

# mind•full: a brainsnack for future leaders with ethical appetites

Volume I • Number Eight • April 1997 • Student Pugwash USA

## renewable energy

Energy is a requirement for modern society. It is needed to heat our homes and food, transport us to work, and light up our evenings. Energy may be obtained from several sources, some of which are naturally replenished and others which are becoming depleted due to overuse. Renewable energy technologies have been promoted, researched, and publicly demanded for many years. Yet, according to the Department of Energy, wind, solar, biomass, hydroelectric, and geothermal power accounted for only 7.2% of total US energy production in 1994. In the same year, nuclear energy and fossil fuels provided 7.7% and 85.2% of energy produced, respectively. Because renewable energy is currently more expensive than other technologies, power providers generally opt for cheaper alternatives like natural gas, coal, or nuclear power.

Some say this lack of reliance on renewable energy is shortsighted, especially given the heavy environmental toll we pay for our dependence on fossil fuels. These side effects include air pollution particles that cause tens of thousands of premature deaths (according to The Energy Foundation), carbon dioxide emissions that may lead to global climate changes, and other toxic wastes that can affect our health and environment in a variety of ways. In addition, nuclear power creates serious environmental challenges.

Since the 1970s, the US government and some state governments have evaluated energy policies. They have taken steps to decrease dependence on foreign fuel and to promote the research, development, and use of renewable energy. Some say the impact of these efforts have been limited. Recent moves toward deregulation of the US energy industry may provide increased opportunities for the use of renewable energy or create further difficulties. Energy demands are likely to increase in the future. Some experts warn we must include energy efficiency measures in any future policies.

The mission of Student Pugwash USA is to promote the socially responsible application of science and technology in the 21st century. As a student organization, Student Pugwash USA encourages young people to examine the ethical, social, and global implications of science and technology, and to make these concerns a guiding focus of their academic and professional endeavors.

The **mind•full** series encourages readers to explore crucial ethical dilemmas associated with the application of science and technology.

STUDENT



PUGWASH

U S A

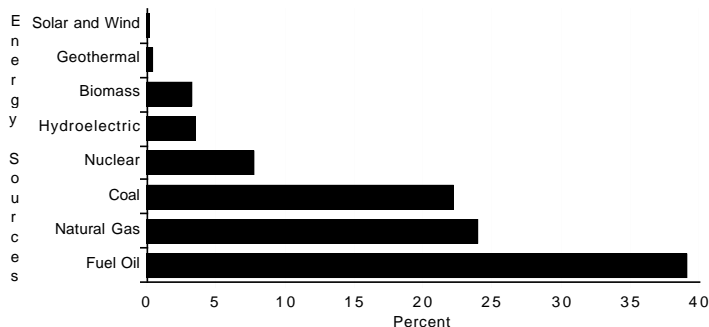
# go figure!

Global energy consumption is expected to rise over the coming decades. While experts may recognize the need to transition to renewable energy resources, fossil fuels remain the primary sources for power generation. There are significant differences between environmental and economic costs associated with alternative forms of energy.

The Organization for Economic Cooperation and Development (OECD) countries, which according to the US Department of Energy contained 18% of the world's population in 1995, consume more energy than they produce. According to the World Resources Institute, developing countries' rates of energy consumption have increased almost threefold since 1973; in 1993, developing countries still accounted for less than one-third of world energy consumption, even though they contain the largest share of the world's population. The former Soviet Union and Central Europe have experienced a recent decline in energy consumption, resulting from economic disruption in the region. When viewing aggregated statistics such as these, it is important to bear in mind that within the broad categories, countries produce and use energy in different ways, at different rates, for different uses, and with different levels of efficiency.

