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Todd Meeting with John Topping 10/17/97

2019-0774-S

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Attention:

TODD STERN

From:

JOHN TOPPING

Subject:

(b)(6)

DEAR MR. STERN,

I AM FAXING THE EDITORIAL AND
RELATED ARTICLE FROM CHEMICALS
ENGINEERING NEWS (SEPT. 22, 1997), MAGAZINE
OF THE AMERICAN CHEMICAL SOCIETY,
ON THE POTENTIAL OF A GREEN ENERGY
INVESTMENT STRATEGY TO SALVAGE THE
KYOTO NEGOTIATIONS AND POSSIBLY
PRODUCE MORE AGGREGATE GLOBAL
EMISSIONS REDUCTIONS THAN EVEN THE
EUROPEAN APPROACH.

THIS APPROACH WAS PRESENTED THIS APRIL
TO AN ASPEN INSTITUTE CONGRESSIONAL
CONFERENCE INVOLVING 5 SENATORS AND 18
CONGRESSMEN AND IN MAY TO THE CHAIR
OF THE G-77. BOTH GROUPS EXPRESSED
CONSIDERABLE INTEREST IN THE APPROACH.
I WILL BE HAPPY TO SEND YOU THE ASPEN
BACKGROUND PAPER IF THAT WOULD BE
HELPFUL.

REST WISHES
JOHN TOPPING

CHEMICAL & ENGINEERING NEWS

The newsmagazine of the chemical world

Volume 75, Number 38
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September 22, 1997

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Courtesy of Michigan Molecular Institute

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EDITOR'S PAGE

Building Dams And Bridges

Every now and then, I wish I lived in a different era—at a time when life seemed simpler, when a problem could be solved in a relatively short period, when people used common sense and ingenuity to get things done. A time when government in particular seemed to work efficiently and cost-effectively.

I had that feeling a few weeks ago when I escaped briefly from the unbearable desert heat of Las Vegas and the ACS national meeting to take a boat excursion on Lake Mead to Hoover Dam. There, an ebullient Interior Department guide regaled my tour group with tales of the herculean task of building this engineering marvel.

One can argue today about whether taming the Colorado River was a good idea. But in this century's early years, when the project was conceived, no one doubted that it was desirable to halt the Colorado River's perennial destructive spring flooding, provide a more stable water source for irrigation, improve navigation, and generate hydroelectric power.

Entire books have been written about this dam, but a few facts give a flavor of the undertaking. After years of devastating floods, seven states got together in 1922 to decide how to divide the Colorado's water. They did so in only three years, and in 1928 Congress passed and President Coolidge signed the Boulder Canyon Project Act. The U.S. would divert the mighty Colorado, build a dam, create America's largest man-made reservoir, and do all of this in record time in an uninhabited desert.

At the time—and perhaps even today—it was an unprecedented engineering feat. A city was built in the middle of nowhere. Nine million tons of rock was excavated, 1 million cubic yards of river bottom was removed, and 3.25 million cubic yards of concrete (greater than the volume of Egypt's Great Pyramid) was poured. New technologies were developed nearly daily, including an ingenious way to cure concrete in a fraction of the normal time.

The immensity of the project boggles the mind, even in our high-tech world. Hoover Dam has a bottom width

of 660 feet and towers 726 feet high. A two-lane highway runs across its top. The largest construction equipment in the world had to be invented, designed, fabricated, and installed on site. The arch gravity dam—at that time the highest in the world—was completed in five years, two years ahead of schedule and \$15 million under its \$165 million budget, which has been repaid to the federal Treasury with interest from the sale of its power. Today, the dam is financially self-sustaining and cranks out enough kilowatt hours of electricity annually for 1.3 million people—some 62 years after it went into operation.

Gazing at this behemoth of modern technology, a testament to human ingenuity and determination, I felt especially proud. I believe the same spirit of cooperation and ingenuity that went into building Hoover Dam can be—and actually is routinely—harnessed today for the common good.

Which brings me to this week's issue of *Chemical & Engineering News*. I urge you to read the candid and captivating interview with John C. Topping Jr., president of the Climate Institute, a leading international nongovernmental organization focused largely on policy and scientific aspects of climate change. Topping is a "bridge builder," bringing together scientists and policymakers as well as developed and developing countries to gain common ground on the subject of climate change.

Topping makes me glad I am living now. His is a voice of reason, common sense, and sagacity in a debate too strident and riddled with hyperbole. He does not look for villains, nor does he think solutions are easy. But he believes that solutions are possible, and that government "has to be creative in helping to catalyze profitable investments and seeing that its actions don't inhibit them." People in the U.S. government who work on climate-change issues should pay attention to Topping. He's the kind of person who could build a dam in record time.

Madeleine Jacobs
Editor

Views expressed on this page are those of the author and not necessarily those of ACS

environment

NEW APPROACH FOR GREENHOUSE TALKS

Climate Institute's John Topping sees green energy revolution as long-term solution to global climate change

John C. Topping Jr. is the president of the Climate Institute, a leading international nongovernmental organization focused largely on policy and scientific aspects of climate change. The Washington, D.C.-based institute, which has an annual budget of just under \$1 million, is supported about equally by the U.S. government, foreign governments, and international institutions and foundations.

Topping, 54, founded the institute in 1986 "to create a real sense that we're all in the same boat—a global climate system that is interconnected." Rapid climate change is likely to be disruptive to everybody, whether they live in the U.S., Japan, or Brazil, he explains.

To aid in this effort, the Climate Institute has tried to build bridges—bridges between scientists and policymakers and bridges between developed and developing countries. For example, to better inform policymakers about the science of global warming, the institute organized the first North American conference on the subject in 1987.

And to raise awareness of climate change in developing countries, the institute conducted studies of the potential implications of global warming for nine key developing nations, using experts in those countries. In these efforts, the institute was doing what are called "country studies," which are now performed by the U.S. government. These assess a nation's current greenhouse gas emissions, and some project what its emissions are likely to be at various times in the next century.

The Sri Lanka study, completed in 1994, projected that energy-sector emissions there would rise 30-fold by 2070. "It was then that I realized that traditional regulatory approaches would not do nearly enough to control the burgeoning emissions likely in developing countries," Topping says.

The institute has also organized briefings on impacts of climate change in 22

different developing countries using local experts.

In 1990, the institute convened industrial and environmental leaders to develop the main elements of a framework convention on climate change. This was used as a model for the framework convention adopted at the Earth Summit in Rio de Janeiro in 1992.

Now, as time is running out before the December meeting in Kyoto, Japan, at which nations plan to sign a climate protocol, arguments over what to do about global warming have reached a crescendo.

do. Recently, Topping says, the institute has put a great deal of effort into promoting the idea of a green energy revolution—a major move to renewable energy and energy efficiency measures—as a common ground among these competing claims. "This would be a much faster and surer way to reduce carbon dioxide emissions than traditional regulatory approaches," he says. It is an approach that the U.S. Senate, developing countries, and most industrialized countries could accept, he says, and it is the only long-term way to get the drastic emission reductions required for climate protection.

