

Steam

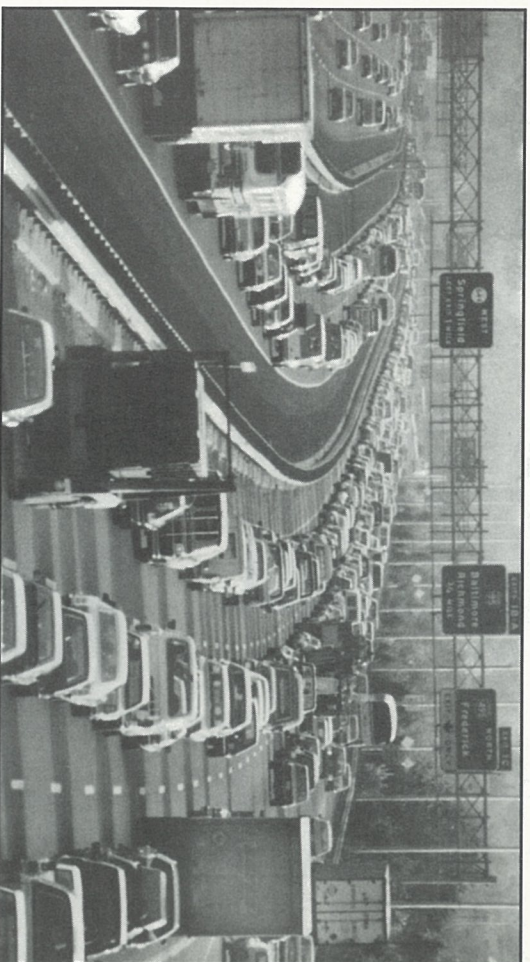


Press

THE JOURNAL OF GEOTHERMAL EDUCATION

FALL 1990

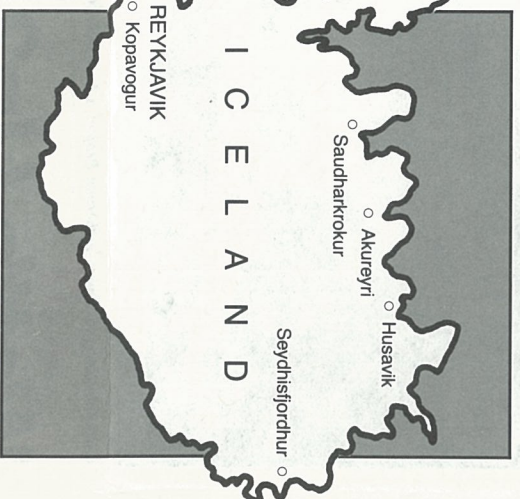
VOL. 1 NUMBER 1



Iceland's Home Heating Comes Naturally

It's provided courtesy of Mother Nature

Perhaps no country has maximized its geothermal resource more than Iceland. When you switch on a light in Akureyri or Kopavogur, chances are that the energy being used to light the bulb came from a geothermal power plant. When you enter a cozy, warm Icelandic's home in the middle of an Arctic winter, it's almost certain that the heating was provided by 'hitaveita', Iceland's geothermal district heating system. In most cases the abundant supply of hot, geothermal water allows for direct use on or very close to the site, but frequently the geothermal energy is transported, where none is available. While electrical power and heating are the two principal users of geo-



thermal in Iceland, there are other applications, some of which are quite unique. One example is to be found at Fludir, an area of many hot springs. In Iceland, where soil temperatures seldom reach 50°F, and top soils are often frozen solid, it is understandable that vegetable-growing would be out of the question. In Fludir, however, geothermal subsurface soil heating has created totally new agricultural yields and has significantly extended growing seasons. Greenhouse heating by geothermal is also widespread on the island. A lumber factory in Fludir puts geothermal to work for space heating, to dry timbers and for curing glue-laminated beams. Fish farms are using geothermal, mushroom farms and even earthworm farms are using hot-springs to improve growing conditions. And — wouldn't you know it — when you dive into a swimming pool in Iceland, it's geothermal that heats the water.