## where our energy comes from, 1994

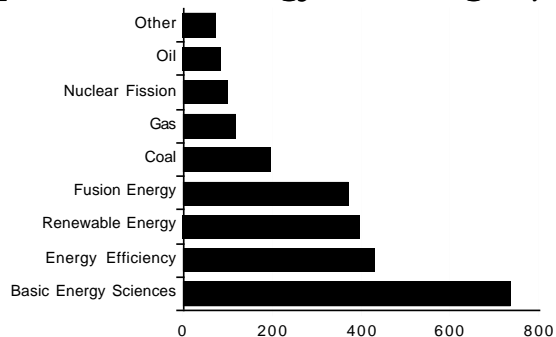
Energy Source	Percent
Fuel Oil	39.1
Natural Gas	23.9
Coal	22.1
Nuclear	7.7
Hydroelectric	3.4
Biomass	3.2
Geothermal	0.4
Solar and Wind	0.1



**Source:** *Renewable Energy Annual 1995*. Energy Information Administration. Washington, DC: US Department of Energy, 1995.

## united states

## department of energy r&d budgets, FY 1995



	Millions of Dollars
Basic Energy Sciences	734
Energy Efficiency	428
Renewable Energy	394
Fusion Energy	368
Coal	192
Gas	116
Nuclear Fission	95
Oil	82
Other	70
Total	2,479

**Source:** *Energy R&D: Shaping Our Nation's Future in a Competitive World*, Secretary of Energy Advisory Board, Task Force on Strategic Energy Research and Development. US Department of Energy, June 1995. Coal figure includes Clean Coal Technology Demonstrations, which amounted to \$37.1 million in FY 1995. Other R&D support is mainly crosscutting capital equipment, plant modernization and field operation, and management for the Fossil Energy R&D programs. Basic energy sciences includes: materials research, chemistry, applied math, biosciences, engineering, geosciences, and support for facilities. Note: The US recently set up a panel of experts to review its energy R&D. The panel chair is John Holdren, who also serves as the chair of the Pugwash executive committee.

# in control or out of it ?

The use of renewable energy sources has a diverse history throughout the world. Many developing countries have long used water and biomass fuels, such as straw, dung, and wood, to supply a portion of their energy. Many are now turning toward renewables, especially solar energy, as cheaper alternatives for bringing power to isolated areas. Europe is leading the world in installed renewable energy capacity.

Projects to bring more power to developing countries are funded by the World Bank, the UN Development Program, the UN Environment Program, foundations, and governments. The 1992 Rio Summit emphasized the need to use energy "in ways that respect the atmosphere, human health and the environment." Since the summit, equity issues between developing and industrialized countries are discussed at conferences on energy-climate interaction, as poorer countries may be disproportionately affected by efforts to reduce carbon dioxide levels.

While joint international efforts to encourage renewable energy have been undertaken, several factors have affected the success of such efforts. These include the environmental impact of the technologies, population increases, investment incentives for research and development, and policies regarding energy efficiency.

## geek speak

**renewable energy**—resources that constantly renew themselves or that are regarded as practically inexhaustible. These include solar, wind, geothermal, hydro and wood. Although particular geothermal formations can be depleted, the natural heat in the earth is a virtually inexhaustible reserve of potential energy. Renewable resources also include some experimental or less-developed sources such as tidal power, sea currents and ocean thermal gradients.

**biomass**—energy resources derived from organic matter. These include wood, agricultural waste and other living-cell material that can be burned to produce heat energy. They also include algae, sewage and other organic substances that may be used to make energy through chemical processes.

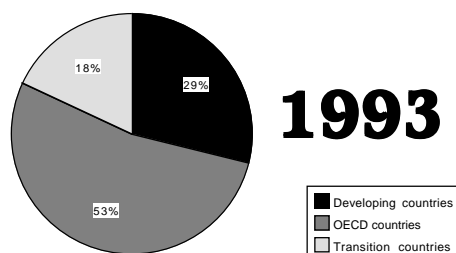
**geothermal**—natural heat from within the earth, captured for production of electric power, space heating or industrial steam.