Before he started the Climate Institute, Topping spent three years as staff director of the Office of Air & Radiation at the Environmental Protection Agency. And before that, he was involved in public-policy-related work on urban strategies, revitalization of cities, and minority business issues. He did his undergraduate work in international relations at Dartmouth College and has a law degree from Yale University. He was interviewed by C&EN Senior Editor Bette Hileman.

Why are countries having so much trouble agreeing on what greenhouse emission reductions to propose in Kyoto?

The big problem we have in the international negotiations right now is that each country comes at the global warming problem very much from its own historical perspective. Australia and the U.S. both have large per capita emissions resulting in part from very sizable industrial investments in fossil fuel. So both countries, feeling they must protect their fossil fuel industries to some extent, are reluctant to make large cuts in per capita emissions. Japan's per capita emissions are already much lower than those in the U.S. because Japan is much more energy efficient. From its standpoint, a per capita limit might be very fair. And many of the developing countries—China, for example, where per capita emissions are one-tenth of those in the U.S., and Bangladesh, where they are one-fiftieth—would



Photos by David Henson

probably happily sign on to a per capita emissions limit at the U.S. level today. But that would mean a 10-fold increase in emissions in China and a 50-fold increase in Bangladesh. These different perspectives cause a huge amount of maneuvering over the question of where the right national emission allocations might be.

Suppose the developed countries—by some fluke—could agree in Kyoto on, say, a 10% emissions reduction by 2010. Would this create problems?

There is a real risk that such an agreement would create a kind of emissions entitlement setup that freezes the system. If we are going to stabilize concentrations in the atmosphere, which is the goal of the climate convention, this will require far, far more than the stabilization of emissions. It will require roughly a 60% reduction in emissions worldwide. What that probably translates to, given the need to work out some kind of equitable arrangement between countries of very disparate per capita levels, would be that countries in the Organization for Economic Cooperation & Development (OECD) would ultimately be required to have something in the neighborhood of an 85% reduction from current levels.

That is not about to happen through a traditional command-and-control regulatory system. The negotiations right now are considering something that is largely command-and-control. Such a mechanism can be fairly effective in dealing with modest reductions of 10 to 20%. But for something really radical, it's rare that command-and-control is effective.

Do you see any other risks in signing an emissions reduction protocol?

Actually, there are two. One risk is that a protocol will be so weak it won't do anything to drive decisions. The second is that even though the protocol is weak, it will not be ratified by the U.S. Senate because it won't involve commitments from the developing countries as required by the Byrd resolution in the Senate. As a result, the Administration might end up signing the protocol, but wouldn't be able to do anything with it for the next few years, while other countries would not reduce emissions either, because they'd be waiting for the U.S.—the biggest single greenhouse polluter in the world—to act.

The practical effect would be that the whole process would freeze for four or five years. So there would be a huge amount of spinning by the fossil fuel lobbies, a lot of emotion generated, a lot of



dust kicked in the air. A piece of paper, a protocol, could become the enemy of emission reductions.

The Administration needs to realize that it's not the piece of paper that is important. What's important is bringing greenhouse emissions under control and getting a process which is self-sustaining in the South [developing countries] as well as the North [industrialized countries].

Then, should negotiators in Kyoto give up on the idea of pushing for mandatory cutbacks on emissions?

We should not be pushing for mandatory emission limits. We should be pushing for actual reductions. It will be easier to get a consensus among the OECD countries and the developing countries on practical common cooperative measures that can drive down the price of green energy. If Third World countries perceive that the emission control approaches taken are going to be very expensive and slow down their development, then it's going to be very hard for them to enter into any kind of agreement. A strategy that works is going to have to be one that has its own very positive economic feedbacks, one that extends opportunity rather than slowing it down.

How would driving down the price of green energy—that is, renewable energy sources and efficiency measures—benefit developing nations?

Developing countries are facing the imperatives of industrialization and poverty alleviation. That's where a conscious effort to extend electricity to the 2 billion people off the electric grid mostly in rural areas of the developing world through decentralized energy forms—

largely solar, wind, and biomass—has remarkable potential.

It could have tremendous positive feedbacks. We've seen the urban populations in developing countries grow from 285 million in 1950 to 1.4 billion in 1990. And the projections are that by 2025, the cities of the developing world will have 4 billion people. What a tripling of the population means for the Mexico Cities of the world is just staggering. This is probably the single largest environmental problem today.

But if there is a green energy transformation, and electricity from renewable sources is extended to people in rural areas, they would have less incentive to move to extraordinarily crowded, polluted cities. It may make a huge difference if rather than 4 billion, there are 3 billion people in the cities of the developing world by 2025. That's much much more manageable.

What would you say is the bottom-line requirement for emission reductions to occur?

Reductions are going to occur worldwide only if green energy becomes cheaper than dirty energy derived from fossil fuels. If the adopted policy does not recognize that from the start, we're in the position where it is going to be like King Canute trying to sweep back the tide because there isn't enough money available through the international community to substantially buy down emissions—to pay a premium for renewable energy. If green energy consistently costs a lot more than other energy, there will be a pittance to buy down something here or there, and the tides will keep rolling in. But if green energy is cheaper, we will have a self-enforcing system. Then a United Nations force or other verification mechanism would not be required to keep the Chinese from burning 3 billion or 4 billion tons of coal a year.

Given the staggering problems of setting up a verification system for something so pervasive as greenhouse emissions and all the concerns with national sovereignty, it's far far more likely that we will succeed in producing this technological transformation than in having the world commit to a system of universal emission limits.

Have major transformations of the sort you are talking about happened at other times in U.S. history?

When you look at what we are facing in the climate area, the closest analogy for what we need to accomplish is the information revolution. In 1951, when Univac

environment

came out as the first commercial large-scale computer, its price in current terms was in the range of several million dollars. Effectively, a team of Ph.D.s was needed to run it. Yet today, a family can purchase a laptop computer for one-thousandth the effective price of Univac in 1951. And a junior high school student can perform far more calculations on the laptop than ever could have been accomplished on Univac. This has happened because of a tremendous revolution in the computer industry that was substantially market driven and aided by a certain amount of government investment.

Are we beginning to see some of the same movements in renewable energy that we saw in the early days of the information revolution?

Yes. In the case of wind energy, prices have dropped dramatically over the past few years. Some projects are now coming on at a wholesale price of about 4.5 cents per kWh. [This is close to the U.S. average wholesale price of electricity.] Prices for photovoltaic electricity on grid are also coming down quickly. It does not take a huge leap of imagination to envision a time when countries around the world—in both the North and South—may be powered by a combination of some fairly decentralized renewables and large-scale on-grid applications. Solar roofing is probably going to be the biggest immediate breakthrough.

What you are finding right now is that one largely fossil fuel company in the U.S., Houston-based Enron, is diversifying its investment portfolio significantly. Enron purchased Tehachapi, Calif.-based Zond, which is a well-established wind energy company. It is involved in a 100-MW wind project in Minnesota as well as one in Iowa with about half that capacity. Enron has also purchased a 50% interest—Amoco purchased the other half—in Solar-ex, a solar firm based in Frederick, Md.

