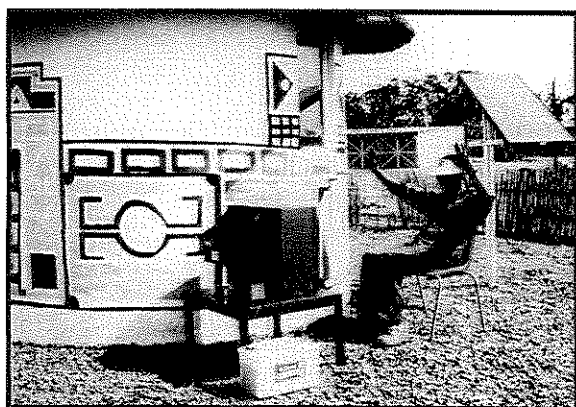


CLIMATE ALERT

Volume 10, Number 3

July - August 1997

Photovoltaic Cells Bring Light and Power to World's Rural Dwellers



Solarex Photo
A South African Villager shows his jubilation in seeing world events on his TV powered by solar panel in background.

Enthusiasm and ferment surround solar PV technology which is a particularly attractive alternative for the 400 million households in the world with no electricity.

In Indonesia, whose population — the fifth largest in the world — lives on 6,000 islands, the US Solarex Corporation has contracted to supply 36,000 solar home systems to rural inhabitants. Each system consists of a 50W module and a battery unit to power light fixtures, a TV or small radio. Excess power generated during the day will charge the batteries for power use at night. These individual home systems are much more practical than a national power grid for the

(Continued on page 6)

Business Discovers Profit In Alternative Energy Investments

Editor's Note: Most industry representatives have till now largely sat on the sidelines as observers in climate change meetings. But world business leaders are beginning to include climate change in their long-run corporate strategies. As it has become clear that technology — green technology — is a key to mitigating climate change, entrepreneurs have become aware of the potential damage to their balance sheets from more frequent floods and droughts and alert to the profitable opportunities from fuel cells and wind turbines.

*In this issue of **Climate Alert**, we report on ventures in several forward-looking industries: photovoltaics, wind, transportation and financial.*

Natural Gas Firm Commits Capital to Wind Energy

In January '97, one of the largest natural gas suppliers in the world, the Enron Corp. of Houston, demonstrated its confidence in the future of alternative energy by buying the Zond Corp., a wind power manufacturer and developer headquartered in California. Enron is supplying a crucial ingredient — capital — to the wind industry.

"Renewable energy will capture a significant share of the world energy market over the next 20 years, and Enron intends to be a leader in this very important market," said Enron chairman and

(Continued on page 3)

UPCOMING CLIMATE INSTITUTE EVENTS

Conference: Climate Change and the New Jersey Coast
Thursday, November 13, 1997 — Ramada Inn, Toms River, New Jersey
Co-sponsor: US Environmental Protection Agency
For information, contact Michele Pena: 202/547-0104, FAX 202/574-0111,
e-mail: mpena@climate.org

First in a series of events being organized as part of the Climate Institute's **Regional Response Program**. Much work needs to be done to improve the accuracy and explanation of regional climate change projections. These conferences — bringing scientific experts together with state and local planners, educators and citizen groups — will help lay the groundwork for a continuing dialogue.

Look for upcoming events in your area.

BP Chief Asserts Business Must Take Some Responsibility for Climate Policy; Company Plans to Measure and Limit its Greenhouse Gases

Excerpts from Speech of John Browne, Group Chief Executive, British Petroleum, Berlin Parliament, September 30, 1997

We can now see ... what we need to do to respond to the challenge of climate change. The key word is "we." ... Now,



John Browne

increasingly, the world has recognized the sense of taking precautionary action ... [a]ction for Government, and industry and consumers working together and in parallel... I think the issue can be managed without disrupting economic development.... If we fail...the danger of disruption at some later point becomes a serious risk.