**greenhouse effect**—the presence of trace atmospheric gases make the earth warmer than would direct sunlight alone. These gases (carbon dioxide, methane, nitrous oxide, tropospheric ozone, and water vapor) allow visible light and ultraviolet light (shortwave radiation) to pass through the atmosphere and heat the earth's surface. This heat is re-radiated from the earth in [sic] form of infrared energy (longwave radiation). The greenhouse gases absorb part of that energy before it escapes into space. This process of trapping the longwave radiation is known as the greenhouse effect.

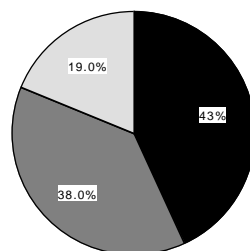
**photovoltaic cell**—A semiconductor that converts light directly into electricity.

**Source:** California Energy Commission, <http://www.energy.ca.gov/glossary/glossary.html>

**share of energy consumption**



**share of energy production**



	Percent consumed	Percent produced
Developing countries	29	43
OECD countries	53	38
Transition countries	18	19

**Source:** *World Resources: A Guide to the Global Environment 1996-97*, The World Resources Institute, The United Nations Environment Programme, The United Nations Development, and The World Bank. New York: Oxford University Press, 1996. Members of the Organization for Economic Cooperation and Development are: Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Japan, Luxembourg, Mexico, the Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, Turkey, the UK, and the US. Transition countries include the former Soviet Union and Central European countries.

State governments, Congress, and over a dozen countries are considering or enacting deregulated systems of energy marketing and distribution. These systems would deregulate the power industry, affecting future electricity rates and service, national and local economies, choice of fuel supplies, and the environment. Some experts support the effort as a positive use of free market competition and consumer choice; others are concerned with the potential harm to the environment and the effects of industry's short term goals of minimizing costs and maximizing profits.

Some view restructuring as a threat to renewables, while others perceive it as an unprecedented opportunity. Under the current system, a public utility is given monopoly status to generate, transmit, and distribute power to all customers in its service territory. Consumers have little choice regarding who supplies their energy. In exchange for monopoly rights, state agencies tightly regulate the utility, set rates, and approve investments in new power plants and infrastructure.

Under restructuring, the monopoly will end. Competitive generation companies will build, operate, and sell energy from their power plants. Consumers will shop for their energy from among the providers, much like today's long-distance telephone service. Public opinion polls consistently indicate that people are willing to pay more for electricity that is generated from renewable resources. Therefore, entrepreneurs could establish renewable energy companies and sell that power directly to consumers. Other companies could build or buy renewable power supplies and include them as part of the companies' "product lines."

### **soakin' up some sun**

Photovoltaics use the sun's energy. They are reliable, non-pollutant, and come in any size. Solar power is expensive, but this is improving. For 24 hour use, energy must be stored or integrated with other technologies. Solar cells convert only about 15% of sunlight to electricity. Toxic chemicals and heavy metals are used and produced in manufacturing.

### **is the answer blowin' in the wind?**

Wind power produces no pollution and has minimal environmental impacts. Turbine reliability is over 90%, operating costs are low, and energy can serve a single household or the utility grid. While large land tracts are needed, grazing and farming can continue. Some people find wind towers visually intrusive and blade noise objectionable. To ensure 24 hour availability, energy must be stored or integrated with complimentary technologies.

### **all steamed up?**

Geothermal energy is an inexhaustible resource on a global or a regional basis. It is a diverse resource capable of providing steam for electricity and direct space heating and cooling. Unfortunately, heat replacement is time measured in thousands of years and individual thermal reservoirs are exhaustible and generally located far from population centers.

### **waterworld?**

Hydropower is a clean, plentiful source of energy, which can be developed over a wide range of sizes. It is cheap to operate and properly designed facilities have little environmental impact. However, large scale projects can cause massive ecological impacts over large land areas due to dam construction, upstream flooding, displacement of indigenous peoples, and loss of fish.

