

ENERGY: Energy Sources, Energy Savings and You

AN ENERGY-EFFICIENT ECONOMY CAN GROW WITHOUT USING MORE ENERGY. TOTAL U.S. ENERGY USE IN 2000 WAS ALMOST THE SAME AS IN 1973, WHILE THE U.S. GROSS DOMESTIC PRODUCT INCREASED 74% DURING THE SAME PERIOD.

AN ECONOMY THAT USES LESS ENERGY ALSO PRODUCES LESS POLLUTION... IN 1998, FOR INSTANCE, U.S. CARBON DIOXIDE EMISSIONS DROPPED BY 0.15%.¹¹

PRODUCED BY EARTHTEAM IN CONJUNCTION WITH THE MILLION KILOWATT HOUR CHALLENGE

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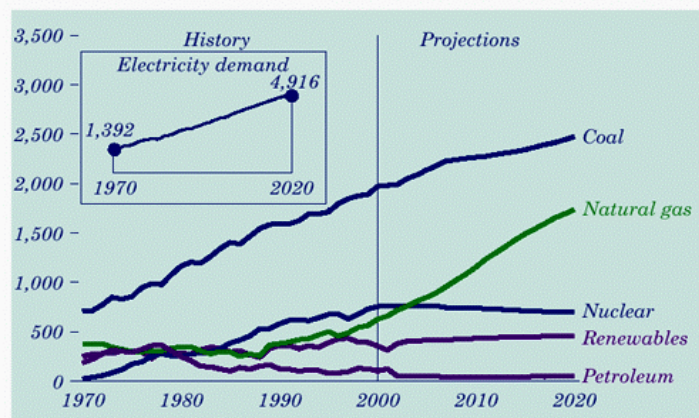
Energy production and use account for nearly 80% of air pollution, more than 88% of greenhouse gas emissions, and more environmental damage than any other human activity.²

...the nation's energy needs are expected to grow by 33% during the next 20 years. Renewable energy can help fill the gap.¹⁰

WHAT IS ENERGY? *Energy is the capacity for doing work and overcoming resistance.¹⁷ Energy may exist in various forms; after it has been transferred from one body to another it is referred to according to its nature, (e.g., heat becomes thermal energy, sun becomes solar energy, etc.)*

HOW WE USE ENERGY There are two types of energy sources, renewable and non-renewable. Renewable energy sources, not including hydroelectric power, account for just 1% of the world's supply; fossil fuels provide about 85%.¹² Similarly, approximately 85% of the energy consumed in the U.S. in 1999 came from coal, oil, and natural gas. Renewable energy resources (hydroelectric, fuels from biomass, geothermal, wind, and solar) supplied about 7.5% in the U.S., and 8% in the form of electricity came from nuclear power plants.¹⁴

Figure 4. Electricity generation by fuel, 1970-2020 (billion kilowatthours)



History: Energy Information Administration (EIA), Form EIA-860B, "Annual Electric Generator Report— Nonutility"; EIA, *Annual Energy Review 2000*, DOE/EIA- 0384(2000) (Washington, DC, August 2001); and Edison Electric Institute. **Projections:** Table A8.

Our environmental well-being—from improving urban air quality to abating the risk of global warming—requires a mix of energy sources that emits less carbon dioxide and other pollutants than today's mix. Our national security requires secure supplies of oil or alternatives to it. . . . And for reasons of economy, environment, security, and stature as a world power alike, the United States must maintain its leadership in the science and technology of energy supply and use.