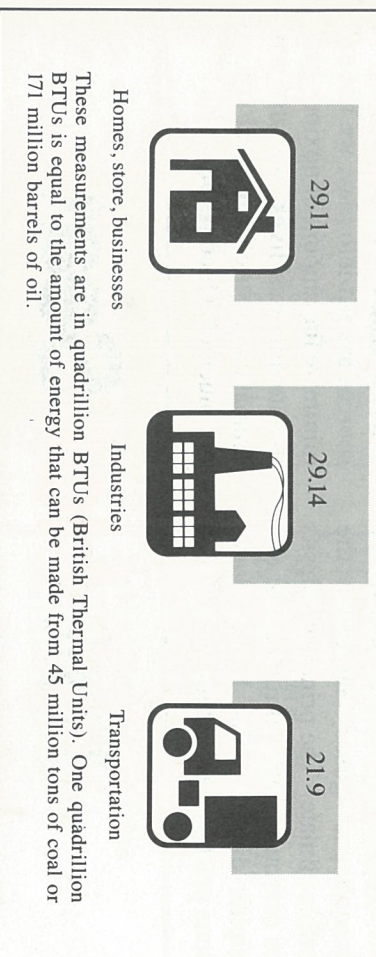
It's Time For An Oil Change!

Renewable energy resources can play a major role in our quest for independence from foreign oil.

Recent events underscore, once again, the fact that we can no longer rely on imported oil. Some ten years ago, when oil prices skyrocketed, service stations across America were besieged by gas lines, the sale of gas caps soared and gas rationing loomed as a real possibility. It seems that we did not learn our lesson from that experience. As that crisis eased, we went right back to the old ways, with no plans or energy programs for future such catastrophes. And, as a result, we became even more dependent. Imported oil now accounts for approximately 50% of our current fuel needs, compared with less than 30% in 1985. But now we have another problem and an added financial burden — the astronomical costs of protecting these foreign oil resources. We know too that, compounding the problem, the burning of oil and other fossil fuels

is doing irreparable damage to our environment. Carbon dioxide emissions, the "greenhouse" effect and global warming are now household words. How can we start to stop all of this and put the U.S back on the road to energy independence? We must begin immediately on an aggressive program to include: increasing exploration and development, initiating energy conservation programs and, perhaps most important of all, developing our renewable energy sources. The true potential of geothermal, solar, wind and other alternative energy reserves within the U.S. is enormous. They are proven resources that, in many cases, cost substantially less than oil, coal and natural gas. But perhaps the biggest incentive for us to focus our energy on these renewable energy sources is the very future of our planet itself.

Energy: Who uses it — and how much?



Geothermal Wins Prestigious Award At White House Ceremony

At a White House ceremony in April 1990, hosted by President Bush, California Energy Company's Coso Geothermal Project was named winner of the prestigious National Environmental Achievement Award for its contribution in reducing greenhouse gases and ozone-depleting chemicals. The Coso project, which is located in California's Mohave Desert, was selected from more than 1,000 nominees submitted to the Searching For Success awards program, sponsored by 23 of America's pre-eminent environmental advocacy organizations. The program's purpose is

to identify projects that successfully counter environmental threats. International acclaim for the Coso Project's environmental attributes came in ceremonies marking the twentieth anniversary of Earth Day by the United Nations' Environmental Program. Considered one of the most clean and sophisticated geothermal power plants in the world, California Energy Company's Coso installation comprises nine geothermally-powered turbine generator units providing the people and industries of Southern California with 240 megawatts of electrical power.

A few words about our new publication.