In addition, British Petroleum recently announced that it deems climate change something that should be addressed internationally and also by BP through its own actions. BP is now the fourth largest solar company in the world with slightly less than 10% of the solar production.

What about renewable energy in developing countries?

Of all the large developing countries, India has the most aggressive interest in renewable energy. The state of Tamil Nadu in southern India has now become second to California in wind energy capacity, and it



is hoping to become the world leader in this area. Biomass and solar are making strong incursions into other parts of India.

Are energy transformations happening in the transportation sector?

Yes. Daimler-Benz, for example, has gotten very interested in hydrogen fuel cells. It purchased a major interest in Ballard Power Systems, Vancouver, British Columbia, which is a leader in that field. There are some indications that Daimler-Benz will be producing vehicles powered by hydrogen fuel cells on a large scale by 2002.

What's happening here is that while the diplomats dither and the countries all circle in different directions, some visionaries in the corporate community are making major changes. The reason I tend to be an optimist is that Ken Lay, chief executive officer of Enron; John Browne, head of BP; the executives at Daimler-Benz; and people like Stan Ovshinsky, who founded Troy, Mich.-based Energy Conversion Devices, do recognize that future energy systems are going to be very different from current ones. These revolutionaries are playing in the energy area somewhat the role that Steve Jobs and Bill Gates played in the computer area.

You'll find eventually that the fossil fuel equivalents of IBM, the major oil companies, will change significantly. What the public process can do, including the climate negotiations, is encourage governments to play a constructive role in reinforcing a revolution that is already under way.

So what do you think governments should do in Kyoto?

They should focus the dialogue on reach-

ing common agreements on increased investments in and promotion of green energy. This is something that the U.S. could buy into as well as developing countries.

What is the attitude of the developing countries now?

They were promised much at the Earth Summit in Rio de Janeiro over five years ago. At that largest gathering of heads of government in human history, leaders of the industrialized world pledged greatly increased aid for environment in developing countries. However, since then, virtually all the industrialized countries except Japan have cut back significantly on their aid. This has created a lack of trust between the North and the South.

Also, the developing countries don't want to get locked into something that is going to hammer them down while the industrialized countries have the luxury of being able to put their wastes into the common atmosphere in order to sustain development. Developing countries know they can't industrialize without increasing emissions unless alternative energy systems are available.

Do the developing countries feel left out of the climate discussions?

They feel they're almost not at the table at all in this whole discussion. Although they are reluctant to get hammered under some sort of an emissions freeze that could put them way way behind where the industrialized countries are in per capita emissions, they have a real interest in limiting greenhouse gases. But nobody has ever come to them with anything other than a handful of joint implementation projects.

Given all that, and given the huge disparity between per capita emissions in the developing and industrialized worlds, it is just completely unrealistic to believe that the developing countries are going to buy into some kind of an emissions limit at their current levels.

On the other hand, if we focus this dialogue on reaching common agreement on increased investments in clean energy, some of the developing countries will be the first ones to come on board and that will get the emission reductions.

What steps can OECD governments take to help the developing world control emissions?

One practical thing we can do is start taking programs in energy efficiency to various cities around the world. The U.S. has

some remarkable mechanisms. The Environmental Protection Agency and the Department of Energy have been working closely with the private sector and have developed the Green Lights program and now the Energy Star program. Energy Star has found ways of producing fax machines and all sorts of office equipment that use much less energy. These programs can be self-financed, and they would yield benefits to the local economies in the Third World. If we combine that effort with an aggressive effort to develop both off-grid and larger scale on-grid renewable energy projects in countries in both the South and North, the prices of green energy will plummet and the availability of energy will increase.

What measures could the U.S. government take to control emissions here?

In the near term, utility restructuring could have the biggest effect on our greenhouse emissions. We could give consum-

How about action in the transportation sector?

We need to find a way to move our transportation system toward some major alternatives to gasoline. This could be the hydrogen fuel cell. It could be a major potential breakthrough in electricity, if some of the solar breakthroughs continue. It could be hybrid combinations—vehicles powered by a combination of batteries and engines.

Do you think there is a danger that foreign companies will outcompete U.S. firms in renewable energy and revolutionary fuel-efficient vehicles?

There is a danger. A few years back, the U.S. produced the bulk of the world's wind energy. Now we produce about 30%. The U.S., through some investments over the past couple of decades, has played a huge role in the development of efficiency technologies and renewable applications. But right now, European and Japanese companies are making most

of the new investments in these areas and have purchased a lot of the U.S. firms. What should be recognized is that the renewable energy industry is potentially as significant as the electronics and computer industry. If major U.S. energy companies step aside on this, they are going to play a largely diminished role in the future.

But I'm hopeful that other U.S. companies will follow Enron's path. Major oil companies should recognize that they have to make these investments in renewables. Once they start doing that, they bring huge levels of sophistication. They bring the financing resources, they bring the marketing mechanisms, all the things that are going to be necessary if this energy transformation is to happen. If the large oil companies start investing in renewables, they can speed up the transformation by a decade or so.

And since we don't know what level of greenhouse gases will produce major disruptions in the climate system, if we can make large reductions in emissions a decade sooner, we not only will improve living standards around the world, but we will stay further away from catastrophic climatic changes.

Should nations use taxes to encourage reductions in greenhouse emissions?

Where it is accepted within the political

system, some countries can use taxes effectively. The British have done this, other countries in Europe have certainly done this. In the U.S. and the developing world, it is unlikely that taxes are going to play a large role.

Given the popular resistance to taxes in the U.S., the only way you can begin to start talking about major energy taxes is as part of some profound tax restructuring that involves a kind of left-right compact—where payroll taxes are essentially dropped, perhaps in order to increase job generation, and replaced with some kind of an energy-plus-consumption tax. But the problems associated with this are so difficult, we will much sooner see government cooperation with business in spurring investments in green energy.

How can governments spur business investments in green energy?

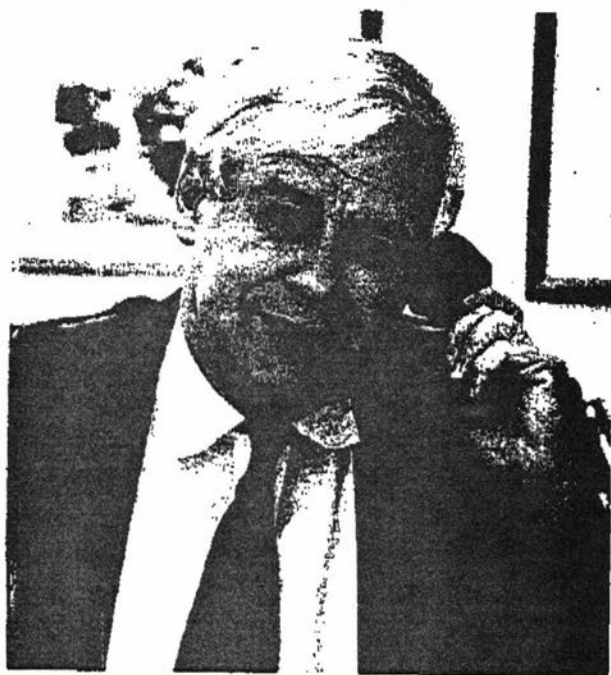
The President could meet with top corporate leaders in this area, invite them to the White House. He could invite the people who developed the cleaner cars, giving major publicity to them. He could convene other combinations of executives to encourage wind or solar energy.