The science of climate change is still provisional. Perhaps all science is provisional. But it would be unwise and potentially dangerous to ignore the mounting concern. We need to take precautionary action now.

Developing the right policies ... will be a complex process ... not solved by denying or restricting the economic expectations of the people of Asia, or Africa or Latin America. Nor will it be resolved by destroying the living standards of the world's developing economies....

What is at stake is economic activity as a whole, not simply the transportation section. Of all the carbon emissions which result from human activity, only 20 percent comes from the transportation sector.

Politicians represent people, and they must define policy.... But business has a responsibility to help the process of defining the means by which that policy can be achieved. The problem of climate change will not be resolved at any single summit meeting.... It will take time

What matters now is that we begin to take rational, precautionary steps, not wait for a finished, polished solution which has unanimous endorsement. Kyoto is an important meeting, but it is just one more step in a continuing process. I hope that some measure of agreement will be reached, and that it will lead to the involvement of the whole world....

Any agreement seems most likely to be around objectives and aspirations rather than around a detailed program. There may be a target.... but it will just be the beginning of the next process — development of the means to achieve that target.

By 2010 total energy demand will rise over 30 percent, an extra 2.3 to 3 billion tons per year, equal to twice Europe's current consumption

Different governments ... will work in different ways to achieve their own targets using instruments which match local circumstances and political realities.

The three policy instruments ... likely to be taken up ... are taxation, carbon trading and joint implementation; each uses the market to change behavior.... The key lies in the detailed design of the instruments and ... the establishment of the right incentives for action.

Taxation. The test of any proposed tax ... should be its actual impact on reducing greenhouse gas emissions, ... not simply a politically convenient means of raising

revenue. ... To be effective, taxation... would have to cover all industry sectors, ... based on a level playing field between fuels, ... set at a rate which actually changed behavior, reduc[ing] emissions by changing the fuel mix or using improved technology.

Trading permits put a value on carbon emissions and establish a ... market [where they can be] bought and sold at competitive ... prices. The playing field must be level. On a macro-scale, industries would reduce emission levels according to the supply of permits in the market. On a micro-scale, companies would be encouraged to seek new technologies....

Joint implementation [does] the most effective things in the places where they have the greatest impact, ... improving competitiveness through technical progress and controlling some of the more immediate environmental problems such as inner city pollution.

The right incentives would produce a more rapid turnover of capital stock which could be

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enormously beneficial because so many emissions and so much pollution come from the oldest plant. The right incentives could also encourage ... sequestration and the capture, reinjection and storage of CO₂. Reforestation is also an attractive way of mitigating ... part of the impact of CO₂ emissions.

Climate change is a matter for public policy But business can't be passive in the process. We must be alive to our own responsibilities. We can't solve the whole problem, but we can make a contribution.....

Four months ago, I set out our objectives in this area:

1) supporting scientific research and contributing to the public policy debate

2) playing our part in joint implementation initiatives

3) investing in renewable energy, particularly in photovoltaics — that is, solar power

4) and controlling our own emissions of CO₂.

In terms of public policy, we've developed a set of principles which we're publishing today.... We've also made some important steps within the company. The one I emphasized

earlier ... at Stanford ... is our commitment to solar power.... The trends in photovoltaics are very encouraging — but there are still large obstacles: the acceptability to consumer,

**The world needs oil
and gas, but the people of
the world need to be
convinced that their needs
can be met without
destructive consequences.**

determin[ing] whether we can achieve economies of scale in production; the technology [improvements] to bring down costs.... By 2020 we believe up to 5 percent of world energy could be supplied by renewable energies, including solar power. Within 50 years it could be as much as half — figures also ...

given by John Jennings, former head of Shell Transport and Trading, ... one of the most experienced people in the energy industry.... Given the current economics, solar won't replace oil and gas as the prime source of energy in the lifetime of anyone in this room. Oil and gas will be required to meet the world's energy needs. That is why we continue to explore and develop new resources, ensuring they are used with maximum efficiency ... and minimum of emissions.... We are setting our own targets to measure and report the volumes of CO₂ emitted from our own operations,... [which will be] independently verified and published. We are developing our own internal emissions trading system.

