California and Renewables: FAQs

FAQ on California Energy Situation for Reporters and Others

What is renewable energy?

Renewable energy can offer inexhaustible power generated by the natural processes of wind, sun, water, plant growth, and heat from the earth being converted into power, steam and heat. Collectively, the energy captured by these technologies is referred to as renewables. Renewables contributed reliable electric power to Californians since the late 1970âs.

Wind

Wind power captures the energy of air currents using turbine blades; as the blades rotate, electricity is generated. Constant innovations in wind technology have made this one of the most pervasive forms of renewable technology. Wind power ranges from large wind ãfarmsä consisting of multiple turbines that are several stories high, to ãsmall windä sytems that individuals can install in their backyards. The American Wind Energy Association provides more specific information about **small wind power** options in California. The California Energy Commission also makes **California specific wind information** available on-line.

Solar

Solar power offers multiple applications, from powering traffic lights to heating water. Solar technologies include: photovoltaic cells which covert sunlight directly into useable energy; solar concentrators which use mirrors to focus the sunâs light and generate intense heat--turning water to steam and generating electricity in the process; and solar thermal heating devices such as solar water heaters and even solar ovens. The **National Renewable Energy Laboratory** offers extensive information about general advances in solar technology. The California Energy Commissionâs **Emerging Renewables Buydown Program** and the **California Solar Industries Association** provides specific information about solar power in California.

Hydro

Hydro power captures the energy generated by waterâs movement and converts it into electricity. While hydro is the largest source of renewable energy in California and the U.S, it can be controversial. In the context of renewable energy, low impact, small hydro, and micro hydro (those installations producing less than 20 megawatts of electricity) projects are considered by some as more environmentally sensitive and appropriate than traditional large-scale projects. The **California Energy Commission** provides California specific information about hydro power.

Biopower
Biopower releases the energy trapped in organic material, or biomass. Biopower uses biomass energy to generate electricity. Biopower has diverse applications from diverse sources: from creating gas that is used to fire electric plants, to recycling cooking oil and using it to power buses and cars. Biopower applications include co-firing with coal, collecting methane and landfill gases and burning urban wood waste to generate electricity. To review the various applications of biopower, visit the **bioenergy discussion list archives**. The **California Biomass Energy Alliance** provides further information about biopower in California.

Geothermal
Geothermal power uses heat from below the earthâs surface to produce electricity or heat buildings and water systems. Geothermal power produces little to no air pollution and is extremely reliable during the lifetime of the power plant. Geothermal applications cover a range of use, from small-scale geothermal heat pumps used in homes, to large-scale power plants that provide electricity. The California Energy Commissionâs **geothermal page** provides specific information about geothermal power in California.

Key definitions
An extensive, easy-to-understand **glossary** of renewable energy and electricity terms is available on the REPP-CREST web site.

Whatâs the difference between renewable and clean or green energy?
Renewables are also sometimes called clean or green energy, though there is no universally recognized definition of these terms. The term ãclean energyä often refers to energy that comes from non-polluting (ãzero emissionsä) sources, though many believe that energy with ãlow emissionsä should also be called clean.

Green energy often refers to energy that is voluntarily purchased by consumers because it is produced in a manner that is less harmful to the environment. For more detailed information on green energy, please refer to the **Green Education** module on the REPP web site. The **Green-E** web site has in depth information about the specifics of the Green-E program, which works with environmentalists and interested parties to define and certify ãgreen energyä products nationwide. Additionally, a collaborative effort between environmentalists and the Pace Law School Energy Project yielded the **Power ScoreCardú** evaluation tool to provide standard measurement techniques to consumers who are purchasing green power. Lastly, in California, the California Energy Commission offers a FAQ sheet on the **Power Content Label**.

How much electricity does renewable energy provide to CA today?
Non-hydro renewable energy (geothermal, biomass, wind, and solar) provided an average of 11.4% of all electricity generated in California during the 15-year period from 1985 to 1999. The largest source was geothermal energy, averaging 7.3% over the 15-year period. Next was biomass at 2.6%, wind at 1.2%, and solar at 0.3%. In all, non-hydro renewables contributed over 23 billion kWh, or 10.4% of all in-state generation in 1999. This is enough electricity to power over three and one-half million California homes.