President Clinton, Japan's Prime Minister [Ryutaro] Hashimoto, and Germany's Chancellor [Helmut] Kohl might pull together the CEOs of the large automobile companies for a day or two. They might consider what governments can do to encourage the development of vehicles that do not have major destructive effects on the environment.

In addition, the President could sit down with the heads of the World Bank, various regional development banks, and Brian Atwood, director of the U.S. Agency for International Development, and look at what can be done for solar energy. He could convene meetings with top leaders of China or India to look at how these countries could cooperate to bring in renewable energy. My sense is that this sort of hands-on activity by the President would really send a signal.

If you were a member of the White House Climate Change Task Force, what would you do?

The OECD countries have averaged about \$8 billion a year, closer to \$7 billion now, in direct government investment in energy R&D. Less than 10% of that has been for renewables and less than 10% for energy-use efficiency. Over the next five years, I would have the Administration, together with Congress,



ers some real voice by setting up a system in which they can choose to pay a modest premium to increase the proportion of renewables by their particular utility. Some incentives of this sort could be built into the restructuring legislation.

Right now, we have a huge potential for doing this. There is a technological revolution under way. There is strong public support. Polls, including those conducted by the utilities, have indicated a certain willingness to pay a premium for renewables.

environment

make renewables and efficiency the bulk of our energy R&D investment.

But at the same time, I would use the G-7 meetings [of the U.S., Canada, Japan, France, Britain, Germany, and Italy, plus Russia] to work with other industrialized countries to produce similar changes in R&D funding. The OECD countries should agree that part of their energy R&D should be focused on applications for India and China. Then, I would move to see that the DOE labs work aggressively with organizations in developing countries to try to make green technologies available. I would try to make the million solar roofs initiative announced in Clinton's speech at the UN actually happen.

If the White House focused on using Kyoto as a benchmark to show that we really are trying to bring about a green energy transformation, it could build some trust in the developing countries.

What do you think will actually come out of Kyoto?

Maybe sometime in the future there will be enough trust between North and South and between Europe and North America so an effective, written, legally binding agreement can be put together. But right now, the best written agreement that could be negotiated in Kyoto would be a fairly weak protocol that would almost certainly be rejected by the U.S. Senate, would involve no commitments by the developing countries, and would involve no incentives for the developing countries to do anything.

That is a far worse situation than one in which you don't necessarily have a legally binding written document, but you have a whole series of commitments by governments to show they are doing something. This would send a signal to the corporate sector that governments are serious about emissions reductions.

Do you see any movement in that direction? Do you think that governments might do anything like that?

We at the institute are hoping to see that change in the next several months. We're trying to talk to various folk. We believe there is a real risk of a train wreck in Kyoto. A train wreck is a situation where nothing creative is announced, there is a breakdown in negotiations and finger-pointing and recriminations for four or five years.

The more constructive path I described would require a lot more creativity by the various parties involved. But it's very doable.

Should governments encourage expansion of nuclear power to help cut emissions?

You have to take that country by country. In the U.S., we haven't had a single new start in almost two decades. The reason is you can't make nuclear power cost competitive given the 10 years it takes to build a plant. Because a substantial part of the U.S. public has profound problems with nuclear power and because we have a very litigious system, it's hard to imagine that a project can be fast-tracked here in less than 10 years.

There are countries where nuclear power can perhaps be made cost competitive. Although it has some disadvantages, it may be preferable to large-scale investment in fossil fuel facilities. So the global mix of energy systems is going to involve some significant role for nuclear power in those countries where it is politically acceptable. In China and Korea and some other countries, nuclear power production may well be expanded.

What do you predict will happen with nuclear power 30 or 40 years from now?

Over the longer haul, I doubt it can be cost competitive. One of its big limitations is that the cost of building the required safety systems creates a kind of floor under the cost. It's not unlikely that in the future solar and wind will come in at 1 or 2 cents per kWh. I don't see the same thing being possible with nuclear.

What lessons do you think governments can take from the Montreal Protocol on Substances That Deplete the Ozone Layer and apply to climate change?

In this area, if there is a lesson, it's really that success in efforts to control greenhouse emissions will require a government-private partnership in which much of the heavy lifting will be borne by the private sector. To implement the Montreal protocol, people like Steve Andersen [a director in EPA's Stratospheric Protection Division] and some in the Air Force worked very effectively with industry to bring on chlorofluorocarbon substitutes in a very short time. The process allowed industry to feel comfortable that it could make this transition without major disruption. Companies continued to make money selling substitute products, and consumers didn't see major glitches.

In our efforts to control climate change, we need to recognize that private companies are not charities. Government has to be creative in helping to catalyze profitable investments and seeing that its actions don't inhibit them.

Do you think that we are already experiencing disrupted climate from greenhouse warming?

I tend to think so. Whether catastrophic changes in climate have already begun or whether it's something much more modest is less clear. Tom Karl, a senior scientist at the National Climatic Data Center of the National Oceanic & Atmospheric Administration, has analyzed a lot of data in the U.S. that suggest what we've seen has been some increase in extreme rainfall events. Climate data over the last generation or two suggest that we're seeing some of the fingerprints of climate change already. And there is pretty solid evidence that heavy rainstorms and blizzards may become more common over the next several generations. It also seems plausible that we will see more intense hurricanes. There are some scientists who predict that. There are others whose research suggests the pattern may go in a different direction.

Would you agree with analyses of the re-insurance industry that show the numbers of catastrophic weather events increasing around the world?

In terms of severe weather, such as droughts and floods, there are more catastrophic events. The water cycle seems to be more volatile.

Do you think Earth has entered into a period of instability in which past climate will no longer be a prologue of the future?