Steam Press is published annually by the Geothermal Education Office to further educate youth and other interested readers about geothermal energy and its vital role in helping to sustain a healthy and clean world. The staff of Steam Press would be

happy to hear from you. Maybe you have suggestions for our next issue, or an article — or even a drawing — you would like to submit. Class sets of Steam Press are available for a nominal charge. 1-800-866-4GEO

Geothermal Is Matchless

No burning issues with this clean, safe, and renewable energy source

Geothermal resources are an important source of energy for both the United States and the world. Right now in the United States there is enough electricity generated from geothermal to supply over 3 million households with electricity; that's enough electricity for the states of Oregon and Washington combined! Natural steam energy comes from heat trapped in rocks and fluids beneath the earth's



crust. Geothermal is "matchless" because it is a *clean, renewable, reliable, and economical* energy source that produces electricity without burning. At high temperatures, geothermal energy can be used to power turbines for electricity generation. Old fashioned power plants burn fossil fuels to make steam that turns the turbines to make electricity. On the other hand, a geothermal power plant doesn't

burn anything because the steam is produced courtesy of mother nature. Like solar and wind, geothermal is a *renewable* energy source, which means that we won't run out of it. Also, geothermal and other renewables have no fuels that must be transported, so there are no chances of accidents like oil spills. Unlike some renewables, geothermal is a very reliable source of electricity. It is available 95% of the time, day and night. Solarthermal is only available when



the sun is shining and wind energy, of course, only when there is a wind blowing. When it comes to providing baseload electricity — geothermal is matchless. There are few fuels that can match geothermal's cost to produce. Natural steam is one of the least expensive ways of generating electricity of all the fuels. In fact, the cost of drilling a natural steam well pays for itself in a few years, which makes the fuel free after that. You can see why geothermal's natural steam energy is matchless!

Look what happens when fossil fuels are burned — and what we can save with renewable energy resources

POUNDS OF POLLUTANTS EMITTED OVER A ONE YEAR PERIOD PER MEGAWATT					
CO ₂	17,000,000	13,400,000	9,060,000	10,500	
NO _x	2,980	2,980	876	0	
SO _x	105,000	92,900	73	1,090	

AMOUNT OF FOSSIL FUEL CONSERVED OVER A ONE YEAR PERIOD PER MEGAWATT			
COAL	3,910 Tons		
OIL	14,600 Barrels		
NATURAL GAS		87,600 MCF	

SOURCE: Gaidard & Gaidard Engineering, 1989. "Using Air Quality Measurements and Improvements Through the Expanded Use of Geothermal Energy." Gaidard & Gaidard, 1989. "Greenhouse Gas Emissions from the Operation of Energy Facilities."

SOURCE: Gaidard & Gaidard Engineering, 1989. "Using Air Quality Measurements and Improvements Through the Expanded Use of Geothermal Energy."

The manner in which America produces most of its electrical energy is deeply affecting the quality of our air, our environment and our very lives. Our energy supply relies principally on the use of fossil fuels, such as coal, oil and natural gas. To generate electricity it is necessary to burn these fuels and the results can be devastating. Fossil fuel combustion releases half of the 'greenhouse' gases that affect the earth's climate. The principal culprits are carbon dioxide, nitrous oxide and sulphur dioxide. The United States alone produces 1.4 billion metric tons

of carbon dioxide every year. That's one fifth of the world's total or five tons for each citizen in our country. And it's increasing each year. The chart above shows the pollutants emitted when we burn these fossil fuels. It also shows how these pollutants virtually disappear when electricity is produced through the use of geothermal energy. When alternate, renewable energy resources are put into play, we not only minimize the amount of noxious gases threatening our lives, we also save dramatically on coal, natural gas and oil, much of which is imported.