No single company or country can solve the problem of climate change.... But I hope we can make a difference ... by showing what is possible through constructive action. There is no immediate crisis, and so long as we take precautionary action, ... [with] a common end, but a diversity of means there will be no crisis in the future.

Wind Energy

(Continued from Page 1)

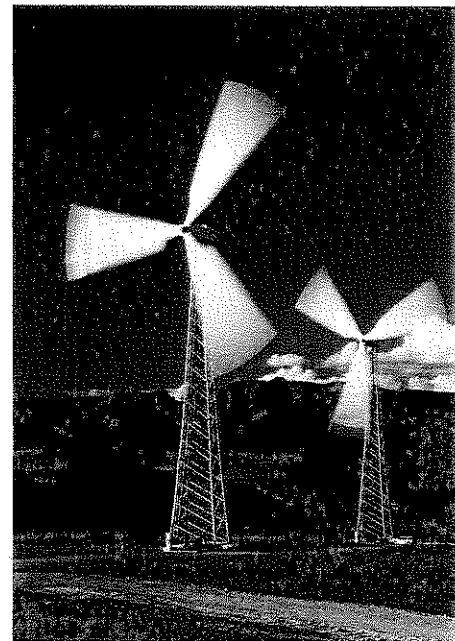
CEO Ken Lay. (Enron is the largest US-owned producer of solar photovoltaic cells and the second largest producer worldwide. See accompanying article on the photovoltaic industry on page 1.)

Zond, founded in 1981 and now known as the Enron Wind Corp., was one of the first wind farm developers in California. It has designed, engineered, constructed and operates over 2,500 wind turbine generators in California. Each year the company's wind power plants generate more than 550 gigawatt hours, enough electricity to offset nearly two million pounds of air pollutants that would otherwise have been generated by fossil-fuel plants.

Enron Wind is constructing projects in the 100 MW size for major utilities in the the US Midwest. It also has overseas projects in Northern Ireland, China, Latin American and other parts of Europe and Asia.

Global wind energy capacity soared 32 percent from 1994 to '95 and is expected to add 30,000 new megawatts of capacity by 2006, according to the American Wind Energy Association. Wind power has been called the world's fastest growing energy source, increasing at an average rate of 20 percent annually, 150 percent since 1990. Conventional power has only grown at three percent or less a year.

(Continued on page 4)



Enron Wind Corp. Photo

Wind Turbines

Wind Energy

(Continued from page 3)

Declining Wind Electricity Costs

	per kWh
Mid-1970s	\$1.00
1996	.05
2010 forecast*	.02

**DOE, EIA, World Energy Projection System (1997) (if favorable financing available)*

The US is still world leader in installed capacity but others are closing the gap rapidly. European wind growth has been called "explosive." Germany and India are the largest single markets, and Germany surpassed the US in installed capacity in 1997. While China is likely to have 100 MW go on line in 1997, it is not likely to meet its goal of 1,000 MW wind capacity by the year 2000. Spain is among the top growth markets and Netherland and Denmark have significant installed capacity. Costa Rica, Mexico and Egypt have also expressed interest in the area.

Large World Potential

The US share of the world wind energy market, which was 90 percent in 1988, has shrunk to 30 percent, because of a lack of policies to support wind power development, chaos in utility restructuring, a push for lower conventional energy prices, and the resistance of utility monopolies. (Only 10 new megawatts of wind power come on line in 1996 in the US.) However, wind power on less than one percent of the land in the 48 contiguous states could provide 20 percent of current US power needs.

Wind power cannot fully replace fossil fuels, but it has the potential to meet or exceed 20 percent of world electricity supply according to Chris Flavin of Worldwatch Institute. In fact, more countries have wind power potential than have large sources of hydropower or coal, Flavin has said.