-- "Challenges and Opportunities for the 21st Century," U.S. Department of Energy.¹³

U.S. Energy Consumption and Electricity Generation, 1999 ¹⁴

Energy Source	Consumption (%Total)	Electricity Generation (%Total)
Coal/Coal Coke	22.6	51.9
Petroleum	39	3.2
Natural Gas	22.9	15
Nuclear	8	18.5
Hydro Pumped Storage		
Renewables (Total)	7.5	11.5
Hydro	3.6	9.4
Biomass/Biofuels	3.3	1.6
Geothermal	0.39	0.46
Solar	0.07	0.02
Wind	0.05	0.12

Renewable Energy Sources *These energy sources are “unlimited” in supply because they can be replenished by nature.*

In 2001, about 6% of total U.S. energy demand was met by renewable sources, with the largest amounts used for electricity generation. Hydropower made up around 39% of U.S. renewable consumption in 2001, with biofuels (including wood and waste), solar, wind, and geothermal making up most of the remainder.⁷ There is a huge potential renewable energy resource--250 times total annual U.S. energy consumption.¹⁴

Renewable Energy Sources Include:

- Biomass Energy (Energy from plants and organic matter)***
These materials can be burned directly, converted into gases or oils to be burned, fermented, or decayed by bacteria. The energy in this organic matter is used to create electricity, heat, and transportation fuels.
Advantages: Abundant; renewable; can eliminate waste products and reduce need for landfills.
Disadvantages: Potential significant air pollution (burning); may be costly.
Facts: Biomass is America’s second largest resource of renewable energy. Agricultural crops can be used to make such liquid fuels as methanol and ethanol; “E85” is a mixture of 85% ethanol and 15% gasoline.¹⁰ In 1989, biomass (mostly from burning wood and manure to heat and cook) supplied about 15% of the world’s energy and about 50% of the energy used in Less Developed Countries¹.
- Geothermal Energy (Energy from heat in the Earth core)*** *This heat is visible in such forms as hot springs, steam, boiling mud and volcanic gases.*
Advantages: Unlimited supply; no air or water pollution.
Disadvantages: Start up and maintenance costs potentially high.
Facts: The geothermal energy potential in the uppermost 6 miles of the Earth’s crust amounts to the energy of all oil and gas resources in the world.¹⁰ Geothermal energy was the third largest source of renewable energy in the U.S. in 1999;¹⁴ in 1996, Iceland and U.S. were the world’s biggest users of geothermal energy; California produced 6% of its electrical energy from geothermal sources.¹

- Hydropower (Water Energy)** *The force of moving water is used to turn turbines, which generate electricity. Two lesser known forms of hydropower specific to oceans are: Ocean Thermal Energy Conversion, which harnesses temperature differences between surface and deep waters; Tidal Power, which uses the enormous power of ocean tides. These two forms of ocean hydropower are still “experimental,” but are used in some countries.*¹⁶

Advantages: Abundant; clean; safe; free; non-polluting; easy reservoir storage; relatively inexpensive to produce electricity; recreational benefits.

Disadvantages: Power plants are expensive to build; potential significant environmental impact (dams can affect water quality and wildlife habitats); reliability depends on plentiful water supply.

Facts: Hydropower is our oldest and largest source of renewable power, producing about 10% of U.S. electricity.¹⁰ In 1989, hydropower supplied 20% of the world's electricity and 3% of the world's total commercial energy.¹
- Sun (Solar Energy)** *The sun's energy is used for heat, light, and power.*

Advantages: Unlimited supply; “clean”-- no resulting air or water pollution.

Disadvantages: Not yet as cost-effective as fossil fuels, expensive to build systems; storage and backup are necessary and not as simple as hydropower reservoir storage; reliability depends on availability of significant and consistent sunlight; current utility interconnection structure makes distributed generation difficult.

Facts: “I'd put my money on the sun and solar energy... What a source of power!”-- Thomas A. Edison. In January 2000...NREL released a report that said that the domestic photovoltaic (PV) industry could provide up to 15% of “new U.S. peak electricity capacity expected to be required in 2020.”⁷ The world's largest solar energy power plant in Southern California's Mojave Desert can meet the energy needs of more than 350,000 people.¹⁰ New approaches include: “Solar Thermal,” which uses many mirrored troughs to focus the sun's heat on oil-filled tubes which drive steam turbines; “Power Tower,” which uses moveable mirrors to beam sunlight to a central tower, powering steam turbines; the “Stirling Engine” method, which is a piston engine driven by heat from the sun; “Dish System,” in which mirrors focus the sun's heat onto a receiver to run a Stirling engine.¹⁵
- Wind (Kinetic Energy)** *Energy from the movement of air.*

Advantages: Abundant; free; no resulting air or water pollution; multiple land use; more expensive than fossil fuels but rapidly becoming more cost effective.