The Hot Seat Geothermal Energy Questions & Answers

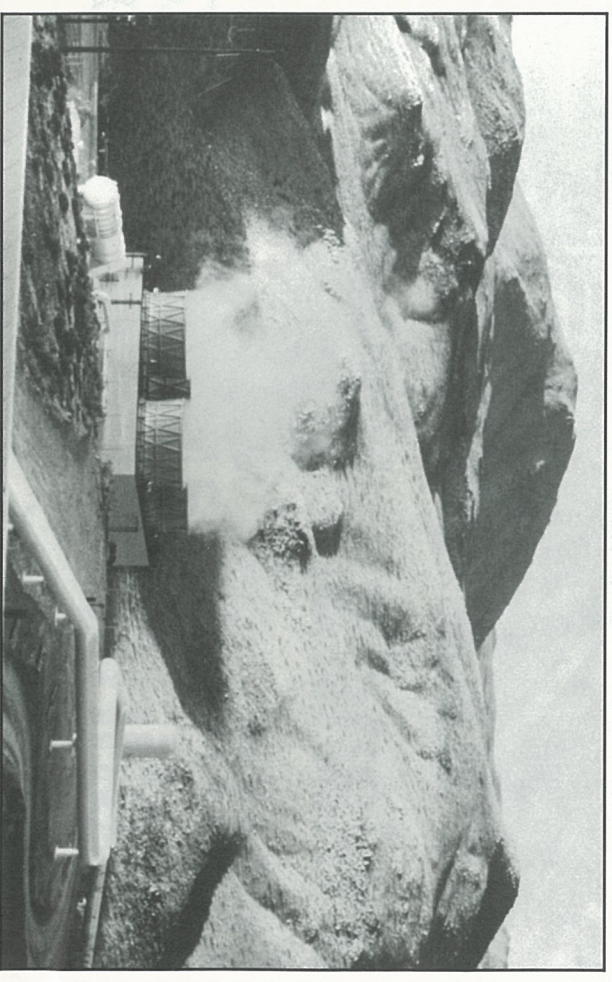
Q. Will development of Geothermal Energy in Hawaii ruin the Rainforest?

A. No. The development of natural steam in the Puna Rainforest (one of the six lowland rainforests in Hawaii) will not destroy it like the rainforests in Brazil. In Brazil, the rainforests are burned to the ground killing all the plants and animals. In Hawaii, there will be minimum impact on the rainforest. Power plant sites, drilling sites, transmission lines and service roads will impact the rainforest less than 1%—and even these impacts will be minimized by

scientists and developers working together to develop a forest management plan. Soon natural steam energy will provide Hawaiians with a safe, clean, renewable energy source.

Q. Will we ever run out of geothermal energy?

A. No. Future generations will always have geothermal energy. Hydrothermal reservoirs contain both water (hydro) and heat (thermal.) The heat is always being generated deep in the earth. The water is replenished by rainfall and by returning the used water back into the reservoir.



California Energy's Coso Geothermal Project, China Lake, California

Watt's Up?

News about our friends in the industry...

California Energy Company, current producer of 230 megawatts of electricity, is especially proud of its Coso power plant, which uses the cleanest possible technology for producing electricity from hydrothermal wells. They have just announced an agreement to purchase the Nevada and Utah based geothermal operations from Chevron Resources Co. **Calpine Corporation** has just completed the purchase of both existing and potential geothermal operations from Freeport McMoran, bringing its current production up to 320 megawatts.* **Calpine** is a developer, owner and operator of geothermal, cogeneration and hydroelectric projects and is committed to using environmentally appropriate resources to supply both steam and electricity. **Magma Power Company** operates four plants in California's Imperial Valley. These plants have been re-engineered so they have no visible emissions. **Magma**, which now produces 148 megawatts of electricity, hopes someday soon to be able to use its excess heat for drying agricultural products. **Ormat Energy Systems**, which develops geothermal energy plants in California, Nevada and Ha-

wai, is the proud recipient of the 1989 Energy Resources Technology Industry Award of the American Society of Mechanical Engineers for generating electrical power using low temperature

Cont'd. on Page 3, Col. 3

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Geothermal Education Office
664 Hilary Drive
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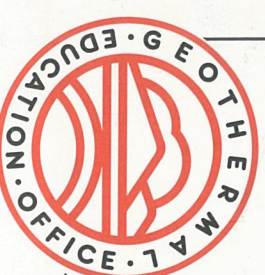
The Geothermal Education Office is a non-profit organization working to ascertain that today's youth understand

- 1) the urgency of protecting our environment while providing needed energy;
- 2) the resultant need for the world to look to renewable energy sources as an important way to sustain our planet;
- 3) what geothermal energy is, what it does, and it's growing place in providing necessary clean energy.