### **burn baby burn!**

Biomass energy has low emissions and can increase productivity of marginal farmland. Steam from burning biomass resources provides both heat and electricity. Biomass requires careful wood crop management and large tracts of agricultural land converted to biofuel crops to ensure sustainability. Fuel costs are high with this technology.

# (anything but a) conclusion

The future of renewables is largely dependent on three factors. First is the public's willingness to support renewable energy development, either indirectly through government subsidies or directly by choosing a "green" power provider. Second, continued improvement in renewable energy technologies and cost-effectiveness will enable them to compete more effectively with conventional technologies. Third, the price of fossil fuels, especially natural gas, will establish the baseline for determining whether renewable energy sources will be financially competitive. What will the future hold for renewable energy? The answer is up to us as we make decisions—individually and collectively—about how we will meet our future energy needs.

How do **you** answer the **tough questions**

Wind and solar power for electricity generation are proven technologies with reduced environmental costs. Yet, they provide only a small percentage of power, in part due to their cost. What factors should we consider when determining the benefits and costs of adopting alternative energy sources as a means of environmental protection? How would you balance environmental and health issues with cost effectiveness?

Do you think the community should be involved more directly in determining what types of energy sources it uses or do you think the public's opinions are already adequately represented through our democratic system? How could citizens participate more fully in the process—through citizens' committees, individual action, advocacy groups, or some other means? What role should the scientific community play in focusing research on alternative energy sources that rely on abundant resources?



Many developing countries use wood as a source of fuel for cooking and heating. While this is an inexpensive resource, it is associated with deforestation, a high level of pollution, health problems from indoor pollution, and it may contribute to the greenhouse effect. Do you think a poor person in one country has the right to use wood as their main source of fuel, even if this contributes to the greenhouse effect? Do you think the government has an obligation to provide alternative energy for people? Do you think the international community has a responsibility to help pay for alternative energy if the local government cannot afford the technologies?

Some energy alternatives include technologies that are not fully developed or tested (for example, hydrogen). Should we use new technologies without knowing their effects? What level of testing should be done to determine the effects of the technologies on the environment, animals, and people? What do you feel is an acceptable level of impact or safety?



.....

• If we can harness renewable energy sources to produce large amounts of energy and/or the cost of power from renewables decreases, consumers may actually use more energy. Is it right to develop and put into use alternative energy sources that might encourage even greater energy consumption? Would increased use of energy be a problem if the energy source is renewable? If so, what would you do to limit overuse of energy from renewable sources?

.....

Sweeping changes in the electric utility industry may inhibit any investment in new renewable energy resources. How much priority do you think we should give to renewable energy in this process of deregulation? What measures do you think would encourage the electric industry to promote renewables? What do you think our energy production infrastructure should look like in 50 years?

One of the cheapest ways to reduce costs is through promoting energy efficiency. Do you think the government should promote energy efficiency over the pursuit of renewables?



Federal and state governments provide funding for a variety of services—hospitals and health care, roads and other parts of the transportation infrastructure, clean water, etc. In addition, the government provides financial incentives to companies to explore, identify, and recover new supplies of fuel. Do you think that the government should give priority of its limited resources to renewable energy through subsidies or incentives, even though these technologies currently make up only a small percentage of our energy production?

Do you think the current reliance on fossil fuels is shortsighted? Following the oil price shocks of the 1970s, many in the US questioned the country's ability to maintain an independent energy supply. Do you think this is a reason why the US should pursue renewable energy sources? Or, do you think the growing global interdependence is a stabilizing factor in international affairs?



The status of renewable energy technologies differs from country to country. Research and development on renewables uses funding from the government and the private sector. Do developed countries have an obligation to developing countries to help plan and implement renewable energy generation?