Companies Vie To Bring Fuel Cell Powered Autos to Market

Auto exhaust emissions are the largest single source of air pollution in the world, especially in urban areas, says James Cannon, author of a recent study of hydrogen as an energy carrier in transportation.

Hydrogen as an energy source



Mercedes-Benz Photo

Mercedes-Benz 6-passenger NECAR II powered by oxygen from the air and hydrogen from cylinders on the roof

could be produced in "virtually unlimited quantities" from renewable sources, Cannon points out, and its use would yield almost no pollutants. This potential has set off a ferocious competition among the world's auto makers.

Front Runner

Farthest ahead is Daimler-Benz which unveiled a fuel cell-powered six passenger sedan in May 1996. The Mercedes-Benz NECAR II can travel more than 62 miles per hour and has a range of 155 miles. Its 300 fuels cells take oxygen from the air, mix it with hydrogen to produce an

output of 50kW. The hydrogen is carried in pressurized gas cylinders on the roof.

Daimler-Benz has said the hydrogen will eventually be replaced by methanol which can be stored in a standard car fuel tank; a gas-generating system would produce hydrogen in the car directly from the methanol. Although this reaction would produce carbon dioxide as a

waste by-product, it is only a fraction of the amount produced by the internal combustion engine.

Helmut Werner, President of Mercedes-Benz, has said, "The fuel cell is no longer a technical gimmick. It offers superb prospects for automotive application in the next century and beyond."

For several years, Daimler has been working closely with Canada's Ballard Power System, Inc. of Vancouver to develop fuel cell systems for buses, vans and now passenger cars. In February 1996, Ballard won a \$6 million contract from Georgetown University of Washington, DC for a 100 kW fuel cell to power a 40-foot bus.

Other Competitors

Shortly behind Daimler, in the fall of 1996, Toyota announced that it had developed Japan's first fuel cell electric vehicle, based on the RAV4L, powered by nickel-metal hydride batteries. The energy conversion efficiency of this 5-door vehicle, like that of other fuel cell-powered cars, is over 60 percent, two to three times that of internal combustion engines which lose more than 80 percent of their energy as waste heat. The only by-product is water vapor; there are no hydrocarbon, carbon monoxide, nitrous oxide or CO₂ emissions.

Volvo and Volkswagen have begun developing a fuel cell vehicle, as have Toyota, Honda, Mazda, BMW, and Renault. Belgium, Canada, Ireland, Italy, Norway, Saudi Arabia are also actively pursuing hydrogen power projects.

United States Role

While the US pioneered the development of fuel cells, Robert Rose, director of Fuel Cells 2000, has noted that it has lost the lead in fuel cell vehicles, and some have said is at least four years behind. Although US spending on hydrogen development has grown dramatically since 1990, increasing 10-fold, the US expenditures in 1995 were \$10 million, surpassed

Economic damage from fossil fuels amounts to \$2.7 trillion

by Japan's \$23 million and Germany's \$12 million. The Department of Energy's concept vehicle is scheduled for the year 2000 with a prototype to be built by 2004. But the US is at a disadvantage, says Patrick Takahashi, outgoing president of DOE's Hydrogen Technical Advisory Panel, because energy prices are low. Hydrogen will not become competitive unless the price of oil doubles, he predicts.

Half of US air pollution regulated under Federal law and 32 percent of CO₂ emissions implicated in global warming come from autos. "The actions US policy-makers and business leaders take now will determine the role the US will play now in the energy systems of the future," Cannon has said. Fossil fuels produce about 23 billion tons of toxic emissions per year (as opposed to only 12 million tons of pollutants from more often vilified tobacco), T. Nejat

Veziroglu, president of the International Association of Hydrogen Energy, has stated. Economic damage worldwide — to the health of humans, plant and animals — from fossil fuels amounts to \$2.7 trillion, he noted.