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Reno Hotel Has Its Own Geothermal System For Heat



The Peppermill Hotel and Casino has had its very own low temperature-geothermal well right in its backyard for over thirty years. The geothermal resource is used to directly heat water for bathing, laundry and heating. The hotel has over 600 rooms, so that is a lot of hot water. Because the hotel has free geothermal heat, they don't have to pay to heat their water, thereby saving the costly burning of fossil fuel. In fact, they plan to sell their extra hot water to the car wash across the road and to other nearby businesses. The Peppermill Hotel's well is a "double jackpot winner" — free hot water and good for the environment too!

Geothermal Is 'Old News' In Italy

People have been using the geothermal resources in the Tuscany region of Italy for thousands of years and they're still going strong. There is evidence that the Etruscans bathed in the geothermal hot springs 3,500 years ago. During the Roman Empire the use of these waters to treat eye and skin diseases became known throughout the Mediterranean. Even 1000 years ago products being produced from the white crusts that formed at the edges of the surface fumaroles and geysers were very sophisti-

cated. Products included yellow sulphur used in salves and gunpowder, and bleaching and drying agents for wool and disinfectants. In these times, the geothermal resources were so important that there were wars over their ownership. As long as 100 years ago, buildings at the chemical plants were heated with geothermal steam piped through copper and lead tubes. Production of boric acid, an antiseptic still used today, and borax, a cleansing and water softening agent, began at the end

of the 1800s. The first time electricity was ever made from geothermal steam was from these geothermal resources in Lardarello, Italy, in 1904. By 1913 electricity was being sold to the nearby community, and by 1943 there were 132 megawatts being produced from geothermal energy (1 megawatt=1000 kilowatts). Tragically, all the power plants and chemical plants were completely destroyed in World War II. But the geothermal reservoir could not be destroyed, even by a war, and today this same geothermal area produces 545 megawatts of electricity. Power plants capable of producing 340 more megawatts are planned to be constructed within five years. Some historians think that even Stone Age people must have used geothermal.

Current Topic: Mighty Magma

The United States Department of Energy has some exciting things happening at Mammoth Lakes, California, where research is underway to see if we can use magma to produce electricity. Magma's heat might be able to be conveyed through fluid in pipes to make steam to power turbine-generators. Magma is a huge potential resource. Would you believe that the amount of energy that

may be available from magma is greater than all oil, coal and gas resources put together? The big question is, "Is it available at shallow enough depths to make it useful to mankind?" Researchers and scientists from the Department of Energy think the answer is "yes." That would be a lot of electricity! The site where they are doing the most experimental drilling — already

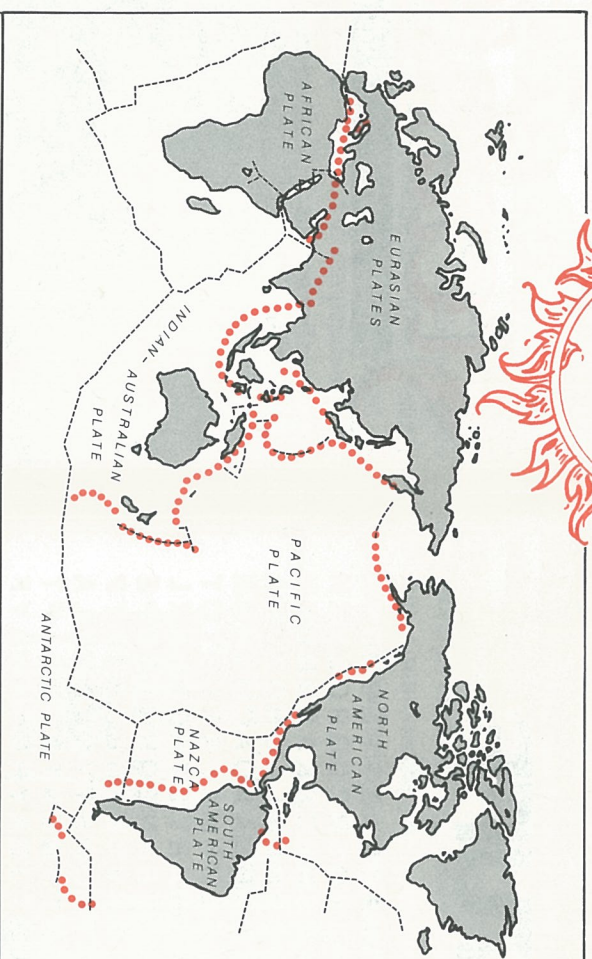
four miles deep! — is the Long Valley Caldera, which was formed over 700,000 years ago from a volcanic eruption over 1,000 times more powerful than the recent Mt. St. Helens eruption! It is a good place for magma research because it is still very geologically active. Maybe someday electricity will be produced from mighty magma! How clean our air would be!