I don't know, but it certainly could happen if greenhouse warming progresses. If we start looking at what we know of past climate, humanity has essentially grown up during a time of fairly benign climate. The past 10,000 years have been a remarkably stable period. But if you look at climate data for the past 250,000 years, they show some very abrupt changes. It is possible that it doesn't take that much to get out of a stable zone. There is a certain amount of evidence from the interglacial Eemian period between about 115,000 and 135,000 years ago that there were very marked changes over decadal time periods. When Earth began to warm, up 2°C from where it is now, as it entered the Eemian period, it experienced very sharp upward and downward movements in temperature. It is possible that Earth may enter into another period of instability. This makes it even more urgent to transform energy systems to control emissions. ◀

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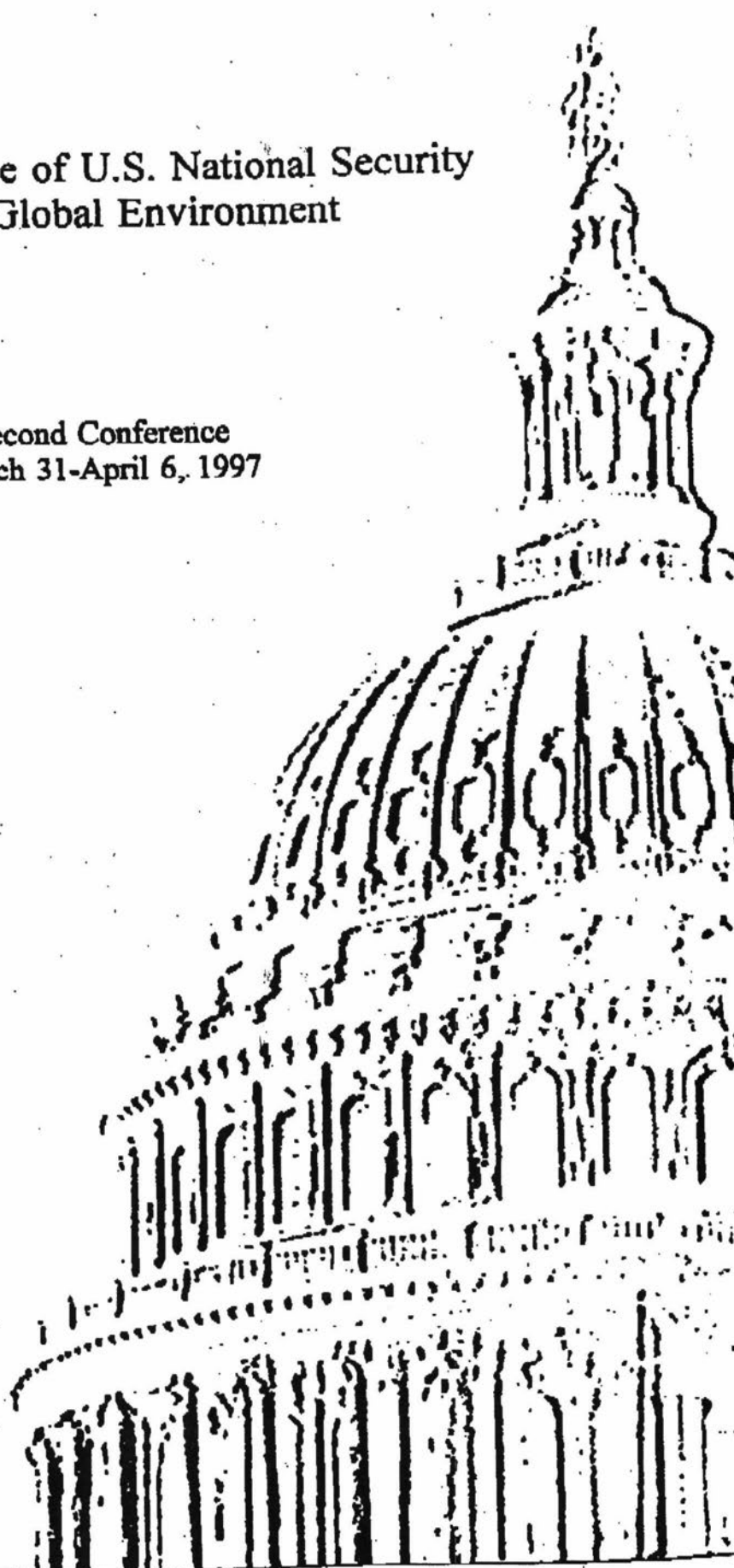
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Catalyzing Green Energy Development: A Way Out of the Looming Climate Negotiations Impasse?

John C. Topping, Jr., J.D.

President, Climate Institute

As the Third Conference of the Parties of the Framework Convention on Climate Change (COP3) slated for December 1-10, 1997 in Kyoto, Japan approaches, the heady optimism of the June, 1992 Rio Conference has dissipated. There is a strong risk that the international negotiations process could become unglued. This could occur either through failure to reach consensus among the parties on practical next steps or by the negotiation of a Kyoto Protocol which cannot secure ratification in certain key countries, especially the U.S. and Russia.

The most recent round of climate negotiations, which concluded March 7, 1997 in Bonn hardly suggested that consensus was near. Although the European Union countries proposed an ambitious binding target for industrialized countries of a 15 percent greenhouse emissions reduction by 2010 from 1990 levels, this approach drew a tepid response from other industrialized countries such as the U.S., Japan, and Canada. Australia, a major coal exporter, strongly opposed the EU proposal.

The U.S. proposal advanced January 17, 1997 by the Clinton Administration fared no better. Modeled after the acid rain provisions of the U.S. Clean Air Act Amendments of 1990, the U.S. approach endorsed legally binding targets for industrialized countries at some unspecified proportion presumably below each country's 1990 emission levels. To reduce compliance costs the U.S. proposed that legally binding requirements

be set well in the future, perhaps not beginning before 2010; that countries be allowed to average their annual emissions over periods as long as a decade; that emissions trading be permitted between industrialized countries, and that countries that missed their binding targets be permitted to borrow with interest against future requirements. Having already drawn sharp domestic criticism from U.S. fossil fuel producers and users and the AFL-CIO for committing to legally binding targets, the U.S. approach was attacked by a number of EU countries for failing to specify particular reduction targets or dates. Some environmental groups also assailed the borrowing provisions of the U.S. initiative.

Developing countries also made clear that any emissions agreement that emerged from the December 1997 Kyoto Conference would apply only to industrialized countries. Some fossil fuel producers, most notably Kuwait and Iran, insisted, furthermore, that should industrial countries commit to binding targets that might reduce fossil fuel use, they should also be obligated to compensate fossil fuel producing countries that might lose export earnings.

Given the sharp differences among and within the key industrialized countries, the prospects for consensus at Kyoto are murky at best. Should an emissions protocol or other legally binding instrument nevertheless be signed at Kyoto, this would under U.S. law be deemed a treaty and would require a two thirds affirmative vote of the U.S. Senate.

This paper will attempt to shed some light on the issues underlying the climate negotiations and to suggest that there may be attractive routes for limiting greenhouse emissions which could command broad bipartisan support in the U.S. and also engage developing countries, the source of most future emissions growth. The most effective means of averting large-scale climate change may be not by constructing a global command and control system to regulate greenhouse emissions, but by speeding a green energy revolution in which energy is used much more efficiently and renewables—such as solar, wind, biomass, and hydrogen—are delivered to consumers at prices below those of most fossil fuels.

What are the Stakes in Averting Climate Change?

Developing an effective global effort to stabilize greenhouse emissions and perhaps ultimately atmospheric concentrations depends significantly on understanding the likely timing and manifestation of impacts. Owing to limitations in climate models, and their difficulties in reliably projecting specific impacts at the regional and sub-regional level, some caution must be exercised in making generalizations about impacts.