If we include hydropower, renewables contribution is even greater. While rainfall amounts and snow packs can vary greatly from year-to-year, hydropower provided an average of 20.4% of all electricity generated in California during the 15-year period from 1985 to 1999. This brings the total contribution of renewables to Californiaâs energy generation to 31.2% over that same 15-year period.

What are examples of renewable energy projects, in California and elsewhere?
Geothermal energy is currently Californiaâs largest source of non-hydro renewable electricity. There are 14 areas in California where geothermal energy is used to make electricity. The main areas are the Geysers area north of San Francisco, areas near Lassen Volcanic National Park, the Mammoth Lakes area, the Coso Hot Springs area in Inyo County, and the Imperial Valley in Southern California. The Geysers area near Santa Rosa is the largest geothermal development in the world, with a capacity of over 1,100 MW.

Biopower is currently Californiaâs second largest source of non-hydro renewable electricity. Biopower comes in many forms, including agricultural residues, landfill methane, urban wood waste, pulp and paper mill residues, and forest residues. The largest biopower plant utilizing both agricultural residues and urban wood waste in California is a 55 MW power plant in the desert community of Mecca, CA, which became operational in 1991. The largest landfill gas power plant in California is the Puente Hills Energy Recovery Facility in the Southern California Edison territory. It has been in operation since 1986, and generates 50 MW of electricity from recovered landfill methane. The largest forest residue facility is the 55 MW Cottonwood Wheelabrator facility in the PG&E territory, in operation since 1987.

Though Pacific Northwest Laboratory ranks California 17th in total wind resources, California currently has the most wind power up and running of any state in the U.S. The major developed wind energy areas in California are Altamont Pass (550 MW), Pacheco Pass (16 MW), San Gorgonio Pass (350 MW), Solano County (64 MW), and Tehachapi (620 MW). Regionally, wind power development has accelerated in the Western U.S. A new wind farm is currently being built on the Oregon/Washington border, and will consist of over 450 wind turbines with a total capacity of 300 MW when completed, or enough power to supply over 150,000 homes.

The largest single photovoltaic (PV) installation in California is the Sacramento Municipal Utility District's (SMUD) 2.3 MW facility at Rancho Seco, the former nuclear power plant. California also gets energy from solar thermal generating plants. The parabolic trough solar electric generating stations (SEGS) in California's Mojave Desert have a combined capacity of over 400 MW, and have been producing power and undergoing continuous research, testing and upgrades since 1984.

An unusual application of PV power is the **worldâs first solar-powered ferris wheel** located at the Pacific Park Amusement Park on the Santa Monica Pier. The ferris wheel is powered by PV cells which were mounted on rooftops in the park during April of 2001. The cells produce 71,000 kWh of electricity annually, reducing energy costs and saving Pacific Park an estimated $7,000 a year. The project is co-funded by the city of Santa Monica, Edison Technology Solutions, US DOE, California Energy Commission, and the Solar Electric Power Association.

Where would I find firms working in the areas of renewable energy?
There are thousands of companies working on all levels of renewable energy technology development, from third and fourth tier suppliers like silica manufacturers for the PV industry, to consulting firms that lend their expertise in evaluating and siting wind projects. There is no single depository for all of the related renewable energy companies; however, these directories serve as a good start:

Global Energy Marketplace GEM contains over 4,000 related links and documents, and is searchable by technology, locale and expertise.

Major Players in Sustainable Energy Cluster for Mesa del Sol. This paper highlights some of companies working in renewables.

The California Consumer Energy Center Specifically for consumers, this directory lists retailers selling photovoltaic systems, wind turbines and fuel cells. No retailers are endorsed or recommended by the CEC. The California Consumer Energy Center also has a list of organizations that **finance the purchase** of solar, wind, and other energy systems

James and James Science Publishers Renewable Energy World Covers the gamut of providers, from consultants to suppliers.

Energy Source Guides Click through this site to find international and local companies with interests in renewables.