The Ring of Fire



And the 'hot spots' of the Western United States

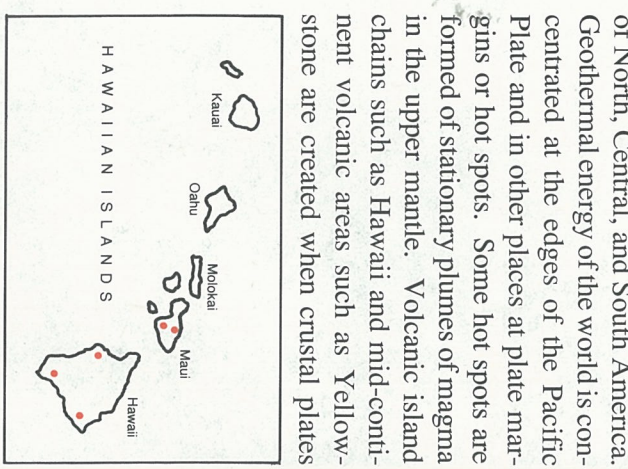
Surrounding the Pacific Ocean is a belt of intense volcanic and geothermal activity called the Ring of Fire. Also called the Circum-pacific Ring of Fire, this semi-circle, and other hot lines and hot spots in the world, are evidence of mighty forces within the earth. The crust of the world is broken into plates or slabs of ocean floor and continent that pull apart and push against one another. The movement of these plates occurs at the average rate of about one inch (2.54 centimeters) per year. Where this pushing and pulling has fractured or thinned the crust, magma can rise—forming volcanoes, geysers and hot



springs on the surface, and hidden geothermal reservoirs underground. The Ring of Fire generally follows the boundary of the Pacific Plate. It is bordered by the Philippines, Japan, the Aleutian islands, and the western edges of North, Central, and South America. Geothermal energy of the world is concentrated at the edges of the Pacific Plate and in other places at plate margins or hot spots. Some hot spots are formed of stationary plumes of magma in the upper mantle. Volcanic island chains such as Hawaii and mid-continent volcanic areas such as Yellowstone are created when crustal plates

slide slowly over the plumes. If you plot on a map all earthquakes in the news for one year, most of them will be on the Ring of Fire. Try it.

Wart's Up, Cont'd. from Page 2



heat sources. **Oxbow**, the biggest geothermal developer in Nevada, holds the record for transporting electricity from a geothermal plant: it built a transmission line more than 200 miles long into California, where Southern California Edison Company takes it another couple of hundred miles to Los Angeles! **Unocal** is recognized for its worldwide geothermal development, producing an average of 1835 megawatts of electricity a day! In addition to projects at both The Geysers and the Imperial Valley, Unocal taps geothermal resources in the Philippines, Indonesia and Japan and is establishing ties in other Asian, African and Latin American countries.

For More Info On...