**electrifying information**

- *Cool Energy: Renewable Solutions to Environmental Problems*, Michael Brower—a comprehensive review of progress in the field of renewable energy technologies. Cambridge, MA: MIT Press, 1992.
- *Energy for a Sustainable World*, Jose Goldemberg, et al—a classic text on sustainable energy policy that provides in-depth coverage of issues at the international level. It identifies and recommends energy technology and policy options for the developed and developing world. Somerset, NJ: John Wiley & Sons, Eastern Distribution, 1988.
- *Energy Politics*, David H. Davis—an excellent overview of the evolution and driving forces that have shaped US energy policy. New York: St. Martins Press, 1992.
- *Power Surge: Guide to the Coming Energy Revolution*, Christopher Flavin and Nicholas Lenssen—discusses and predicts the changes in the global link between energy use and its environmental impact. The Worldwatch Environmental Alert Series. New York: W.W. Norton & Company, 1994.
- *Powering the Midwest: Renewable Electricity for the Economy and the Environment*, Michael Brower, et al. Cambridge, MA: Union of Concerned Scientists, 1993. Tel: 617-547-5552.
- *Renewable Energy Annual 1995*. Energy Information Administration. Washington, DC: US Department of Energy, 1995.
- *Renewable Energy Sourcebook: A Primer for Action*. Public Citizen Critical Mass Energy Project, 1995. Tel: 202-546-4996.
- *Renewable Energy: Sources for Fuels and Electricity*, Thomas B. Johansson, et al—over 1,100 pages of everything you need to know about renewable energy technologies. Washington, DC: Island Press, 1992.
- *Renewable Resources in the US Electricity Supply*. Energy Information Administration, US Department of Energy, Washington, DC, 1993.
- *Renewables Are Ready: People Creating Renewable Energy Solutions*, N. Cole and P. Skerret—a guide to renewable energy technologies that are currently in use in communities and villages across the country. Also provides strategies to overcome political and economic barriers to renewable energy development at the community level. Cambridge, MA: Union of Concerned Scientists, 1995. Tel: 617-547-5552.
- *Soft Energy Paths: Toward a Durable Peace*, Amory Lovins—a classic that led to increased interest in renewables. HarperCollins, 1979. ISBN 0060906537.

# check it out !

**on the lighter side**

- *Crack in the World*—Mystery Science Theater 3000 does a really great spoof on this film about scientists trying to tap into geothermal energy who end up splitting the earth in half.
- *The China Syndrome* (movie and book)—gives a chilling view of a nuclear meltdown.
- *Atlas Shrugged* (Ayn Rand)—contains some sections on alternative energy, for those who don't mind reading a few thousand pages.
- *Oil* (Upton Sinclair)—none of us have read it, but we hear it's good.

# cyberspace

**top picks**

- US DOE Energy Efficiency & Renewable Energy Network (contains a vast amount of information on government and nonprofit programs promoting energy views)—<http://www.eren.doe.gov/>
- Center for Renewable Energy and Sustainable Technology (comprehensive resources on all aspects of renewables and energy efficiency)—<http://www.solstice.crest.org/>
- World Energy Efficiency Association (nonprofit organization assisting developing countries in accessing and collecting information on energy efficiency)—<http://www.weea.org/>

**best of the rest**

- American Solar Energy Society—<http://www.sni.net/solar/>
- American Wind Energy Association—<http://www.igc.apc.org/awea/>
- EcoNet Home Page—<http://www.igc.apc.org/econet/>
- Energy Foundation—<http://www.ef.org>
- Energy Information Administration—<http://www.eia.doe.gov/>
- Federal Energy Regulatory Commission—<http://www.fedworld.gov/ferc/ferc.html>
- International Energy Agency—<http://www.iea.org>
- Links to the World-Public Utilities—<http://www.leg.state.mn.us/lrl/links/pubutils.htm>
- National Renewable Energy Laboratory—<http://www.nrel.gov/>
- Nuclear Energy Institute (pro-industry site)—<http://www.nei.org>
- Organization for Economic Cooperation and Development—<http://www.oecd.org>
- Public Citizen Critical Mass Energy Project—[http://www.essential.org/orgs/public\\_citizen/CMEP/home.html](http://www.essential.org/orgs/public_citizen/CMEP/home.html)
- Renewable Energy Generation Technologies—<http://es.inel.gov/new/business/sba/options2.html>
- Sustainable Energy Links—<http://www.newenergy.org/newenergy/>
- Sustainable Minnesota's Electric Utility Deregulation Resources—<http://www.me3.org/projects/dereg/>
- The National Council on Competition and the Electric Industry—<http://www.erols.com/naruc/ncei.htm>
- UN Department for Policy Coordination and Sustainable Development (great background on Rio Summit and subsequent activities)—<http://www.un.org/dpcsd/>
- Union of Concerned Scientists (good background material on energy and CO2 emissions, particularly related to the US)—<http://www.ucsus.org>
- Worldwatch Institute—<http://www.worldwatch.org>