California Energy Commissionâs **green power providers directory** provides a non-comprehensive look at whoâs operating in Californiaâs renewable energy market.

What are the environmental benefits of renewable energy?
According to REPPâs most recent analysis, non-hydro renewables have been meeting at least ten percent of Californiaâs energy needs without compromising the stateâs commitment to human health and environmental protection.

Both human and environmental health are affected by air quality and renewables provide clean reliable power while helping the state meet its Clean Air Act goals. Geothermal power alone saves California approximately 2.5 million tons of CO2 emissions annually÷the equivalent emissions from driving an average passenger car 6.3 billion miles a year. Biopower plants reduce the amount of emissions into the air from controlled agricultural burning÷converting agricultural residues, urban wood waste, and even landfill gas, into power. Wind and solar photovoltaics systems installed on homes and businesses reduce the need for power from polluting fuels, especially during peak hours of energy usage. Solar thermal and geothermal heating technologies reduce the amount of energy needed to heat water and drive industrial processes, again reducing the use of polluting fuels.

In addition to offsetting the emissions of polluting fuels, renewable technologies, particularly geothermal power, require less land than other forms of fuel that require, among other items, large mines. Wind farms can produce clean energy on

a large scale while ranching and farming continues around the turbines. Solar photovoltaics can often be applied to unused spaces such as roofs and the tops of parking structures.

Where renewables are used, they do not cause the degradation of watersheds associated with coal mining. They do not require the massive amounts of water associated nuclear power production, coal mining, and petroleum refining. Nor do renewables produce radioactive wastes or other poison by-products such as arsenic, lead, and mercury. Power generation from coal is the largest source of mercury in the U.S.

While renewables do not have the same negative impact on natural ecosystems that conventional power sources do there are environmental concerns associated with each renewable technology. The production of solar panels uses some of the same chemicals associated with the computer industry and solar energy is often stored by using lead acid batteries (this is not an issue for solar thermal technologies).

Some models of wind turbine can kill birds. However, at the Altamont Pass, site of 7,000 wind turbines, the number of confirmed raptor fatalities due to collisions with turbines was a low sixty in over 2 years, compared to 3,000 birds killed over two nights in collisions with four chimneys at Florida Power Corporationâs Crystal River Generating Facility in 1982[1]. Traditional large-scale hydro sources can damage rivers. Certain types of geothermal plants will eventually exhaust the heated water they tap for power.

Fortunately, each of these concerns is being addressed. Innovations in solar technology are increasing the effectiveness of the production process while reducing the amount of materials required. (Manufacturing of new ãthin-filmä photovoltaics requires less silicon that older designs.) Alternatives to lead-acid batteries are being developed and lead acid batteries are becoming more recyclable in the case of solar power storage. Wind turbine designs have been modified to address bird nesting and hunting behaviors. The siting process for wind plants now takes into consideration factors such as proximity to migration routes and the presence of birdsâ prey.

Small hydro power projects can be built using ecologically sensitive low-impact techniques that take the needs of marine life like salmon, into account.

Geothermal energy producers are experimenting with ways to re-inject the waters they have extracted in order to prolong the life span of the heated reservoirs they tap for power.

All energy use affects the environment yet not all energy technologies have the same impact on it. When compared to conventional energy technologies, renewables are a part of the long-term sustainable solution to increasing energy needs without degrading and depleting natural resources.

For more information about renewables and the impact of fossil fuels on human health and the environment, read REPPâs groundbreaking paper **The Environmental Imperative**.

What have been the barriers to expanded deployment of renewable energy?
While not an exhaustive list, some key barriers are listed below:

Disruptive technology
Most renewables require a new way of thinking about and managing power systems. Renewables involve concepts such as intermittency (for example, wind turbines run 3 minutes out of 10, rather than 8 minutes out of ten like coal plants), distributed generation (power located near the user, typically in small units compared to large, central-station power plants), and new fuel supply networks (in the case of biomass). These issues present a ãdisruptiveä managerial challenge requiring early adopters on both the supplier and consumer end. For a discussion of disruptive technologies and renewables, see REPPâs analysis of **PV markets**.