GEOTHERMAL ENERGY
Geothermal Education Office
664 Hilary Drive
Tiburon, CA 94920
1-800-866-4GEO

OTHER ENERGY RESOURCES
Center for Renewable Energy Education
777 North Capitol St. N.E., Suite 805
Washington, D.C. 20002
(202) 408-0309

National Energy Education Development Project (NEED)
P.O. Box 2518
Reston, VA 22090
(703)860-5029

National Energy Foundation
5160 Wiley Post Way
Salt Lake City, UT 84116
(801)539-1406

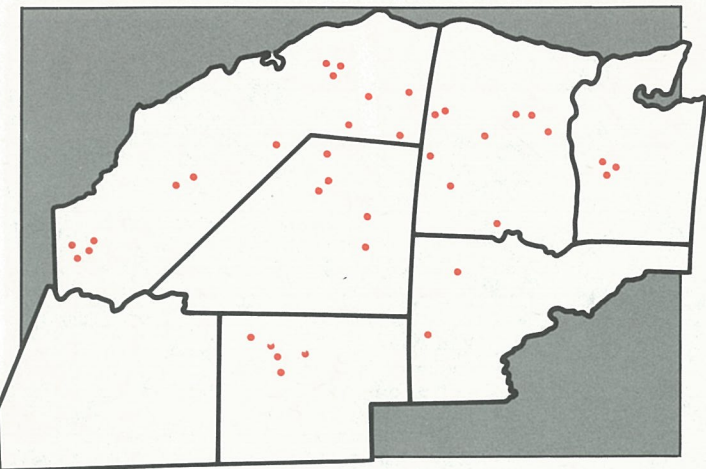
ENERGY EFFICIENCY
Energy Extension Service
each state has a separate listing
(Governor's office)

Pacific Gas & Electric Company (ask for booklet, "30 Simple Energy Things You Can Do To Save The Earth")
77 Beale St., Rm. 1768
San Francisco, CA 94106
(415)973-2757

GLOBAL WARMING
National Wildlife Federation
(ask for slides, "Let's Clear the Air")
1412 Sixteenth St., NW
Washington, DC 20036

Renew America
(ask for "Sustainable Energy")
1400 Sixteenth St., NW
Washington, DC 20036

Worldwatch Institute
1776 Massachusetts Ave., NW
Washington, D.C. 20036



Sustainable Energy. The Bright Lights of Our Future.

Clean, safe energy solutions that will reduce greenhouse gases by 50%.

If America continues to burn fossil fuels and to waste energy, the level of carbon emissions will increase. These emissions can result in environmentally destructive climate change (global warming). It is possible to reduce the amounts of these emissions if we use sustainable energy – energy that does not become depleted (it's "renewable") and will not harm our environment. In 20 years, our country can reduce its emissions by 50% if we use renewable energy and increase energy efficiency. There are many things America and other countries can do to develop sustainable energy for a bright energy future. First, we can stop wasting gasoline by improving fuel economy, reducing the miles we drive, improving mass transit systems, and using renewable transportation fuels. Next, we need to design and build energy-wise buildings. Over 1/3 of the energy demand is to heat and cool offices and homes. We also need to use more efficient lighting systems and appliances. There are new light bulbs that use 90% less energy than old fashioned light bulbs. Additionally, factories need to

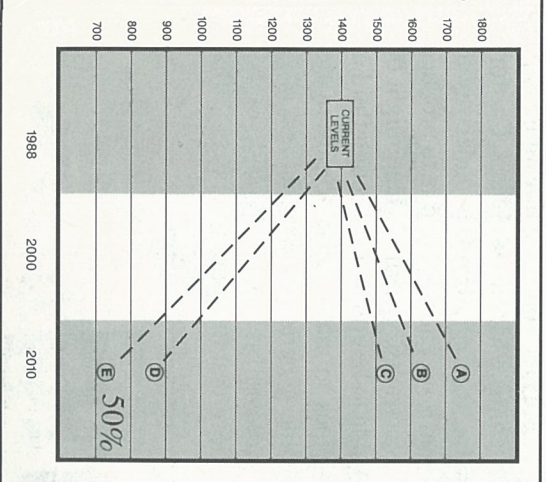
be designed to use less electricity. Electric motors should be designed to be more efficient. Lastly, recycling can save lots of energy. It requires much less energy to remake a product than it does to make it from raw materials, sometimes as much as 95% less! In addition to energy efficiency the development and use of renewable energy sources for electrical generation are necessary to reduce greenhouse gases and to promote a sustainable energy future. Geothermal, solarther-

mal, wind, biomass and hydro power are ready for us to use today. How America continues to produce and use energy is going to become of critical importance to the quality of our environment. Oil spills, air pollution, acid rain, and global warming are all by-products of the present need to burn fossil fuels in our electrical power plants, factories and automobiles. We must change our attitude toward energy and encourage other countries to do the same.