**web power!**

This **mind•full** was written by David Blecker. Dave is an energy analyst with MSB Energy Associates, Inc. Special thanks to Tim Larson, consultant on energy and environment issues at RPM Systems, for his comments. Dave and Tim are both "veteran Puggers." Any errors are the responsibility of Student Pugwash USA.

## board of directors

Constance Pechura, Chair  
Michael Berger  
Richard Bryant  
Anne Cahn  
Peter Carpenter  
Rebecca Derrig-Green  
Natalie Goldring  
Paul Jellinek  
Matthew Lee  
Alan McGowan  
Indira Nair  
Eric Roberts  
Dann Sklarew  
Nathan Steinwald  
Anna Yusim

## board of advisors

Sissela Bok  
Honorable George Brown  
Audna England  
Richard Graham  
Hal Harvey  
John Holdren  
Walter Kohn  
Sally Lilienthal  
Shirley Malcom  
Richard Nelson  
Victor Rabinowitch  
Robert Rosensweig  
Frank von Hippel  
Victor Weisskopf  
Herbert York

## but wait, there's more!

- **mind•full: a brainsnack for future leaders with ethical appetites.** Other issues available upon request: international weapons trade; emerging infectious diseases; access and the Internet; public's role in science; future of nuclear weapons; water quality and availability; war and disease. Coming next fall: science, principles, and power; beyond nuclear weapons; genetics.
- **Jobs You Can Live With: Working at the Crossroads of Science, Technology, and Society.** The fifth edition of the Student Pugwash USA internship directory. It highlights approximately 200 organizations that work to promote the ethical use of science and technology and provides suggestions on how to go about the internship and job search.
- **The Global Issues Guidebook.** A student-authored discussion and classroom resource on science, technology, and society issues.
- **Pugwatch.** The chapter newsletter.
- **Chapter Organizing Guide.** Provides chapter members with an A to Z guide to getting a campus-based chapter up and running.
- **Tough Questions.** Student Pugwash USA's newsletter.

## recent supporters

Apple Computer, Inc.  
Carpenter Family Trust  
Ciba Educational Foundation  
Ciba Limited  
Department of Energy (US)  
Cyrus Eaton Foundation  
W. Alton Jones Foundation  
Henry P. Kendall Foundation  
Jeffrey Leifer (founder)  
John D. and Catherine T.  
MacArthur Foundation  
Stewart R. Mott Charitable Trust  
National Science Foundation  
New-Land Foundation  
Ploughshares Fund  
Rockefeller Family Associates  
Samuel Rubin Foundation  
United States Institute of Peace  
University of Wisconsin  
World Bank  
Individual Contributors

STUDENT



PUGWASH

U S A

**student pugwash usa**  
**815 15th street, nw, suite 814**  
**washington, dc 20005 usa**

**address correction requested**

## how to find us

telephone: 202-393-6555 or 1-800-wow-a-pug • fax: 202-393-6550  
e-mail: [spusa@spusa.org](mailto:spusa@spusa.org) • Web: <http://www.spusa.org/pugwash/>