Renewable Energy 101

Worldwide demand for energy is expected to triple within the next three to four decades. Given the environmental, economic, and security consequences that come with our fossil fuel dependence, we have no choice but to embrace renewable energy resources. Ensuring sufficient resources and reliable infrastructure to deliver electricity at a cost that people can afford demands that U.S. energy supplies become diversified, distributed and efficient. Renewable energy offers a clean, reliable, cost-effective solution to our nation's long term energy needs.

Renewable resources generate reliable power that is compatible with the U.S. electric grid and produces no toxic air emissions, water pollution or waste. Renewables add an economically stable source of energy to the mix of US generation technologies. They can be installed closer to local electric loads and distributed throughout the country. Decentralized power generation reduces the burden on our overtaxed and fragile electric grid, allows incremental capacity increases that more closely match demand and creates new markets in cutting-edge, high-efficiency generation and power management technologies. Such a system would also reduce the potential for disruption as well as the costly waste intrinsic in transmitting electric energy over long distances (about 30 percent of electricity is lost in transmission).

Renewable fuels are inexhaustible and free, tapped and developed locally. Towns that own renewable energy projects are more economically sustainable, keeping a larger portion of economic value within the community. Renewable energy projects generate revenues, property taxes, land lease fees, and stable, long-term, good-paying jobs that help to stimulate the local economy and contribute to the economic base.

Studies have shown that communities located near coal fired power plants suffer from higher rates of birth defects, asthma, cancer and other illnesses[1]. Communities that develop and own local renewable energy projects enjoy better air and water quality; asthma sufferers breathe easier, children splash in the local creek without fear of mercury contamination. Because the environment is healthier, people and families are healthier too.

SOLAR

On a sunny day, the sun emits the equivalent of 1000 watts of energy per square meter of the planet's surface. Just a tiny fraction of this energy (around a hundredth of a millionth of a percent) is enough to meet all of our power needs many times over – if we could simply harness it effectively.

There are several ways to harness the sun's energy for useful purposes. Two different approaches are often referred to as "passive" and "active" solar. Passive solar is an architectural

[1] "Air of Injustice" October, 2002 – collaboration of the Black Leadership Forum, The Southern Organizing Committee for Economic and Social Justice, The Georgia Coalition for the Peoples' Agenda and Clear the Air.

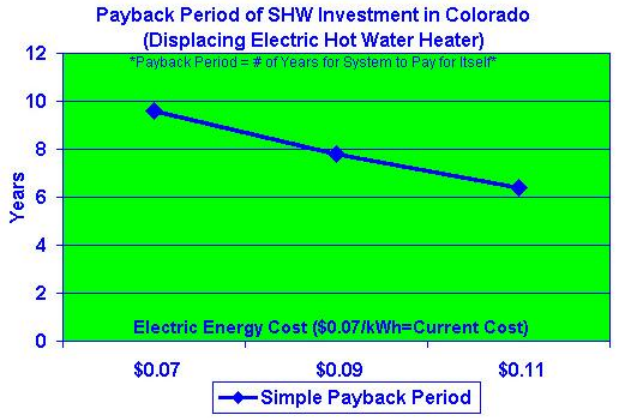
design approach in which south facing windows are incorporated into building designs, often with an adjacent stone floor or wall to absorb heat, which is then distributed throughout the house via fans and/or vents.

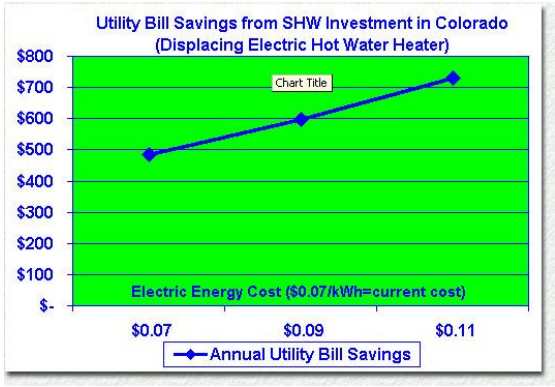
The two active solar technologies that are the most common are Solar thermal and Solar photovoltaic (PV).

Solar thermal technology has been around for many years. During the "energy crisis" of the 1970s and early 80s, the Carter Administration began an aggressive incentive program for home solar thermal systems and many thousands of these systems were installed throughout the US.

Solar thermal technology is fairly simple: solar collectors contain small tubes with water or some other liquid running through them and are covered with a heat absorbing, flat, black plate. They are installed on a south facing surface like the roof. Sunlight heats up the water, which is then pumped into a well-insulated hot water storage tank.

The cost of a solar hot water system varies. As an example, a family of 4 uses about 100 gallons of hot water per day. A typical solar thermal system that would heat a significant percentage of this family's hot water needs might cost about $5,000 and would save the family about $500 per year when utility prices are in the 7¢ per kilowatt hour range, giving an economic payback of just under 10 years.