Cost concerns
Even though renewablesâ costs have been reduced by over 80% since 1980, renewables still cost more than other sources of power. Wind power costs half-a-cent per kilowatt-hour more than natural gas power plants, while geothermal, biomass, and PV in increasingly order of cost, also cost more. Fortunately, in many cases, government research and development, as well as corporate innovation, have lowered costs beyond the expectations of observers across the political spectrum. For further analysis of price performance and more background read **Winner, Loser or Innocent Victim: Has Renewable Energy Performed as Expected?**.

In the Northwest, utilities such as Bonneville Power Administration and PacifiCorp are developing wind power because it is

nearly competitive with natural gas, but with much lower risk of high power prices associated with fuel price escalations.

Regulatory barriers
Finally, there is a range of regulatory barriers to hooking up renewables to the electricity grid. Barriers include:

- Transmission concerns affect large renewables plants like wind, geothermal, and biomass. Issues include charging more for intermittent renewables like wind and charging more to new power plants hooking up to the grid.

- Distribution grid issues affect small-scale **micropower** such as PV and small wind. These issues include overly burdensome technical requirements to connect, charging unnecessary fees to connect, and even requiring excessive and needless equipment in spite of established, third-party standards for products such as PV. Distribution grid policies directly affect small customers trying to, for example, put a small wind turbine on their property. Fortunately, California is perhaps more advanced than any other state in easing installation of micropower (or distributed generation such as fuel cells, photovoltaics, or microturbines), yet challenges still persist, particularly from utilities not interested in having customers rely less on their services.

What California policies and incentives are currently in place to develop renewable energy?
The state of California has a number of aggressive programs for promoting both industrial and small-scale development of renewable energy. Created by the California State General Assembly in 1974, the **California Energy Commission** (CEC) is the primary organization charged with meeting the stateâs energy needs in a reliable and affordable fashion. The development and support of renewable energy sources is one of the five major responsibilities of the CEC.

An important tool for encouraging the use of renewables is net metering. **Californiaâs net metering rules** require that both regulated and unregulated electric utilities allow all customers to produce their own electricity, send extra energy back into the electricity grid, and receive monetary compensation for the excess energy. For participants in the net metering program, this effectively reduces their energy costs by the amount of excess power produced. While size is limited to systems that produce no more than 1,000 kW (1 MW) of peak generating capacity, the overall rules provide an economic incentive for businesses and homeowners to invest in renewable energy systems.

In addition to net metering, California has a number of other state, city, and utility supported programs designed to foster the development, purchase and use of renewables. While many of the general state programs currently in place may appear to favor the small-scale purchase of wind and solar systems by consumers, other renewable technologies are also supported. These programs apply to more than one renewable technology and they provide incentives for industrial scale developers of geothermal and biomass power that are less visible to the public.

One aspect of the **California Energy Export Program** is to encourage the development and exportation of renewables and efficiency technology to international markets.

California's Renewable Energy Buydown Program increases the rebates available to purchasers of renewable energy systems from $3,000 per kilowatt to $4,500 per kilowatt, or 50 percent off the system purchase price (whichever is less).

For research and development of renewables, the **Public Interest Energy Research Grants** (PIER) program provides incentives for the further development and innovation of renewable technologies by a range of actors including academic institutions, small businesses, and industrial developers. PIER grant recipients must address one or all of six goals. The goals are: to reduce the cost of electricity and increase the value; to increase the reliability of the electric system; to reduce the environmental impacts of electricity generation, distribution and

use; to enhance California's economy; to demonstrate a connection to the market; and to advance science and technology not provided by competitive and regulated markets.

The Renewable Energy Trust Fund, enacted in 1996 and expiring in January 2002, is a state fund that provides overall funding for the development of solar thermal electricity, photovoltaics, wind, hydro, renewable transportation fuels, geothermal electric and waste energy programs.

The California Energy Commissionâs **Self Generation Program**, was enacted in March 2001 and expires in December 2004. It is intended to encourage the development and purchase of photovoltaics, wind, and fuel cells. Implementation will begin when the guidelines are completed.

