball filters help keep the pond water fresh. Planting beds are raised to reduce bending over and have a "keyhole" design for ease of access.

Electric Vehicle Roundup

October 7, 2023
3:00–5:00pm
American Mountaineering Center
Parking Lot

The next step after powering your home from the sun is to power the electric vehicles in your garage! That's part of the new sustainability model for America – put enough solar panels on your home not only to cover the lighting, heating, cooling, and other needs of your home, but also to charge your electric car(s).

Think of your car like your smartphone – plug it in when you arrive home, and you'll leave every morning with a full charge. Or, If you're lucky enough to have workplace charging, you can do the same at work and maybe not have to plug in at home. Those who are at home during daylight hours and have rooftop solar panels may want to charge their electric vehicle(s) while the sun is shining.

From 3 to 5 pm on Saturday, October 7th, before the After-Tour Party and Green Expo at the American Mountaineering Center, we'll have a display of electric vehicles (including some you may not have seen yet). Their owners look forward to sharing their EV experiences and answering your questions about their particular car. This year, our sponsors from Audi Denver, Planet Hyundai, and Lucid Air also will have their representatives on hand to demonstrate the merits of these electric vehicles.

If you already own an electric or plug-in car, plan on parking it with the others at the American Mountaineering Center. Call Jim Smith at 303-525-1851 if you have any questions.

Rebates and Tax Incentives for Sustainable Living

Electric Vehicles (EV)

Federal

- **$7,500 tax credit**
- Income qualified (<$300K filed jointly, <$225K single)

State

- **Tax credit of $5,000** for EV< $80,000, additional **$2,500** for EV < $35,000 in 2024
- **Rebate of $6,000** for trade-in on new EV: Income qualified (80% of median)

Solar PV

Federal

- **30% tax credit** Installation 2022 – 2032

State

- 2.9% sales tax exemption
- EnergySmart Colorado: Depending on your location, you could be eligible for a rebate of anywhere from **$400 to $2,500**.

Xcel

- **Solar•Rewards Program** Income qualified
- **Solar*Rewards Community** income qualified for Solar Gardens

Heat Pumps

Typically require certification

Federal

- Inflation Reduction Act (IRA), heat pumps and heat pump water heaters (HPWHs) are eligible for a **30% tax credit**, 2023
- Up to a limit of **$2,000** per taxpayer

State Tax Incentives

- 12.9% state tax credit
- Exempt from the state sales tax, which is 2.9%.

Utility Rebates

- Xcel and Tri State
- Rebates for all utilities: https://loveelectric.org/rebates/

New Homes

- 12.9% state tax credit
- Some local government and utility credits https://loveelectric.org/new-homes/ scroll to "Tax Credits and Rebates"

Energy Efficiency

Federal

- **Tax credits** for Heat Pump water heaters and clothes dryers, electric stoves, electric wiring and service, and insulation, air sealing and ventilation
- **Tax credits** higher for household incomes < 80% of median

State

- Similar to federal **tax credits**. Includes electric bikes and electric lawn equipment in 2024

Xcel and Denver

- Rebates and discounts

Web Sources

Electric Vehicles

- irs.gov/credits-deductions/credits-for-new-clean-vehicles-purchased-in-2023-or-after
- energyoffice.colorado.gov/transportation/grants-incentives/electric-vehicle-tax-credits
- energyoffice.colorado.gov/vehicle-exchange-colorado

Solar PV

- energy.gov/eere/solar/homeowners-guide-federal-tax-credit-solar-photovoltaics
- energysmartcolorado.org/rebates-for-your-home/
- co.my.xcelenergy.com/s/renewable/solar-rewards
- co.my.xcelenergy.com/s/renewable/solar-rewards-community