Some of the most probable and most significant impacts are likely to fall on coastal areas which may experience sea level rise induced-inundation, shoreline erosion, salt water intrusion into fresh water supplies and increased damage from coastal storms. In some small island states such as the Maldives in the Indian Ocean and some South Pacific countries, a rise of only two or three feet might destroy the viability of the entire nation. Larger countries such as Bangladesh, Viet Nam, Indonesia, Philippines, China, and Egypt have millions of people situated in low lying coastal areas, vulnerable river deltas or islands that could be inundated by sea level rise or ravaged by tropical cyclones. Yet, the threat of sea level rise and severe storms is not

merely a phenomenon that will affect the Third World. The Gulf and Atlantic Coasts of the U.S. are especially vulnerable. On average, sea levels have risen about a foot in both of these regions over the past century, with roughly half of this attributable to global sea level rise and the other half to factors such as ground water withdrawal, oil and gas drilling and natural subsidence. With climate warming this rate of sea level rise is likely to increase significantly with local sea level rise in the range of two to three feet probable along the U.S. Gulf and Atlantic Coast. This may translate to a shoreline recession of several hundred feet with loss of many sandy beaches, coastal wetlands, and some coastal development. Probably the two most vulnerable states to this threat are Louisiana, where entire coastal parishes may disappear into the Gulf of Mexico, and Florida whose fresh water supply may face intrusion of salt water as sea levels rise. Other coastal areas threatened with significant shoreline loss include Massachusetts' Cape Cod and the Carolina Coast. Although scientists disagree on whether super hurricanes such as Gilbert, Hugo, and Andrew will become more frequent as global temperatures rise, the insurance and reinsurance industries have begun to examine this possibility. At a minimum, it is clear that storm surge, the source of much death and destruction in hurricanes, will be a greater problem as seas rise.

From a U.S. standpoint, perhaps the other greatest threat posed by climate change is a possible greater fluctuation in the hydrological cycle with both droughts and floods becoming more frequent. In 1992 a group of atmospheric scientists at Australia's Commonwealth Scientific and Industrial Research Organization (CSIRO) projected such trends. Modeling likely changes for Australia, Western Europe, India, and the Midwestern U.S. under warmer temperatures (around 2070) they projected more days of intense rainfall in all places with the number of days of an inch or more of rain roughly doubling in the U.S. Midwest. With higher rates of evaporation associated with higher temperatures, soil moisture may de-

crease in many regions, despite the increased incidence of occasional heavy rainfall.

In assessing the impact of climate change on humanity either in the U.S. or elsewhere it is important to recognize that climate change is only one of a number of human-induced stresses. A growing population translates to more people thirsting for a finite water supply, intensified agricultural use as topsoils wash to the sea, and frequent overharvesting of fish stocks. Technological advances may allow many industrialized countries such as the U.S. to accommodate to such changes, but developing countries buffeted by population growth, diminished topsoil, reduced per capita water availability and climate change may prove less resilient. One spillover of this to industrial countries may be a large increase in so-called environmental refugees, individuals forced to flee their homelands owing to a breakdown in environmental carrying capacity. The potential for a flood of environmental refugees may be especially acute for the U.S. Current climate models suggest that Mexico may be one of the countries most adversely affected by climate change with crop production possibly falling drastically in Northern Mexico. Continuing stresses on the land in Haiti and Central America and hurricane-induced damage to smaller Caribbean islands may trigger periodic large and rapid movement of desperate peoples to U.S. shores.

Two crucial factors in limiting adverse impacts are the rate of change and the overall magnitude of the warming. Fragile ecosystems, such as coral reefs, coastal wetlands and forests are especially vulnerable to rapid change. They are likely to be imperiled by any global temperature rise above 0.1°C per decade, the low end of the anticipated warming. Agriculture is believed to be somewhat more adaptable to rapid rates of change, but should global temperatures rise more than 2.0°C , overall crop yields may suffer significantly. In fashioning an effective response to climate change humanity may need to limit greenhouse emissions significantly enough to hold the rate of warming to

manageable levels and ultimately halt the warming by stabilizing concentrations of greenhouse gases such as carbon dioxide, methane, and nitrous oxide.

Considerations in Stabilizing Global Concentrations of Greenhouse Gases

Halting of the absolute rise in global average temperatures will ultimately require a stabilization of global atmospheric concentrations of greenhouse gases. Even then temperatures are likely to rise for one or two generations due to the large momentum in the climate system. The oceans act as a buffer delaying the heating of the atmosphere. Yet these delayed effects will eventually be realized in higher atmospheric temperatures, even should concentrations be stabilized. It is estimated that human activity to date, especially fossil fuel burning and deforestation, has banked about 1°C of still unrealized warming. Moreover, each year, atmospheric concentrations rise as greenhouse emissions far exceed the ability of sinks, e.g. the upper layers of the ocean, the soil and vegetation, to store them. Stabilization of concentrations of the most significant of the greenhouse gases produced by human activity—carbon dioxide—would require reductions of about sixty percent in the current global annual emissions rate. Yet carbon dioxide emissions are still rising in most industrialized countries and are rising at a much more rapid rate in most developing countries.

These trends pose major intergenerational issues and some issues of international equity. Barring a climate surprise, e.g. a sudden change in ocean circulation or entry into an era of wild fluctuations in regional temperature, it is possible that industrial countries may experience only modest and generally manageable adverse impacts of climate change during the lifetimes of current policymakers. Yet, during this same period, developing countries which have had much lower per capita emission rates, may already be experiencing sizable disruption—drought induced famines, evacuation of many coastal settlements, and

large-scale loss of life from floods and coastal storms.

Yet, even should a fairly rosy climate scenario prevail in industrialized countries during the lifetimes of today's decisionmakers, the adverse consequences may be much greater for their children and grandchildren, who will experience the brunt of the currently banked unrealized greenhouse warming and some further warming resulting from current emission trends. During the lifetime of the children or grandchildren of many participating in this conference, global temperatures are likely to be well past anything experienced since the beginning of human civilization. Risks which today seem fairly remote—shifts in ocean circulation affecting currents such as the Gulf Stream or partial disintegration of the Antarctic ice sheets—could pose a real threat to many of those who have not yet reached voting age. Moreover, due to the huge momentum in the climate system, future generations may, despite their technological sophistication, be hamstrung in reversing these disruptions.

Governmental institutions have not had a great history of rising to intergenerational challenges. Such concerns have often been better addressed by religious institutions that have sometimes taken the long view; the classic case being the construction of a cathedral which may span several lifetimes. Success of an effort to stabilize global concentrations of greenhouse gases may require a similar level of dedication and imagination. Perhaps unprecedented in its scope, such an effort, spanning several generations, will be undertaken during a time of profound political and technological change.