The California Public Utilities Commission (CPUC) officially launched its new "self-generation" incentives for customers of the state's investor-owned utilities[2]. The $125 million per year program provides incentives for customers to install generating facilities to supply part or all of their on-site energy needs. Incentive funding will flow through 2004 to utility customers who purchase and install eligible facilities, including photovoltaics, wind turbines, fuel cells, microturbines, small gas turbines and, internal combustion engines. The facilities must be interconnected for parallel operation with the utility grid in order to qualify for the program.

The Solar Energy and Distributed Generation Grant Program provides rebates of between $750 and $2000 for solar or distributed generation systems.

A substantial number of Californiaâs incentive programs are aimed at developing solar power.

For example, a state **property tax exemption**, valid from Jan. 1999 to Jan 1, 2006, for active solar energy systems, not including swimming pool heaters or hot tub heaters.

Utility rebates are offered in the following cities and regions:

- Los Angeles: **The Residential and Commercial PV Buydown Program**.
- Palo Alto: **PV Partners**.
- Pasadena: **Solar Power Installation Rebate, Pasadena Water and Power, Solar Power Installation Rebate**.
- Plumas-Sierra: **Rural Electric Cooperative leasing and rebate program** for solar and geothermal renewable energy systems as well as advice for home building and re-modeling to make buildings more energy efficient.
- Sacramento: **Solar Water Heater program** and the **PV Pioneer II program**.
- Santa Clara: **Solar Electric Buy Down Program**.

Can renewables help solve the California electricity woes?
Many critics claim that it is too late for renewables to contribute significantly to the solutions of Californiaâs energy woes. However, three immediate contributions renewables can make are: added wind capacity to existing wind farms; lowering regulatory barriers to promotion of solar resources; and re-activating dormant bioenergy plants. Also, it is still possible for individual customers to buy renewables such as solar photovoltaics (PV) and small wind turbines. These systems, particularly PV, usually run when blackouts are most likely÷during a summertime day. And since Californians face sharp price increases in their bills, running on-site power can avoid electricity consumption from the grid, especially when it is most expensive during summertime

days. To learn more about how individual Californians can help abate the problems, read more about incentives.

Non-hydro renewables (geothermal, biomass, wind, and solar) already provide over 10% of Californiaâs electricity. Additional power can be made from existing renewable energy power plants (qualifying facilities) fairly quickly, given the right economic and regulatory incentives. New renewable power, such as wind, can be brought on line fairly quickly when compared to fossil fuel power technologies, but getting new renewables to generate additional power in California this summer will be difficult unless siting and permitting is already under way.

In the medium- to long-run, renewables offer many values that will go far to helping Californians benefit from a stable electricity system:

- First, fuel-free renewables reduce financial risk to consumers. Wind, geothermal and solar have predictable cost-streams through their operating lives, and do not suffer from seasonal changes in natural gas prices or hydroelectric power availability. All renewables contribute to a diversified energy portfolio, which is as wise as developing a diverse personal investment portfolio, particularly since the risks of renewables are not related to those of fossil fuels and nuclear power.

- Second, renewables can offer power during peak demand periods. Both biomass and geothermal provide power year-round, and as often as fossil fuel power plants. And wind and solar patterns in California happen to coincide well with power demand patterns, both on a seasonal and daily basis. This means that all renewables are available when Californians need them the most, and when power is most valuable.

- Third, renewables can respond rapidly to demand growth. Wind and solar are ãmodularä÷they can be manufactured in small increments and deployed either a few at a time or many at a time. Thus, they are flexible in responding to changes in power demand, particularly if, in the case of wind power, there are already wind farms to which more turbines can be added.

- Fourth, renewables reduce the risk of higher costs fueled by environmental regulations. Fossil fuel and nuclear industry advocates frequently complain about the high cost of environmental regulations. Since renewables tend to have zero emissions or low emissions, and since they do not generate toxic and radioactive wastes, their operators usually need not fear of new regulations that will add to their operating costs. This is very important for consumers, since the cost of environmental controls are usually passed on to electricity bills.