But establishing a hydrogen-based transportation system will probably take several decades, according to Cannon, and in the meantime natural gas, a fossil fuel with substantial advantages over oil-derived fuels, could ease the transition. Natural gas already powers 750,000 vehicles in the world and would dramatically reduce air pollution, with less carbon monoxide and toxic air pollutants, fewer hydrocarbon and CO₂ emissions, less nitrous oxides than gas.

3 Hydrogen Technological Modes:

- in internal combustion engines
- in fuel cells for electric vehicles
- in a hybrid combination of engines and fuel cells with electrical storage systems such as batteries.

The hydrogen electric hybrids, combining on-board engines that generate power with electrical systems that store power, have possibly the greatest market potential. Demonstration models are lighter, smaller, more versatile and yield better performance.

A decade of research could lead to a variety of vehicles fueled by hydrogen, performing as well or better than today's vehicles with much less impact on the environment. Support could come from a shift in investment away from nuclear or fossil fuel research. Veziroglu asks the fossil fuel companies to make long-term plans to phase out their marketing of fossil fuels and replace them with hydrogen, initially manufactured from fossil fuels, then with nuclear energy, eventually with renewable energy. We should make a conversion to a full hydrogen energy system in an orderly and planned way as fast as possible, he pleads. "We need fossil fuels to be saved for future generation's chemical raw materials."

Insurance Firms, Banks Will Invest Funds In Solar Energy

Confronted by the risks of floods, droughts, windstorms and sea level rise, 50 firms in the world's financial community have agreed to boost the market for photovoltaic cells. The 50 include some of England's biggest financial companies — Barclays', Nat West, Lloyd's, TSB Group, Royal and Sun Alliance, as well as General Accident (Scotland), Salomon Brothers (US), and Storebrand (Norway) — who attended the Oxford Solar Investment Summit in December 1996. They hope through encouragement of mass production to slash costs from £9 to £1.5 a watt, competitive with fuel prices.

To do its part, the National Westminster Group (NatWest, a British bank) announced in May that it will install solar panels in one of its buildings. A UK insurance company, Guardian Royal Exchange, has pledged cash for the installation of solar panels at its Ipswich headquarters. General Accident is considering a similar move. At the same time a German insurance company, Gerling Konzern, has announced an investment of \$2 million in SunLight Power International, a new solar energy company whose goal is to supply PV panels to communities in developing countries who have no access to electricity. (For more information on this project, see page one.) The Japanese government has announced £100 million in subsidies to put photovoltaic cells in 10,000 homes and offices. Sharp, Sanyo, Canon and Mitsubishi have stepped up their solar divisions.

Another initiative suggested at the Summit was to persuade 40 cities to use solar power to produce heat and light for public buildings (a project similar to the one described in Atlanta, Georgia on page

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Insurance

(Continued from page 5)

7). And if the insurance industry invested its \$1.4 trillion resources in green energy technologies, Summit organizer Jeremy Leggett pointed out, it could play a crucial role in lowering the price of photovoltaic cells.

Global climate change is the single most important issue facing the world today.

Several reinsurance industry leaders have publicly expressed their concern about climate change and have been active in trying to persuade the international community to set limits on greenhouse gases emissions. The insurance industry is worried that as extreme weather conditions continue to increase around the world, causing severe damage, the number of insurance claims will continue to rise. Highly volatile weather patterns are being recognized as one of the consequences of rising atmospheric concentrations of greenhouse gases. "Global climate change is the single most important issue facing the world today," says Kaj Ahlmann, chairman and CEO of Employers Reinsurance Corp. "If we don't do something about climate change on the global level, we'll see some changes that will alter the lifestyle of our children and grandchildren."