Disadvantages: Reliability dependent on constant and significant supply of wind; requires significant amounts of land; potential negative visual impact; more expensive than fossil fuels but rapidly becoming more cost effective.

Facts: Wind energy has been the fastest growing source of energy in the world since 1990, increasing at an average rate of over 25% per year.¹⁰ In 2001, wind-electric generation worldwide increased by 31%; in the United States it jumped by a staggering 66%; three of the wind-rich states—North Dakota, Kansas, and Texas—have enough harnessable wind energy to satisfy all the nation's electricity needs.¹⁵ The American Wind Energy Association estimates that new wind farms in 2002 will eliminate emissions of 7.5 million tons of carbon dioxide from fossil-fuel power plants.¹⁵ Wind power experts project that wind energy could provide over 5% of the nation's electricity by 2020¹⁵, and that by the middle of the 21st Century wind power could supply 10% of the world's electricity.¹

Non-Renewable Energy Sources The remains of plants and animals that lived during prehistoric times are referred to as fossil fuels. These energy sources are limited. They are found only in certain places in the world, are always underground, and cannot be replaced, reused or re-created.

Overall, the U.S. relies on oil for about 39% of its total primary energy requirements, natural gas for about 23%, and coal for 23%; this means 85% of the energy consumed in the U.S. comes from non-renewable sources.⁷ According to the Edison Electric Institute, proven oil reserves will last for 37 years or so; natural gas, 61 years; coal, 211 years. These numbers suggest that fossil fuels are cheap and plentiful.¹²

Because these energy sources cannot be replaced, it is important that levels do not diminish and that Earth's fossil fuels are preserved. Stewardship and conservation on your part are essential to this effort.

Non-Renewable Energy Sources Include:

- ***Coal*** *Coal is used for heating and to provide energy to power plants and manufacturers.*
Advantages: Currently abundant; established infrastructure and delivery system; price has stayed relatively low over time.
Disadvantages: Limited supply; sometimes hard to find/access; very polluting; burning leads to build up of CO₂, which impacts global warming.
Facts: The U.S. ranks 1st worldwide in coal reserves. 90% of the coal consumed in the U.S. is used for electricity generation⁷; in 1999 coal produced nearly 52% of all U.S. electricity.¹⁴
- ***Natural Gas*** *Natural gas is used to cook food, heat houses, and to power some vehicles and machinery. It is considered the fuel of choice in much of the world.*
Advantages: Currently abundant; relatively inexpensive; established infrastructure and delivery system.
Disadvantages: Limited supply; sometimes hard to find/access; cleaner than oil and coal but still polluting; burning leads to build up of CO₂, which impacts global warming.
Facts: In 1999, about 15% of U.S. electricity generation came from natural gas.¹⁴ Projections show demand for natural gas will increase at an average annual rate of 2% between 2000 and 2020, a faster projected annual growth rate than for electricity (1.8%), petroleum (1.5%), or renewable fuels (1.7%).⁸
- ***Oil (Petroleum and Shale oil)*** *Oil is used in plastics, clothes, fertilizer, gasoline... everything from Frisbees and snow skis to space shuttles and their fuel... from running shoes and bathing suits to CDs and telephones.*
Advantages: Currently abundant; versatility; price stayed relatively low over time.
Disadvantages: Limited supply; sometimes hard to find/access; polluting; burning leads to build up of CO₂, which impacts global warming; major economic and national security implications.
Facts: In 2001, imported oil was responsible for meeting approximately 59% of total oil U.S. demand.⁷ This compares with 34% in 1973.¹⁰ The U.S., the world's second largest oil extractor, has only 4% of the world's oil reserves but uses nearly 30% of all oil extracted each year. In 1996, the burning of petroleum fuels emitted about 30% of the carbon dioxide added to the atmosphere annually.¹