Heat Pumps

- loveelectric.org/news/building-electrification-rebates-for-2023/

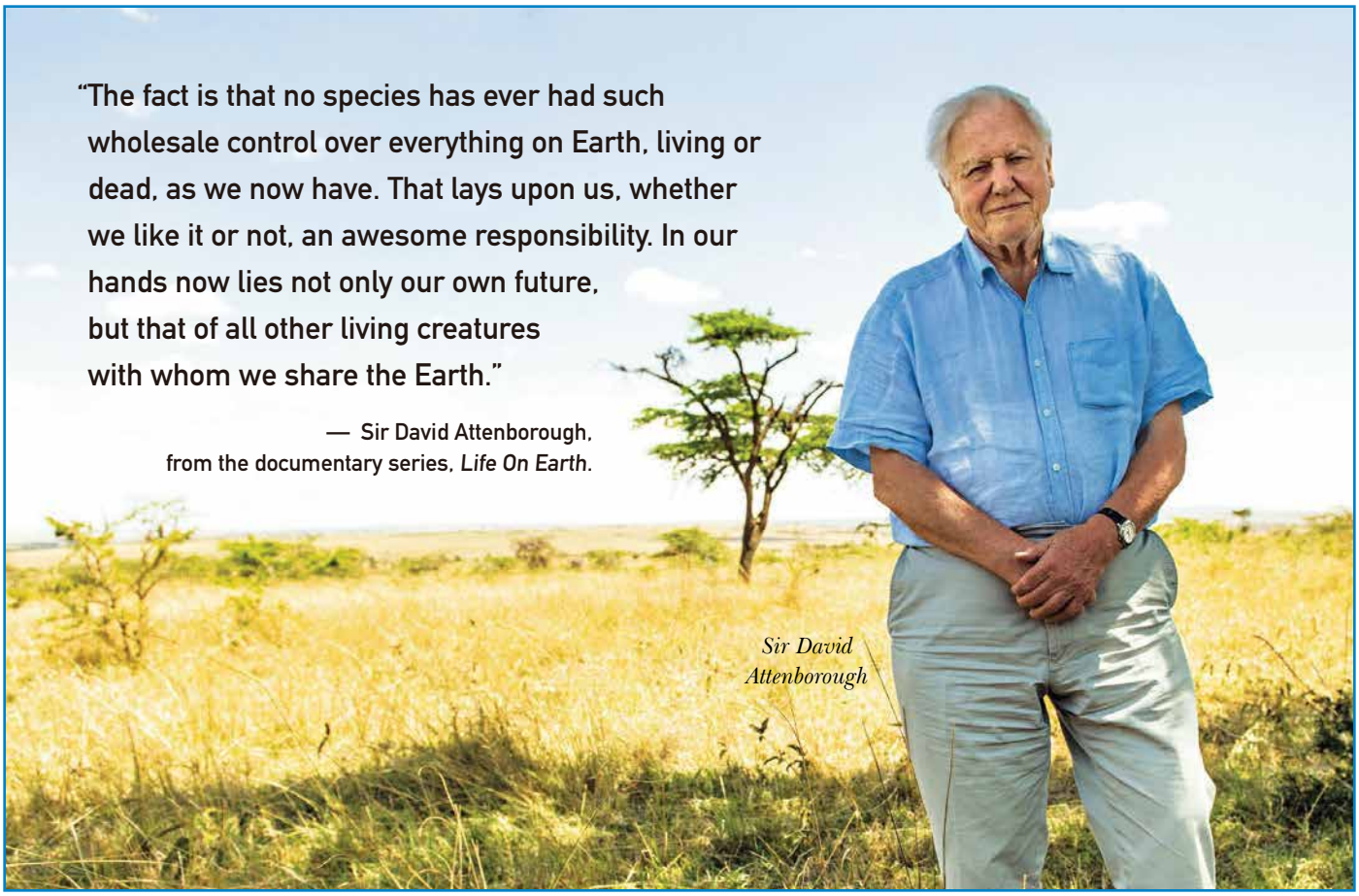
Summary for Existing Homes

Heat Pump system cost	Federal tax credit (30% up to $2,000)	State tax credit plus sales tax exemption, on equipment costs (12.9%)	Utility rebate – Tri-State member co-op	Total amount of rebates and tax credits	Final cost of heat pump system with rebates
4-ton, efficient, non-cold climate (Tier 1) heat pump – $16,000 total ($8,000 for equipment)	0*	$1,032	$1,800	$2,832	$13,168
4-ton, cold-climate heat pump on CEE and NEEP lists – $19,500 total ($9,750 for equipment)	$2,000	$1,260	$2,400	$5,660	$13,840