During this time throughout the world it is likely that the power of national governments will continue to erode with power devolving to regional and local governments, to multinational corporations, or even to transnational non-governmental organizations, e.g. Greenpeace and the International Red Cross, and international media organizations such as Time Warner, ABC, Disney and the Murdoch empire. This likely devolution of power seems especially true in

China, the country today most likely to be cited as a bastion of centralized state power. Year by year power ebbs in Beijing with the economically vibrant coastal provinces gaining more and more say over their economic destiny. Even in the unlikely event that the government in Beijing would agree this year to a future national emissions target, one can hardly be sanguine about its ability to enforce its writ ten years from now on energy decisions in Guangdong Province.

Just as the command and control apparatus is weakening in China, the likely greatest source of greenhouse emissions in the 21st century, other rapidly growing developing countries seem even less disposed to submit to any form of command and control regulation whether its objective be to limit local air or water pollution or to protect the global environment. Even if sovereignty concerns over energy policy can be addressed, such countries have often had a dismal track record in ensuring compliance with the environmental laws they have on the books.

In the face of these trends, a traditional command and control approach to limiting greenhouse emissions may be grossly ineffective, much like King Canute trying to roll back the tide. It may also prove counterproductive, rigidifying the climate negotiations into legalistic formulations and causing major energy producers to spend their resources on fighting controls rather than undertaking fundamental innovations. The enormity of the task in stabilizing greenhouse concentrations—one which will require about a sixty percent reduction below current emission levels worldwide and perhaps an eighty percent reduction in current OECD countries—underscores the inadequacies of a traditional regulatory approach.

An alternative to such an approach would be concerted international effort to catalyze rapid development and application of greenhouse benign energy technologies, especially renewables and end-use efficiency. Through a series of public private partnerships and a fundamental reorientation of government investment and lending for energy purposes this strategy would seek, over the medium term, to

drive the price of "green energy" below the price of most conventional fossil fuels. A possible model for this effort is the information revolution. Today, at about one tenth of one percent of the cost of a team of Ph.Ds working on Univac, one of the first commercial computers, a junior high school student can perform more sophisticated analysis on a home computer.

Background to the Rio Climate Treaty

The largest gathering of heads of government in human history, the United Nations Conference on Environment and Development, (UNCED) was held in June, 1992 in Rio de Janeiro, Brazil. Over 150 countries signed a climate treaty which sought to address an emerging environmental challenge. Article 2 of the Rio climate treaty states:

The ultimate objective of this Convention and any related legal instruments that the Conference of the Parties may adopt is to achieve, in accordance with the relevant provisions of the Convention, stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system. Such a level should be achieved within a time-frame sufficient to allow ecosystems to adapt naturally to climate change, to ensure that food production is not threatened and to enable economic development to proceed in a sustainable manner.

Aside from setting up a structure for ongoing negotiations, for communication of information among parties and for monitoring of progress, the Framework Convention on Climate Change set out certain broad principles and commitments, the most significant of which was for developed countries who were parties to the treaty to seek to return their greenhouse emissions to year 1990 levels. Although the Rio climate treaty lacked the binding targets and tough enforcement provisions favored by many environmental groups, some small island nations and several European countries, it had been negotiated in the diplomatic equivalent of warp speed.

The 1990 Intergovernmental Panel on Climate Change (IPCC) Assessment, which pro-

vided the undergirding for the Rio treaty, concluded that by the end of the 21st century humanity could experience a rise in global average temperatures of 1.5-4.5°C (2.4-8.1°F) and experience a rise of global sea levels of about one to three feet. Stabilization of concentrations of greenhouse gases in the atmosphere would, the IPCC report indicated, require a reduction of about 60 percent in global annual emissions of greenhouse gases such as carbon dioxide. From both a technological and an economic standpoint the IPCC analysis indicated such reductions were not currently feasible. Indeed, the much less ambitious goal of stabilizing global greenhouse emissions, a circumstance under which global greenhouse concentrations would still mount, was a daunting task.

Recognizing these difficulties and the divergent views among the potential parties to the climate treaty, the Framework Convention adopted an even more modest goal. Developed country parties (largely OECD and former Eastern Bloc countries) were loosely committed to stabilizing greenhouse emissions at 1990 levels by the year 2000. The Framework Convention, however, provides no sanctions for failing to achieve these objectives. These commitments remain, for all practical purposes, voluntary undertakings. Developing countries whose per capita emissions are generally much lower than those of the industrialized countries face requirements only to report emissions. As a mild inducement for developing countries to limit greenhouse emissions the Framework Convention commits developed countries who are parties to the treaty to "provide new and additional financing resources to meet the agreed full costs by developing country Parties" in analyzing their emissions and to "meet the full agreed incremental costs" of implementing emissions limitation measures.

Developments Since the Rio Conference

The scientific consensus has solidified considerably since the Rio Earth Summit. In its Second Assessment Report adopted in late 1995 with the input of about 2500 scientists, the

IPCC concluded that "the balance of evidence suggests that there is a discernible human influence on global climate."

By coincidence, 1995 also proved to have the warmest average global temperature of any year in the past century during which we have had worldwide temperature records.

At the same time that temperature records and scientific consensus are converging to establish that climate change is a near term threat that may already be affecting humanity and ecosystems, current international strategies for limiting greenhouse emissions seem to be falling abysmally short.

With two notable exceptions, United Kingdom and Germany, virtually all large OECD countries seem likely to fail by year 2000 in returning their greenhouse emissions to 1990 levels. Although both countries have diligently built greenhouse emissions considerations into energy and transportation policy, each has also benefited from particular national factors. In Britain the Tory Government, having no obligation to the coal unions, has been able to realize large scale economic savings and greenhouse emission reductions by substituting plentiful North Sea natural gas for coal. Germany has cut its greenhouse emissions in part by reducing large scale energy inefficiencies in the former East Germany.

Like most other OECD countries, the U.S. seems likely to miss its goal of bringing total annual greenhouse emissions to 1990 levels by the year 2000. The core of the U.S. effort has been some voluntary initiatives such as EPA's Green Lights and other energy efficiency programs and DOE's Climate Change Challenge partnership with the electric utility industry. U.S. shortcomings in meeting emission stabilization goals have been attributed to a variety of factors—a reduction in real costs of fossil fuel energy, continued increases in vehicle miles traveled and underfunding of the administrative costs of the voluntary programs. Somewhat similar explanations appear to underlie the difficulties of other industrial countries in meeting emissions stabilization objectives.

Meanwhile, greenhouse emissions are grow-

ing at a rapid rate in most developing countries. Roughly two billion people lack access to electricity. Governments are scrambling to extend the electric grid, with annual increases in electricity use growing as much as 8 percent annually in Asia. Rapid increases are also occurring in motor vehicle use, with the great majority of these vehicles, except in Brazil, powered by fossil fuel.

A Long Term Strategy to Catalyze Green Energy Development

Stabilization of atmospheric concentrations of greenhouse gases, a central objective of the Framework Convention on Climate Change, will require a much more imaginative strategy than any currently in play in the climate negotiations. Such a strategy would simultaneously engage countries from North and South and would reorient governmental policy to speed development largely by the private sector of applications of inexpensive greenhouse benign energy, especially end-use efficiency, solar photovoltaics, wind, biomass, and hydrogen.