Today's solar thermal systems are simpler than in the past, with fewer moving parts and are easier to maintain, but the basic technology is still pretty much the same as it was in the 1970s. They are generally very reliable and will last 25 years with minimal maintenance.

Solar Photovoltaic (PV) or solar electric technology converts sunlight directly into electricity. This is the same technology that is often used to power calculators or watches. Solar electricity requires no fuel, emits zero pollution and has no negative health or environmental impacts. Solar technology is efficient and reliable and requires virtually no maintenance; once installed, solar panels can provide heat or electricity for many years.

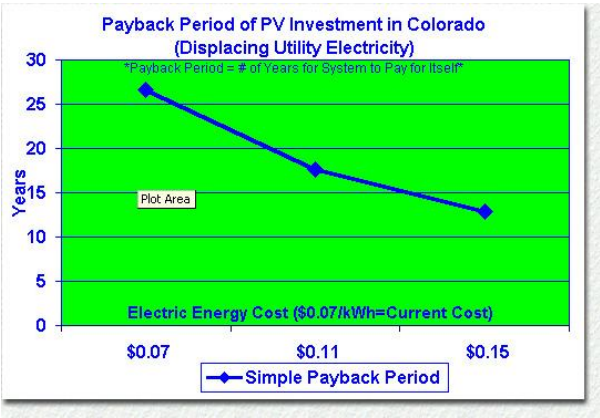
There are several different ways to configure PV systems, but most commonly, systems are wired directly into the home's electrical system. Here's how it works: Solar cells contain a semiconducting material – usually silicon, although other materials are starting to be explored and used. When sunlight hits the solar cells, it heats up the atoms in the silicon and electrons start bouncing around to produce DC electricity. Multiple solar cells are generally configured

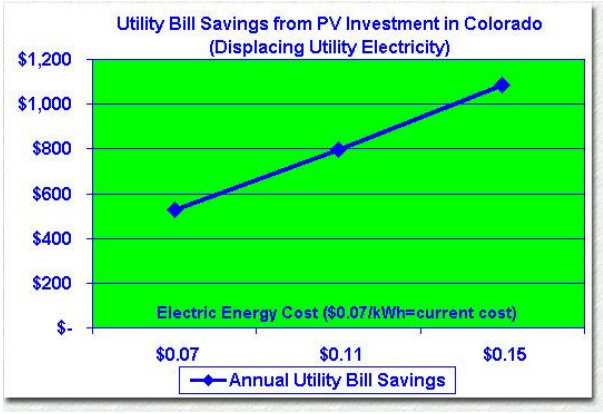
into modules and installed into a PV array. The array is wired through the roof into an inverter which converts the DC electricity into AC, and then is connected directly to the home's electrical supply.

In many cases the PV system is interconnected with the electricity grid and net metered. Interconnection allows homeowners to add excess generated electricity from their PV system to the grid, and draw from the grid when they need to. For example, during the day when the sun is shining, the PV system may generate more electricity than the home needs, in which case that excess electricity is allowed to flow into the grid. Then at night, the home may need to draw more electricity than the system produces, and the home's needs are supplemented by grid electricity. Net metering involves installing a single meter on the home that runs forward when electricity is being drawn from the grid, and backward when excess electricity is being added to the grid. Net metering increases the economic benefit of PV since it allows homeowners to essentially sell excess power back to the utility.

Like solar hot water systems, the cost of PV varies considerably with the size of the home, number of occupants, electrical energy use and especially regional electric utility rates. The overall cost effectiveness of a PV system can be substantially increased by ensuring that the home is as energy efficient as possible.

A 2,000 watt (2 kW) PV system could reasonably provide about half of the electricity needs of an energy efficient 2,000 square foot home. A 2,000 watt PV system costs about $16,000 to install. With net metering, a 2,000 watt system would save the homeowner about $530 per year on their electric bill, yielding a payback of around 26 years at current electricity rates. As electricity prices rise, the yearly electricity savings increase as well.





In November 2004, Colorado became the first state ever to adopt a renewable energy standard by popular vote. Amendment 37 requires that qualifying Colorado utilities generate 10 percent of their electric supply from renewable energy sources by 2015. Amendment 37 stipulates that four percent of the renewable energy requirement come from distributed solar electric systems and requires that the state's two largest utilities – Xcel Energy and Aquilla – implement a rebate program for PV. While details of that program are still under negotiation, it is likely that Xcel rebates will help to cover up to half of the cost of installing a PV system.