- ***Nuclear (Nuclear Energy)*** *Power generated from the radioactive decay of uranium.*
Advantages: Highly cost effective once established; not air polluting.
Disadvantages: Expensive to build plants; radioactive waste is highly toxic and has very long half-life; disposal presents major problems including security, storage, proliferation and insurance issues.
Facts: In 2001, nuclear plants supplied about 20% of total U.S. electrical generation, second only to coal in the U.S. electricity generation mix.⁷ ... because of safety concerns and waste disposal problems, the United States will retire much of its nuclear capacity by 2020.¹⁰

TIPS FOR CONSERVING ENERGY

Appliances

- Use appliances during non-peak hours (dish washers, clothes washers and dryers, etc.) *Peak hours are Noon – 6 pm in PGE's Service Area.*
- Use energy efficient appliances. *30% of home energy waste can be captured with efficient "Energy Star"- labeled products. "Energy Star" washing machines can save up to 7,000 gallons of water per year! ... "Energy Star" dishwashers are up to 50% more efficient than pre-1994 models... "Energy Star" refrigerators can save up to 40% more than pre-1993 models; "Energy Star" TVs use up to 75% less energy in standby mode than other models.*
- Use appliances efficiently. *Run dishwashers, clothes washers and dryers with full loads... wash clothes in cold water (you could save 85% of the energy and dollars you use on washing!) ...use a clothesline instead of a dryer.*
- Don't dry your dishes. *Save 1/3 of dishwasher costs by turning off the machine after the rinse cycle, or use the "overnight dry" or "economy" setting.*
- Unplug your 2nd refrigerator to halve your refrigeration consumption. *Store all perishables in one refrigerator.*
- Unplug stand-alone freezers. *Minimize frozen food storage need so you don't use extra energy.*

Heating/Cooling

- Monitor thermostats! *Close room doors to save heat and cold! During winter, each degree of temperature decrease saves about 3% on your energy bill... lower the setting when you're asleep... during the day, put on warm clothing. When it's too hot for you, set the thermostat to cool "just enough"... cool down small areas instead of the entire house...wear cool, loose, clothes.*
- Install a passive solar heating system.
- Plant shade trees to cool buildings and reduce need for air conditioning.
- Improve insulation... *install storm doors and windows and eliminate drafts around doors and windows... air leaks waste as much energy as a large open window....weather-stripping and caulking can save up to 10% of home energy costs!... insulate your hot water tank.*
- Install energy efficient windows. *You'll save up to 1/3 on your heating/cooling bills.*
- Use window coverings to insulate. *In summer, close drapery and shades to keep rooms cool... in winter, let the sun's warmth in!*
- Microwave instead of using conventional electric ovens and stoves. *By creating less heat in your home, you'll save on cooling costs.*

Lighting and Electronics

- Turn off lights! *Save money and energy by turning off lights, video games, VCRs, DVDs, radios, TVs, computers ... ANYTHING that consumes energy... when you are out of the room or not using them.*
- Let "Mother Nature" light your home. *Sunlight's brighter than lots of light bulbs, and it's free!*
- Don't like coming home to a dark house? *Instead of leaving lights on, use timers on some lights in your home, or install motion detectors on exterior flood lights to improve home security.*
- Replace incandescent light bulbs with CFLs. *Fluorescents are cost-efficient! They provide 3_ times more light than same wattage incandescents, reduce lighting energy use by as much as 60% and last up to 10 times longer! If every U.S. household used "Energy Star" light fixtures, we'd save 70 billion kilowatt-hours and prevent 100 billion pounds of CO₂ per year -- equal to removing 10 million cars from roads!*
- Replace halogen torchiers with CFL lamps. *They're safer (halogen lamps become so hot they can be a fire hazard) and more efficient.*
- Turn off decorative pumps and lights. *Outdoor fixtures and landscaping lights are energy eaters.*
- Use solar cell-powered lighting rather than hard-wired lights.
- Unplug infrequently used TVs, VCRs, DVDs, etc. *Eliminate "standby" power energy consumption—energy used even when the set is not in use. About 1/2 of all energy used by stereo systems, VCRs and TVs is devoted to standby mode. Use the power management function on your computer to minimize standby drain ("sleep"/"standby"/"power saver"); you can access this through the Control Panel.*
- Operate all computers on a single power strip. *Switch off when not used to eliminate standby power loss.*
- Unplug TVs and turn off power strips to save energy when not in use. *TVs are among the biggest home power drains, using more electricity than microwave ovens and three times more than dishwashers each year. TVs top the list of U.S. "standby" energy users-- TVs draw enough standby power each year to light 5 million American homes. Generating this power creates 1 million tons of carbon emissions.*
- Turn off computer monitors. *When not in use, turn it off—monitors soak up electricity.*