In March, Munich Reinsurance reported that natural catastrophes for 1996 amounted to \$60 billion, not a record but continuing a trend of ever increasing losses and ever increasing costs. The two great natural catastrophes of last year were the floods of China and Hurricane Fran on the US east

coast. The floods in the middle and lower Yangtze from late June to mid-August were the worst in 150 years, affecting 2 million people. About 2700 died from the floods and landslides, and two million were made homeless. Total economic losses amounted to \$20 billion.

A comparison of the last 10 years with those of the 1960s, according to the Munich Re report, shows there has been a four-fold increase in "great" natural catastrophes, an eight-fold increase in economic losses and a fifteen-fold increase in insured losses, and these losses are likely to become more pronounced. New extreme meteorological conditions, no experience on how to handle them, and no appropriate preventive action produce a recipe for catastrophe.

Bankruptcy

The Global Insurance Company, the biggest company of its kind in the world, had to pay out most of its reserves of 70 billion marks last year, according to a report from Greenpeace, and announced a 500 percent rise in premiums to save itself from wholesale collapse. It blamed the dozens of windstorms in Asia and central Europe, and the enormous number of tornadoes in the US for its spate of losses.

"Given the further increasing number of extreme climate events we cannot insure against any new risks," a spokesman for the company's board declared.

Solar

(Continued from page one)

homes without electricity.

Solarex, a joint company owned by the Enron Corp. of Houston and Amoco Corp., one of the largest producers of crude oil and natural gas, has many other ventures in the works. It is supplying solar cells for what will be the largest solar roof at a training facility in Herne, Germany: 500 kW solar cells laminated between sheets of glass. Spaces between each cell will make the roof partially transparent, allowing sunlight into the building and providing natural light to reduce the building's energy requirements. Solarex has signed an agreement for a 50 MW solar facility in the state of Rajasthan, India. India has other photovoltaic programs, with installation of solar-power lanterns and street lights and plans for more than 150 village power plants.

Rather than selling solar systems as Solarex does, SunLight Power International works under a "fee for service" concept, installing and maintaining its own power systems at affordable costs. SunLight Power has recently received a \$2 million investment from GAIA Kapital, a German venture capital firm, enabling SunLight to expand its existing business with partners in the Dominican Republic and Morocco by providing photovoltaic services to unelectrified communities in Africa, Asia and Latin America. The goal of David Freeman, chairman of the board and CEO of SunLight, is to supply clean, renewable energy at almost the same price presently off-grid customers now pay for batteries, kerosene and candles. Freeman is former chairman of the Tennessee Valley Authority and the New York Power Authority.

On Mexico's



Solarex Photo
Solarex array powers water pumping system in Senegal

Yucatan Peninsula, the remote village of Xcalak — population 350 — is 68 miles away from the nearest utility. Formerly the village depended on diesel generators which kept breaking down. Now it has added solar electric modules and wind generators to form a diesel-hybrid system which is much more reliable and has made it possible to add service for more people and businesses.

In the US, the ferment in the photovoltaic community shows up in many individual projects:

- **Kaiser Permanente** in partnership with the Enron Corp, decided in 1995 to move massively into fuel cell power for its hospitals, medical offices and office buildings. Starting with its southern California headquarters in Pasadena, it is installing a 200 kW fuel cell which will provide electric power, domestic hot water space heating and absorption heating to a 7-story building housing 1200 employees. Kaiser is aiming for 160 installations in five years which it believes will show savings over its present fuel bills. Enron will buy the units from ONSI of South Windsor, CT which will own, install, operate and maintain the plants and sell the electricity to Kaiser for a guaranteed pay base.
- **The City of Littleton** in Colorado has chosen PV to irrigate 1400

Domestic Projects Show Cities How to Save Municipal Energy

Energy efficiency is not only the most essential step towards reducing greenhouse gas emissions, it is also the most cost effective. Over the past four years, the cornerstone of the Climate Institute's domestic activities has been its Municipal Energy Program. The Institute has sought to reduce greenhouse gas emissions by measures that will benefit local environments and economies in cities around the country.