Economic Value of Installing Solar Technologies in Colorado

When considering an investment in a home solar energy or solar hot water system, homeowners typically want to know how much it will cost, how much it will save and how long it will take to recover their investment. Yet an investment in solar energy pays back dividends that are often difficult to quantify and as a result, usually overlooked. Does a homeowner consider the payback of installing granite countertops or stainless steel appliances? Considerations like the increase in property value, as well as other local and global benefits of going solar are often more important to homeowners than their straight economic costs and payback. Generally people that install PV understand that these benefits may not necessarily be something they can see and feel every day, but they take a more global view of the impacts of their consumer spending choices.

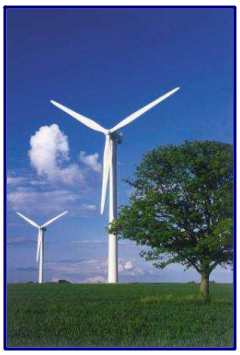
Many homeowners invest in solar systems as a hedge against future energy price volatility or for other "value-added" or non-tangible economic benefits. For example, solar electric systems combined with battery storage can increase the reliability of power supply and ensure electricity is available for key functions during utility outages. The link between fossil fuel use and national security is also a factor for some people who choose to go solar. The nations and regions where oil and gas resources are concentrated are hotbeds of political and social instability. The U.S. spends many billions of dollars every year protecting its oil and gas interests in these regions and many people prefer not to support these activities with their energy dollars.

For some, environmental considerations are often a major factor in the decision to go solar. Purchasers of solar energy systems contribute significantly to the reduction of pollutants emitted from conventional fossil fuel generation.

In Colorado, over 90% of our electricity generation comes from coal-fired power plants. Generating electricity from coal is probably the most toxic and polluting process known to man and contributes to things like: off-the-charts asthma rates in children, cardiac disease, and respiratory problems. The EPA estimates that fine particle pollution from coal-fired power plants contributes to 300,000 deaths per year. That's 100 times more deaths than 9/11 EVERY YEAR. Mercury emissions from coal-fired power plants are contaminating fish and other wildlife up through the food-chain, and mercury is showing up at dangerous levels in people's systems all over the world. The effects of mercury contamination are largely unknown but thought by many scientists to contribute to low birth weight and birth defects, autism and other neurological problems. Coal fired electricity generation is also the largest contributor to global climate change, which many consider to be the greatest threat that humanity has ever faced.

Over its 30-year expected life, a 2 kW solar electric system will eliminate over 260,000 pounds of CO_2, nearly 650 pounds of SO_2, and over 530 pounds of NO_x that would have been produced from an equivalent amount of conventional generation in Colorado. The reduction of CO2 alone is equivalent to:

- Not driving an automobile over 250,000 miles (effectively taking a car off the road permanently);
- Keeping over 130,000 pounds of coal in the ground; or
- Planting nearly 53 acres of trees.



WIND

Wind power plants generate efficient, dependable and cost-effective electricity from a limitless, free resource. No fuel is explored for, extracted, transported, refined, or combusted. Wind energy generates zero emissions, zero atmospheric pollution and zero toxic waste. Creating electricity from wind requires zero consumption of natural resources, very little water, and minimal land.

Technological advances in today's wind turbine designs have made wind technology more efficient – harnessing more of the wind's energy and at lower wind speeds – and more cost-effective than ever before. Wind power technology is now 98% dependable; it is increasingly competitive with coal and nuclear energy and is significantly cheaper than natural gas or any other new clean energy technology. With today's energy infrastructure and today's technologies, wind could comfortably generate 20% of our nation's electricity requirements – as it already does in other countries.

Wind power also supports our Nation's energy independence and security and can strengthen our struggling rural communities by increasing local tax bases, providing new sources of income to farmers who house turbines on their land, and creating long-term, permanent jobs. According to a study by the New York State Energy Research and Development Authority, "wind energy produces 27% more jobs per kilowatt hour than coal plants and 66% more jobs than natural gas plants"[2]

BIOMASS and BIOGAS

Organic wastes, such as agricultural and forest residues, can also be used to generate electricity. When these materials are burned, the heat is used to produce steam, which drives a turbine to generate electricity. Likewise, the heat from biomass can be used more directly to heat homes or for other uses, like for example, when you burn wood in your fireplace.

Biogas is another form of energy created when organic matter is converted into liquids and gasses, or captured when gases escape from landfills or livestock waste in the form of methane. Biogas has a wide range of uses, including electricity generation. Transportation fuels, such as ethanol and biodiesel are also forms of biogas.

There are multiple advantages to using biomass to generate electricity. Biomass offers an additional source of income to farmers and rural communities, while reducing waste disposal costs. Utility companies can generate electricity from biomass with the same equipment power plants use to burn fossil fuels.

Outside the U.S., biomass is rapidly becoming one of the most important and useful fuels. For example, it accounts for one third of the total fuel use in India. In the US, it is estimated that biomass has the potential to supply 14% of electricity use and 13% of the nation's motor fuel.

[2] U.S. Department of Energy; "*Wind Energy for Rural Economic Development*"