- energystar.gov/about/federal_tax_credits/air_source_heat_pumps

Energy Efficiency

- irs.gov/credits-deductions/energy-efficient-home-improvement-credit
- irs.gov/pub/taxpros/fs-2022-40.pdf
- energy.gov/scep/home-energy-rebates-frequently-asked-questions
- energysmartcolorado.org/tax-credits-incentives/#:~:text=A%20new%20Colorado%20State%20tax,equipment%2C%20not%20including%20installation%20charges.
- co.my.xcelenergy.com/s/residential/home-rebates



VITAMIN COTTAGE NATURAL GROCERS

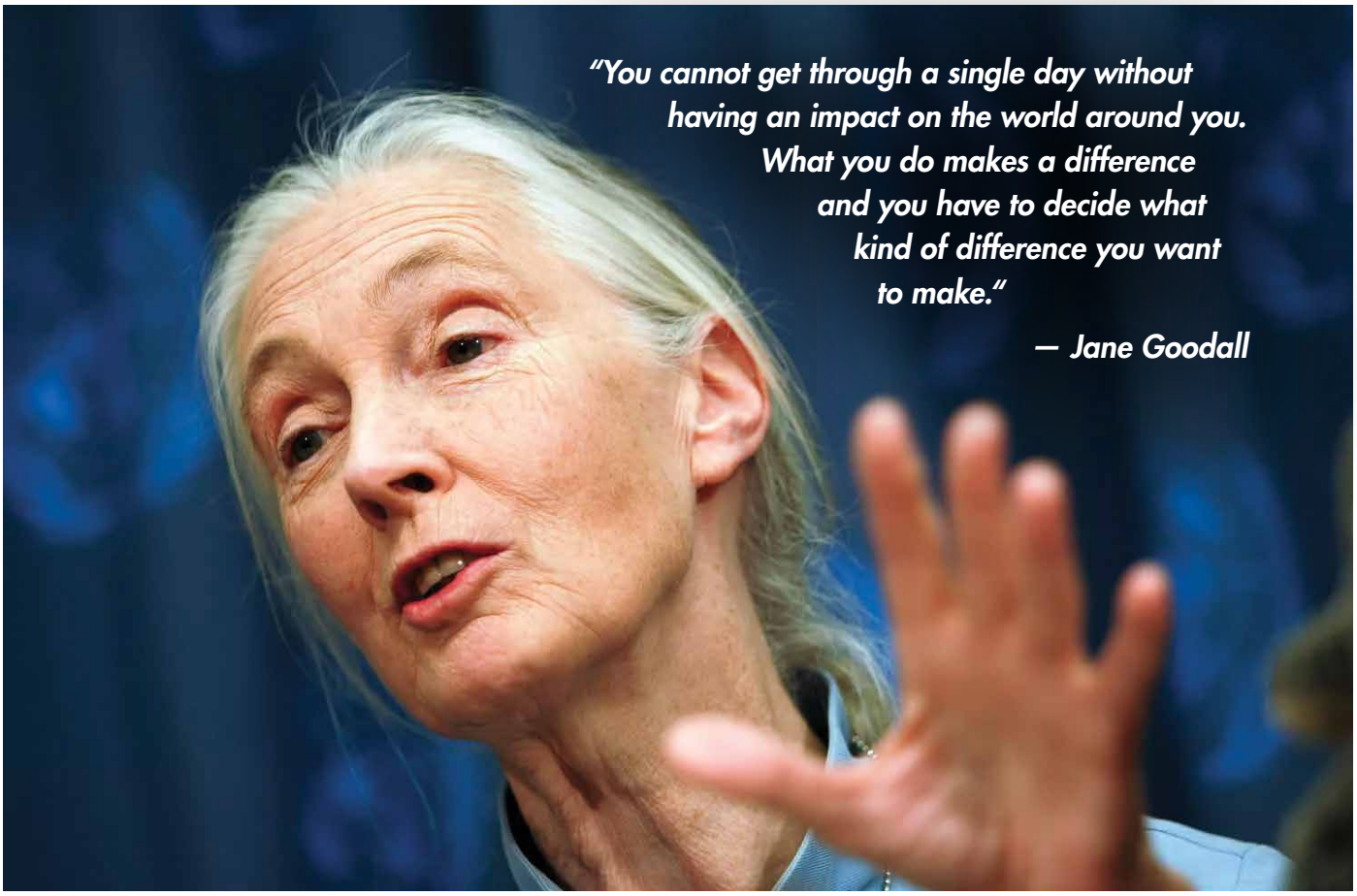
NATURAL GROCERS

Thank You!