Like the information revolution that has reshaped our lives, this transformation of global energy use would be largely market driven. Once fully functioning it would be self executing—China would not let its coal burning rise to three billion tons a year because cheaper, cleaner fuel would be available rather than due to fear of economic sanctions. At first glance, seemingly utopian, this approach may be more likely to achieve large scale global emissions reductions and involvement of key countries such as China or India than would a traditional regulatory regime. Moreover, rather than requiring new resources, change may be effectuated largely through a reorientation of existing governmental resources—the roughly eight billion dollars of annual OECD country government investment in energy R&D, the billions of dollars of loans, investments, and grants made each year by multilateral and bilateral development assistance agencies, and direct purchases by governments for their own purposes (buildings, vehicles, and energy)—and the launching at the highest levels of international public private partnerships.

All of these measures can be accomplished by executive action coupled with requisite majority Congressional support for annual appropriations or other implementing legislation. They do not require treaty ratification. They can also go a long way towards cost-effective implementation of any new emissions agreement that may emerge from Kyoto COP3 and receive the required U.S. Senate ratification. The strategy envisioned below builds on the green energy partnership approach endorsed by the 1995 Manila Asia Pacific Leaders Conference convened by Philippine President Fidel Ramos. Current U.S. voluntary initiatives such as EPA's Green Lights Program and DOE's Climate Challenge partnership with the electric utility industry, and a variety of creative financing and market pull initiatives of groups including The Rockefeller Foundation, Greenpeace, and the Edison Electric Institute. Although success of these initiatives will require sustained U.S. Presidential level leadership and involvement, it will also require the engagement of heads of government of the other G-7 countries, leaders of developing countries such as China, India, and South Africa, and chief executives of multilateral banks, international automotive manufacturers, multinational energy firms, leading investment banking firms, and major foundations concerned with environment and development.

Reorientation of OECD country government investment in energy R&D so that within a few years the bulk of this investment is directed towards end-use efficiency and renewables.

For the past decade and a half direct OECD government funding of energy R&D has averaged about eight billion dollars annually with only about ten percent going to renewables and a similar proportion to end-use efficiency. The bulk of this funding has gone to large-scale nuclear and fossil projects. In a single year the OECD spent as much on nuclear and fossil R&D as has been spent on photovoltaics (PVs) since research into PVs began more than 40 years ago. (Although greenhouse benign, nuclear power is cost competitive only in a handful of countries

and certainly not in the U.S.) Moreover, even should modest advances occur in nuclear or fossil plants, these advances would be unlikely to yield much benefit to the nearly two billion people who today lack electricity, most of whom live in rural areas of developing countries.

With very modest R&D funding, wind energy became a cost-competitive commercial energy option with electricity costs dropping 50 percent during this period. In California, wind is now available at some places at about 4.5 cents a kilowatt hour, well below average national U.S. electricity costs. The cost of electricity from photovoltaics has been cut by a factor of ten over a sixteen year period. Already cost competitive for off-grid applications, PV is approaching commercial competitiveness for on-grid applications with major projects by Solarex, an Enron-Amoco joint venture, nearing completion in Nevada and India. The Nevada project will deliver about 100 megawatts of electricity at about 5.5 cents a kilowatt hour.

As the host of the June, 1997 G-7 Economic Summit in Denver, President Clinton is ideally positioned to nudge the heads of government of the G-7 to commit to a reorientation of their energy R&D investment to focus more on end-use efficiency and renewables. Moreover, such an initiative would appear to have a good chance of commanding bipartisan support in the Congress. Indeed, one of the most significant developments in an often polarized 104th Congress was the emergence of a genuinely bipartisan and ideologically diverse Renewable Energy Caucus, a group which succeeded in floor amendments to restore funding for renewable energy programs.

Reorientation of multilateral and bilateral energy financing programs to focus significantly on end-use efficiency and renewables, especially applications in remote site rural areas of developing countries.

Only a tiny fraction of the energy investment of major multilateral agencies including the World Bank, the Asian Development Bank, and the Inter-American Development Bank has

gone to renewables such as PV, wind or biomass. Their energy portfolio has been dominated by large-scale fossil projects, often serving major urban areas. Such projects largely validate already well established technologies and do little to bring down the unit price of delivered power. Such projects can, when economically feasible, obtain financing in the private capital market. Some critics question whether multilateral institutions should be investing in such projects when so many in rural areas of developing countries lack access to electricity. Aside from bureaucratic inertia of the banks and host country fixation on large-scale projects, a major obstacle to development bank financing of off-grid renewables has been the high transaction cost associated with generally small-scale projects. With support from The Rockefeller Foundation some promising intermediary institutions, e.g. E&Co and REM Capital Corporation, have arisen and the multilateral banks now seem to be taking renewable development seriously. Both through its vote on particular multilateral projects and its informal influence, the U.S. Government can strongly reinforce this trend.

Applying the lessons learned in U.S. voluntary energy efficiency programs to developing countries and former Soviet Bloc nations.

Among the most successful of all the programs in the history of the U.S. EPA are the so-called Green Programs to improve lighting and energy efficiency in buildings and other facilities and spur voluntary improvements in areas such as computers and office equipment. Some related DOE programs have shown similar high energy efficiency gains for very little public investment. These programs have resulted in excellent applications software which can enable building managers to assess potential efficiency savings and design of programs with very quick payback from energy savings. With minor adaptations, such software could be used widely in developing countries experiencing explosive increases in annual electricity use in major urban areas.

Using public private partnerships to seize niche markets in industrialized countries for renewable technologies.

Examples of such partnerships include:

- The Utility PhotoVoltaic Group effort in which the electric utility industry and U.S. DOE are working to launch PV demonstration projects in the U.S.
- The Oxford Solar Investment Summit Process spearheaded by Greenpeace activist Jeremy Leggett. This effort seeks to kindle interest among major insurance companies and other financial institutions in PV investments and to obtain electricity consumer commitments for PV projects. Among those that have provided pledges to buy PV power are Greenpeace members and senior citizens' homes.
- The Solar Roofing initiative emanating from the September 1996 Washington Summit on Protection of the World's Climate. Solar roofing shingles were identified as the renewable technology with the greatest near-term potential for mass penetration into the U.S. consumer market. At a rate of just over 10,000 installations a year on home roofs these shingles could produce electricity at just over six cents a kilowatt hour. To speed this entry of solar roofing to the consumer market the Climate Institute, in cooperation with some religious, university, and solar groups, is seeking to launch an initiative to spur installation of solar roofing on college facilities and religious institutions. Such institutions not only share an environmental ethic and are highly visible, they also have a base of regular givers who will periodically consider capital gifts without diminishing annual giving.

Convening Summits of senior officials of government and industry to speed green energy development.

In recognition of the international nature of the energy and transportation markets these meetings may need to involve heads of govern-

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New Approach for Greenhouse Talks

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