Transportation

- Turn down a ride! *Save oil and natural gas by driving less. Ride your bike, walk or take public transportation.*
- Carpool. *If you must drive, use a carpool... join one or arrange one, but carpool!*
- Drive an energy efficient, high gas-mileage vehicle.
- Keep your automobile tuned up; keep tires inflated properly.
- Drive slower. *The faster you drive, the more gasoline you burn.*

Water

- Save water! *Save money and energy by turning off the faucet when not using water. Take showers, not baths (a deep water bath uses twice the water of a shower!) ... take shorter showers... don't leave faucets running while brushing your teeth, shaving, washing dishes, etc. Saving hot water means you save energy; saving water helps conserve this precious natural resource.*
- Use a low-flow shower head to reduce hot water waste...and to conserve water in general.
- Reduce your hot water energy usage. Heating hot water accounts for as much as 20% of home energy costs. *Set your hot water heater to as low as 115-degrees (low-medium). Afterwards, raise the setting gradually if you find that you run out of hot water.*
- Insulate your hot water tank.
- Reduce your hot tub temperature by 15-degrees, and heat only when ready to use it. *Always use an insulated cover to maintain heat after use ... avoid operating during peak hours ... leave the heat off for the summer.*
- Reduce your pool pump operating costs. *Reduce hours of operation and set clock so pump's not operating during peak hours.*
- Turn off the pool heater during summer hours. *Save energy and money by reducing unnecessary heating.*
- Use an insulating pad on your water bed. *Save energy and money by eliminating heat loss.*

Other

- Remember the 3 R's. *Reduce! Reuse! Recycle!*
- Reuse bags! *Save oil, natural gas and trees by reusing plastic and paper bags from home. Or, use a tote bag—again and again!*
- Buy products that use minimal packaging.
- Do a home energy audit to improve home energy efficiency in your home. *Improve insulation... install storm doors and windows (weather-stripping and caulking can save up to 10% of home energy costs!) ... eliminate drafts around doors and windows... install devices that reduce hot water consumption...insulate your hot water tank.*
- Encourage your school to do an energy audit. *Schools spend more money on energy than computers and textbooks combined! Identify possible improvements and suggest ways to reduce your school's energy consumption.*
- Design and distribute energy conservation awareness posters. Place them in your school, in local businesses... everywhere!

A journey of a thousand miles begins with a simple step.

-- Confucius

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LEARN MORE ABOUT ENERGY CONSERVATION AND CHANGE

For more information, check these web resources and the references cited above:

California Department of Conservation www.consrv.ca.gov
 California Environmental Resources Evaluation System www.ceres.ca.gov
 California Energy Commission www.energy.ca.gov
 California Energy Commission Consumer Energy Center
www.consumerenergycenter.org
 California Regional Environmental Education Community www.creec.org
 Edison International Kids Power Lab www.edisonkids.com
 EE Link/Environmental Education Resources on the Web www.eelink.net
 Energy Information Administration, U.S. Dept. of Energy www.eia.doe.gov
 Lawrence Berkeley National Laboratory 20% Solution To Saving Power
www.savepower.lbl.gov
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