To Natural Grocers in Golden for providing us with meeting space to plan this event!

Thank you!

to our partners in the Arkansas Valley for another successful tour event!



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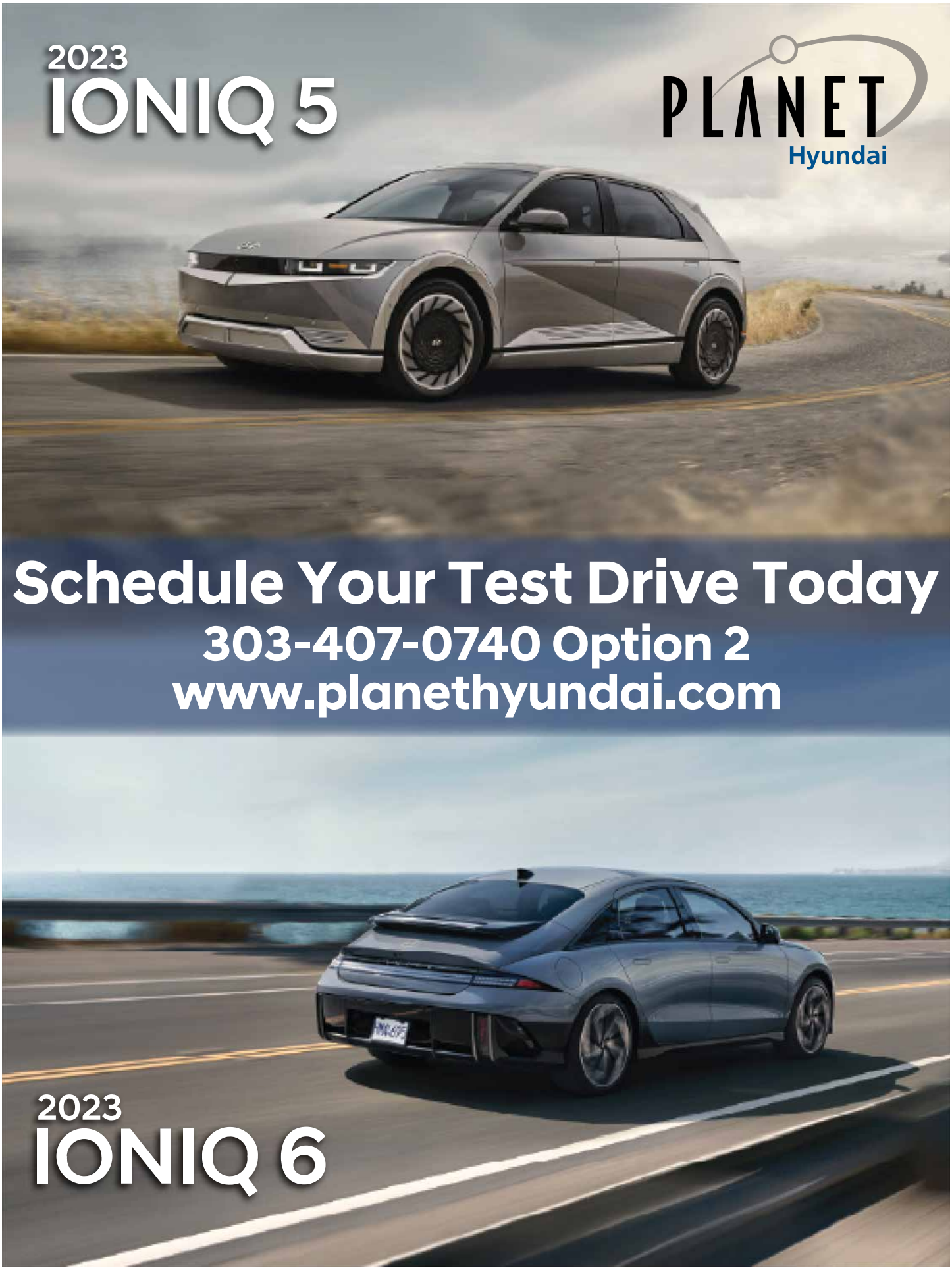
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