Finally, it is important to note that energy efficient technology (such as lighting and appliances) and energy demand reduction through consumer energy conservation (such as turning off the air conditioner when one is out of the house) can go a long way toward ameliorating Californiaâs electricity crisis.

How much would it cost a household to do renewable energy?
There are several ways to consider the cost of renewables for California consumers.

First, if a fleet of renewables entered the state and were funded by an across-the-board fee, then the impact per household will be very small. For example, one study by REPP
(**Expanding Wind Power: Can Americans Afford It?**) found that adding over 3,000 MW of wind to Texas would cost each Texan household just 75 cents a month.

Second, if renewables were funded by voluntary payments from Californians responding to ãgreen powerä offerings, and only a small portion of Californians paid, then costs would vary. One estimate finds that nationwide, households pay between $1 and $10 a month to buy green power voluntarily[2]. Note, however,

that green power marketing has limited impact in adding renewables to the electricity mix, contributing 450 MW in existing and planned renewables nationwide over approximately 4 years of activity [3]. Green marketingâs future in California is uncertain given overall uncertainty about what the stateâs rules will be in the near future.

Third, if a consumer were to purchase micropower such as PV or small wind, another cost estimate is required. PV costs between $4,500 and $10,000 for a 1-kilowatt system, while small wind systems cost between $6,000 to $22,000 depending upon size, application and service agreements with the manufacturer[4]. Fortunately, the state of California, as well as certain municipal utilities, offer excellent incentives to purchase PV and small wind systems.

Again, by focusing on costs, we are not looking at the other benefits to the pocketbook, such as reduced grid power purchases and more reliable electricity. Furthermore, it is important for consumers of small renewable energy systems to install energy efficient appliances and lighting, thereby reducing energy use, saving money, and reducing the overall cost of a combined renewable and energy efficient power system.

Where can I get more information about what's happening in California?
More information about renewables in California can be found using the resources described below:

Join REPP and the Renewable and and Appropriate Energy Lab (RAEL) in California at a forum **"California's Renewable Energy Future: What's Next?"**.

For a quick look at what renewables have to offer California, read the brochure **The Renewable Energy Solution**. You'll need to download **Adobe Acrobat** (it's free) to read it.

To find renewable energy firms, manufacturers, providers, and installers, try a search in the **Global Energy Marketplace**.

The California Energy Commission (CEC) is an excellent general resource on electricity and renewables. The CEC also hosts an interactive database where users can look for specific **economic information** about tax credits and other financial incentives related to installing renewable power.

The **National Database of State Incentives for Renewable Energy** provides a comprehensive listing of regulations and grant programs in California, other states in the region and nationwide.

In northern California, the Sacramento Municipal Utility District has a number of renewable energy options including **solar** and **efficiency** programs.

In southern California **Green LA** , a project of the Los Angeles Department of Water and Power, encourages customers to use renewables and efficiency to meet the cityâs energy needs in a sustainable manner.

The **California Solar Energy Industries Association** provides legal information and suggestions about how to select solar energy systems.

California has a number of **small, independent power producers**. Additional links concerning renewables are available on-line from **Home Power Magazine**.

More information about green energy and green energy markets can be found in the **Green Education** module and the **Green-E** web sites.

For general information about renewables visit the **REPP-CREST** and the **National Renewable Energy Laboratory** web sites.

More information about renewables in California will be posted to this web site periodically.

REPP-CREST is publishing a paper in Fall 2001 examining the role of renewables in Californiaâs energy future. The paper and its findings will be posted on this web site upon completion. Check back the home page for announcements or write to **REPP** to join the press release list. In addition, REPP-CREST has published over 30 **papers** on renewable energy, most of which are available online.

Bibliography:

1. David Maehr et al., ãBird Casualties at a Central Florida Power Plant,ä Florida Field Naturalist, August 1983, pp 45-68.

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3. Lori Bird and Blair Swezey. Estimates of Renewable Energy Developed to Serve Green Power Markets. December 2000. Available at http://www.eren.doe.gov/greenpower/new_gp_cap.shtml. Viewed July 13, 2001.

4. American Wind Energy Association website. http://www.awea.org/faq/rsdntqa.html. Viewed July 13, 2001.

Attachments: