



## An Introduction to Rural Energy Options

The costs of electricity and natural gas in Colorado have been on the rise and have increased well beyond the rate of inflation. To combat rising costs and take advantage of generous financial incentives, now is the time to explore energy-saving opportunities.

The following are some energy options to consider for your farm or rural area:

### HOME AND BUILDINGS

According to the Energy Information Administration (EIA), about 40% of total energy consumed in the United States is in buildings.

- Lighting upgrades offer one of the quickest returns on investment of all energy options.
- Installing and utilizing programmable thermostats can lower heating and cooling costs by 10% while increasing comfort.
- A whole-building approach including air sealing, insulation, landscaping for energy conservation, and use of passive solar heating will ensure energy use optimization.
- Proper maintenance of air conditioner and furnace filters and other energy generators can result in a 5 – 15% savings in energy costs.
- Rebates can lower the up-front cost of efficient appliances.



Sources; and for additional information:

- [www.energysavers.gov](http://www.energysavers.gov)
- <http://www.ext.colostate.edu/pubs/pubs.html#energy>
- [www.rechargecolorado.gov](http://www.rechargecolorado.gov)

## ENERGY AUDITS

Home and on-farm energy audits reveal ways to save energy through energy conservation and efficiency that are customized to the property being audited.

- Do-it-yourself home energy audits and assessments are available at <http://hes.lbl.gov/consumer/> and at [www.energysavers.gov](http://www.energysavers.gov).
- Professional audits performed by energy engineers and certified energy managers can be low-cost and partial rebates may be available for them.
- Professional audits utilize blower door tests, infrared scans, and a walk-through to identify air leaks, insufficient insulation, and other forms of energy waste.
- Energy auditors use utility usage histories and current utility rates to make recommendations for energy conservation and efficiency measures.
- Energy audits may or may not include opportunities to integrate renewable energy.

Sources; and for additional information:

- <http://hes.lbl.gov/consumer/>
- [http://www.energysavers.gov/your\\_home/energy\\_audits/index.cfm/mytopic=11170](http://www.energysavers.gov/your_home/energy_audits/index.cfm/mytopic=11170)
- [www.rechargecolorado.gov](http://www.rechargecolorado.gov)

## GREENHOUSES

Heating typically makes up 75% of annual energy use in greenhouses, and there are many options for conserving greenhouse energy.

- Reduce air leaks by weatherstripping, repairing holes or broken glass, and lubricating fan louvers to ensure a tight close.
- Line inside sidewalls and endwalls and add a single or double layer of plastic over leaky glasshouses to reduce infiltration and heat loss by 50%.
- At \$1.00 to \$2.50 per square foot, installing a thermal curtain below the greenhouse ceiling can have a one to two year payback. Insulate heat and water lines and the walls behind them.
- For new greenhouses or major renovations, floor heating is more efficient than heating from above, and consider an open-roof design to eliminate the need for fans.

Sources; and for additional information:

- [http://www.extension.org/pages/Greenhouse\\_Energy\\_Conservation\\_Checklist](http://www.extension.org/pages/Greenhouse_Energy_Conservation_Checklist)
- <http://www.extension.org/ag%20energy%20greenhouse%20efficiency>

## IRRIGATION

According to a 2003 USDA survey, annual energy costs for irrigation averaged \$36 per acre, with an additional \$12 per acre spent on irrigation equipment maintenance and repair.

- Ensure that your pump, valves, and fittings are properly sized for primary applications and adjust pump levels and capacities to dropping water tables.
- Maintain all parts of your irrigation system adequately and regularly.
- Consider premium-efficiency motors with fewer rpms when installing new systems.
- The up-front cost of a variable frequency drive may have a quick payback period if you need to produce a wide range of flows.
- Consistent irrigation scheduling can reduce energy use by up to 30%.
- Low Energy Precision Application and low-pressure irrigation systems such as drip or micro-sprinklers can offer significant energy and water savings.

Sources; and for additional information:

- [http://attra.ncat.org/attra-pub/PDF/energytips\\_irrig.pdf](http://attra.ncat.org/attra-pub/PDF/energytips_irrig.pdf)



ATTRA photo by Roger Barton

## SMALL HYDROPOWER

Small, or micro, hydropower systems up to 100kW in size can be used for mechanical processes such as water pumping or to generate electricity both on- and off-grid.

- Diverting water for electricity requires a channel or pipeline to deliver water, a turbine or waterwheel, a generator, a regulator, wiring, and possibly an inverter.
- Generating power from small hydro resources can require vertical elevation changes (head) of only 2 feet or more in areas of high flow (quantity).
- Submersible turbines can be supported by as little as 13 inches of water.
- When determining the potential power output of a water source, consider the seasonality of the flow.

- Separate water rights may need to be acquired to generate electricity depending on the decree of the existing water right, and other permitting issues may apply.

Sources; and for additional information:

- <http://www1.eere.energy.gov/library/pdfs/29065.pdf>
- [http://attra.ncat.org/attra-pub/farm\\_energy/studies/irrigation.html](http://attra.ncat.org/attra-pub/farm_energy/studies/irrigation.html)
- <http://water.state.co.us/>
- <http://www.solarenergy.org/>

## SOLAR GROUNDWATER PUMPING

Solar-powered pumping systems (SPPS) are durable, can be mobile, and offer long-term economic benefits, especially if utility power is greater than 1/3 of a mile away.

- An SPPS consists of a water well, a solar PV array and mount, a pump controller and DC pump, discharge piping, a storage tank, a tank flotation switch, and a water tap.
- SPPS storage tanks should be sized to hold at least 3 days worth of water to account for nights and cloudy days when no power can be produced.
- If retrofitting an existing well for an SPPS, biofouling and sediments should be removed.
- A well-designed mobile SPPS system can be economical if livestock are moved throughout the year to areas with accessible wells and tanks.
- Install a shutoff switch in pumps in low-yield wells to avoid dry pumping.

Sources; and for additional information:

- <http://www.ext.colostate.edu/pubs/natres/06705.html>

## SOLAR PHOTOVOLTAICS

Plentiful sunshine and aggressive financial incentives make solar electricity generation an attractive option for small acreage and other homeowners in Colorado.

- Grid-tied solar PV systems can offset all or some of a site's electricity requirements, while battery backup systems allow for off-grid applications.
- The average cost per installed kilowatt in Colorado is \$6,000, and the average home would require 5.3 kW to offset 100% of its electric needs.
- Incentives and rebates can reduce the cost of a PV system by over 50%, and financing options exist that will cover the up-front cost of an installation.
- PV systems can either be roof or ground-mounted and should face south without shade.
- As with any renewable energy installation, energy efficiency measures should be taken beforehand to reduce the size and cost of the PV system.

Sources; and for additional information:

- <http://www.ext.colostate.edu/energy/solar.html>

## SOLAR THERMAL

Solar thermal energy can be a cost-effective solution for both space heating and domestic hot water.

- Solar air collectors can warm indoor air an additional 40 degrees or more through a closed loop, fan, and damper.
- Solar hot air systems can be roof, wall, or window mounted and have long lifetimes because of their relative design simplicity.
- Solar hot water systems can serve to heat space through radiant floors or baseboards and can also provide for domestic hot water.
- In Colorado, water and an anti-freeze such as glycol is circulated through corrosion-proof plumbing, the solar collector, and storage equipment to heat domestic hot water.
- Solar water heaters can reduce water heating costs by 50 to 80%.

Sources; and for additional information:

- [www.energysavers.gov](http://www.energysavers.gov)



## WIND

The National Renewable Energy Laboratory's wind resource map for Colorado shows that winds are viable for power generation across most of the eastern plains but can vary by site.

- A minimum of class 2 winds – 13.2 mph or above when measured at 50 meters in elevation – is suitable for residential power generation.
- Residential turbines up to 10kW and commercial turbines up to 25kW can be connected to the grid, but wind systems can also use batteries for off-grid use or power outages.
- Small wind systems can cost between \$4,000 and \$8,000 per kW installed.
- The amount of electricity generated per kW depends on the average wind speed of the site, the type of turbine to be installed, and the tower height of the turbine.

- Generating power above what the site needs is usually not be cost-effective as excess electricity is generally purchased at low wholesale rates by the utility.

Sources; and for additional information:

- <http://www.ext.colostate.edu/pubs/consumer/10623.html>
- <http://www.engr.colostate.edu/ALP/>

## GEOTHERMAL HEAT PUMPS

Geothermal or ground-source heat pumps utilize the relatively constant temperature of the earth as a heat exchanger.

- Closed-loop systems circulate a water/antifreeze mixture through a vertical or horizontal underground loop via a pump and high-density polyethylene pipe.
- Small acreages may be able to take advantage of the more inexpensive horizontal loop system if enough land is available.
- A typical residential 3-ton unit can cost \$4,000 or more per ton and so are most cost-effective when replacing an entire HVAC system or in new construction.
- Typical annual energy savings is 30 to 60% compared to conventional HVAC systems.
- Geothermal heat pump systems can work with existing ductwork for space heating and cooling and can also be used to supply domestic hot water.

Sources; and for additional information:

- [www.energysavers.gov](http://www.energysavers.gov)

## REBATES AND INCENTIVES

Financial incentives for the purchase of energy efficient and clean energy technologies can provide for 30% or more of project costs.

- A 30% tax credit is available for the installation of geothermal heat pumps, wind turbines up to 100kW, solar water heaters, and solar PV systems.
- A 30% tax credit up to \$1,500 is available for energy efficient HVAC systems, insulation, roofs, water heaters, windows, doors, and biomass stoves installed in your principal residence through December 31, 2010 unless extended.
- Different electric and gas utilities offer a range of incentives for energy audits, energy efficiency, and renewable energy on top of federal and state tax credits and rebates.
- The Governor's Energy Office maintains a comprehensive list of all local financial incentives at [www.rechargecolorado.gov](http://www.rechargecolorado.gov)

Sources; and for additional information:

- <http://www.dsireusa.org/>



**Resource: Colorado State University Extension Energy Specialist (970) 491-3784**