How Renewable Energy and Energy Efficiency Can Reduce Carbon Emissions By 50%

The graph on the right shows how we can achieve dramatic reductions in carbon emissions. Follow the letters to see the trend:

- A. Low efficiency with Renewable Energy growth frozen at 1988 level.
- B. Low efficiency with low growth Renewable Energy
- C. Low efficiency with medium growth Renewable Energy
- D. High efficiency with medium growth Renewable Energy
- E. High efficiency with high growth (sustainable energy)



Would You Believe...?

The junk mail alone that Americans receive in one day could produce enough energy to heat 250,000 homes.

If all automobiles in the U.S. were fitted with steel-belted radial tires, 400,000 barrels of oil *per day* would be saved.

If each household in this country lowered its average heating temperature by only 6°F we could save the energy equivalent of 500,000 barrels of oil per day.

An average 60 watt incandescent bulb lasts about 750 hours. A fluorescent bulb that gives off the same amount of light uses only 1/4 of the wattage and lasts about 10,000 hours.

Stands of urban trees can cool average air temperature by up to 10° F, thus reducing local energy demand for air conditioning by 10% to 50%.

If each commuting car carried one more person, who otherwise would be driving alone, 600,000 gallons of gasoline *per day* would be saved.

Throwing away one aluminum can wastes as much energy as if that same can had been half filled with gasoline and it had been poured on the ground.

The above information is courtesy of: The Earthworks Group. (1989) *50 Simple Things You Can Do To Save The Earth.*

HOT STUFF

WORDSEARCH

The following terms relating to the Ring of Fire can be found in the word search. The words are spelled horizontally, vertically and diagonally.

- Core
 - Mantle
 - Tectonics
 - Continental Drift
 - Volcano
 - Magma
 - Crust
 - Geothermal
 - Plates
 - Geyser
- S Q L M A G M A C B I Z T Y E G M O F R
D G C B A H J K O S R C D G R C E Y Z H
P A J M L I C S N K C P K A S B R U K M
V O L C A N O P M E Y L L Q N O Z U E A
U F X M L Y R X B C A A Q A C D G H S N
F A N I E L E O H R M A F B T L C T O T
G X L M O A C R X R Y L T F G E H N X L
E K H I E N O I E A N E Q R W A S O P E
Y I O S W J R H V X M F G E D B J R Y P
S S L T R O T R Q W S T Y N V A R E L A
E A S H C O N T I N E N T A L D R I F T
R W R C E L B T J B A Y R N I A W A Y F
M N Y G H Y W S K C X Z M J D I L R E M
E I F U N I L H U S X Y F T U W M B R B
F C N T A B P A U T E C T O N I C S V P

Electricity

CROSSWORD

ACROSS

- Power that turns on a lightbulb
- Energy that is good for our environment
- A practical waterfall
- The amount of electricity needed to power 1,000 households
- Not wasting energy
- Converts mechanical energy into electrical energy
- Energy that we won't run out of
- An energy source that uses a propeller to produce electricity
- Earth's own natural heat

DOWN

- How electricity gets into our homes
- A natural spring that produces hot water (Old Faithful)
- Energy from the sun
- Substances used to produce electricity that can

cause air pollution, acid rain and global warming

- Steam turns this to help produce electricity
- A place where electricity is generated
- Molten rock within the earth
- Makes things go
- This turns turbines to help produce electricity

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- Oil: The Beginning Of The End
- Turning Up The Heat In Iceland