The Energy Smart Atlanta project has audited several municipal facilities in that Georgia city, showing energy use could be reduced by at least 30 percent, using building upgrades — lighting, heating, ventilation, air conditioning, fans, insulation — that pay for themselves. The project is also developing a color-coded energy intensity — dollars per square foot — map of the city's buildings. These and other tools have shown top decision makers that Atlanta could greatly benefit from implementing a strategic energy manage-

ment plan. The project was funded by the Turner Foundation, with technical support from Southface Energy Institute. Staff members Doug Gatlin, Chris Dabi, and Jack Werner were involved in the project.

The city is now ready to create and staff an Office of Energy Management and Conservation and to take advantage of many dollar savings and energy efficiency opportunities. The office will greatly strengthen the city's ability to conduct more energy analyses of buildings and achieve even greater energy savings. During Atlanta Challenge, an Earth Day celebration at the CNN Center in Atlanta, Mayor Bill Campbell stated that both he and the City Council strongly support creation of the Energy Office.

The Climate Institute's Energy Smart Atlanta project, part of a broad-based campaign launched in the fall of 1994, is envisioned not only as a catalyst for change in Atlanta but as a model for

(Continued on page 8)

newly planted native trees along a bike path in a park along the South Platte River.

- PV powers appliances and

lights in a remote house in Florida where it would cost \$15,000 to extend a line to the nearest utility.

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_____ Please send me _____ copy/copies of **Environmental Exodus: An Emergent Crisis in the Global Arena**, by Norman Myers with Jennifer Kent, June 1995. Cost: \$15 plus postage.

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Domestic

(Continued from page 7)

other cities. The project is encouraging at least ten cities across the US to implement building energy efficiency measures by carrying out US DOE-sponsored Rebuild America Action plans as well as following guidelines of the EPA's Energy Star Buildings program. Fulton County, GA and Louisville, KY have made building upgrades as partners in the project.

In September, 1996 the Institute published a compendium, Steps to Successful Municipal Energy Management, which included ten case studies on innovative ways cities across the US have used energy efficiency upgrades in city-owned buildings for economic and environmental benefits. The study, edited by Doug Gatlin, was prepared in collaboration with ICLEI and Public Technology, Inc. (PTI), and may be ordered from the Climate Institute.

UNEP Energy Efficiency Upgrade

The Institute is working with the North American Regional office of UNEP to implement sustainable measures (such as lighting, insulation, sustainable wood furniture, paints and carpets which do not emit volatile organic compounds) for UNEP's New York City offices. These building retrofits are intended as a model for other UN and international development agencies to follow. Dan Power leads the Climate Institute team working on this project.

Over the last year the Climate Institute has organized three regional workshops — in Toledo, Albany, and New Orleans — on how to successfully engage communities to participate in energy efficiency measures. They have covered such topics as: how to finance an energy efficiency project, how to sell it as a project that would help reduce costs and improve productivity. This effort has been supported by the Depart-

ment of Energy's Rebuild America Program, and has been under the leadership of staff members Jack Werner and Doug Gatlin.

One of the attractions of energy efficiency is that it provides a bridge to a truly sustainable energy future based on the use of renewable fuels. Beginning with its September 1996 Washington Summit, the Climate Institute has expanded its efforts to accelerate adoption of renewables and energy efficiency technologies both at home and abroad. While continuing to fulfill its role as an international bridge between scientists and policy makers on climate change, the Institute is now also aggressively pursuing hands on initiatives that will lead to real emissions reductions within the United States, which is still the world's largest greenhouse gas emitter.

For information on any of these energy programs, please contact Chris Dabi, 202/547-0104.

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Readers Please Note:

Through an error, the previous issue (No. 2) was dated May-June. In any case, we will publish six issues this year.

The Climate Institute is a private nonprofit organization formed to advance public understanding of climate change including the greenhouse effect and of strategies to avert stratospheric ozone depletion.

