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SECTION OF ENVIRONMENT ENERGY AND RESOURCES

Energy Committees Newsletter

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NOTE FROM THE EDITOR

Joseph Siegel
Vice Chair, Publications
Renewable Energy Resources Committee

This is the second of two issues on the subject of emerging connections between energy and environmental goals. The first issue was published in October 2005 and can be found at www.abanet.org/environ/committees/energy/newsletter. In the current issue, we are fortunate to have four articles on a broad array of topics. The first article, by Dominick Graziano, addresses carbon capture and storage technology as a means to reduce greenhouse gas emissions. The second article, by Michael Zimmer, examines green buildings and the energy, cost and environmental benefits of sustainable building design. The third article, by Matthew Kuryla and Thomas Jackson, addresses the potential for wind power to provide abundant energy with minimal environmental impact. The final article, by Alan Miller, addresses efforts by the Global Environment Facility to stimulate greenhouse gas technology transfer to developing nations.

An important development on the intersection of energy and environmental goals has recently been initiated by the Renewable Energy Resources Committee. The committee has announced a project on Renewable Portfolio Standards (RPS) and is seeking participants to assist in the project. In order to help mold individual State RPS programs into an effective national driver for renewables development, the committee has identified a roadmap with three dimensions: (1) finance—linkage to effective trading markets; (2) technology—compatibility with emerging regional generation attributes systems; and (3) environment—discernible correlation to existing and proposed environmental trading systems. The committee's three vice chairs for these respective areas (Leonard Hochschild, David South and Tom Kerr) are jointly developing a succinct guide to legal principles applicable to achieving this goal, drawing on actual experiences throughout the country. You are invited to join The RPS Project by directly contacting the committee chair, Roger Feldman (r.feldman@bingham.com).

COMMITTEE NEWS

Renewable Energy Resources

The Renewable Energy Resources Committee continues its monthly teleconference series as follows:

Jan. 18, 2006 *"Legal and Policy Issues Leading to the Commercialization of Hydrogen Fuel Cell Technology"*
The panel will offer far-reaching thoughts on the emerging legal issues that will arise or present barriers to the commercialization of hydrogen technology near term and over the longer term, including: the Energy Policy Act of 2005, and current thinking on energy

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On behalf of the energy committees, Joseph Siegel was editor of this issue. The other Energy Committee newsletter vice chairs are Jay Hickey, Richard Roos-Collins, Peter Mostow, Bill Burton, Lauren McGregor and Marla Mansfield.

In this issue:

This newsletter is a publication of the ABA Section of Environment, Energy, and Resources, and reports on the activities of the committee. All persons interested in joining the Section or one of its committees should contact the Section of Environment, Energy, and Resources, American Bar Association, 321 N. Clark St., Chicago, IL 60610.

policy or regulation leading to or creating barriers to commercialization; safety issues; environmental, emissions, land use and society concerns; private/public procurement, leasing and contractual issues; insurance and liability issues, financing issues, tax credits and other subsidies. To register log onto http://store.mountainmedia.com/ceepinc/calendar.cfm?do=detail&d=3191&c=4943&p=33497.

Feb. 15, 2006 *"Solar Energy: Ready for Market "*
A discussion by a panel of experts will provide a technical update, a review of solar incentives and the capacity for and economic feasibility of solar in the United States, and an analysis of successful state strategies to promote the development of solar energy. To register log onto http://store.mountainmedia.com/ceepinc/calendar.cfm?do=detail&d=3191&c=4943&p=34111.

March 15, 2006 (tentative date) *"How FERC Looks at Renewable and Distributed Electricity Resources"* http://store.mountainmedia.com/ceepinc/calendar.cfm?do=detail&d=3191&c=4943&p=32168.

April 19, 2006 *"Renewables in the International Area: Kyoto and Beyond"*
http://store.mountainmedia.com/ceepinc/calendar.cfm?do=detail&d=3191&c=4943&p=34148

The Renewable Energy Resources Committee has recently announced a project on Renewable Portfolio Standards and is seeking interested participants to assist in the effort. See Editor's note, above, for details.

CARBON CAPTURE AND STORAGE— A VIABLE TECHNOLOGY FOR THE ABATEMENT OF GREENHOUSE GAS EMISSIONS?

Dominick J. Graziano

In 1742, when Benjamin Franklin invented the Franklin Stove (which provided more heat while burning less fuel than other fire places), the concentration of CO_2 in the atmosphere was approximately 290 parts per million (ppm). By 1960, the concentration of CO_2 in the Earth's atmosphere had risen to 315 ppm, it increased to 350 ppm by 1988 and is 370 ppm today. *See*, SPENCER WEART, THE DISCOVERY OF GLOBAL WARMING 203 (Harvard 2004). We are currently increasing the concentration of CO_2 in the atmosphere at a rate of about 2 ppm per year. Some scientific reports suggest that we must prevent atmospheric CO_2 concentrations from reaching 450 ppm if we are to avoid "catastrophic" climate impacts.

Despite dire warnings from scientists and a steady stream of scientific reports detailing the potential global impacts from continued climate change caused by the buildup of greenhouse gases (GHGs), the use of carbon emitting fossil fuels is likely to continue well into the future, and is likely to rise along with the growing economies of India and China. *See*, The "Assessment Reports" issued by the United Nations Intergovernmental Panel on Climate Change (IPPC) available at www.ipcc.ch; and reports issued by the Pew Center on Global Climate Change, available at www.pewclimate.org. Recently, periodicals as varied as Foreign Affairs, Scientific American, and The Financial Times have published articles discussing the feasibility of carbon capture and storage (CCS) as a possible bridge technology while the world weans itself off of fossil fuels and towards renewable sources of energy. FOREIGN AFF., Nov./Dec. 2004; SCI. AM., July 2005; FIN. TIMES, Aug. 23, 2005.

On Sept. 25, 2005, the IPCC, which is made up of over 2000 experts from over 100 countries, issued its long awaited "Summary Special Report on Carbon Dioxide Capture and Storage" (Special Report), available at www.ipcc.ch. At the time of this writing, only the "summary report for policy makers" was available for review. Nonetheless, it outlines critical issues associated with implementing CCS technology, including economic costs, safety and environmental risks, its potential for ameliorating climate change and related issues.

The Special Report defines CCS as "a process consisting of separation of CO_2 from industrial and energy related sources, transport to a storage location, and long term isolation from the atmosphere." It affirms CCS as a viable GHG mitigation option that could be implemented along with energy efficiency improvements, the use of less carbon intensive fuels, increased use of nuclear power, renewable energy sources, and creating and nurturing biological sinks. It also acknowledges that widespread adoption of CCS will depend upon technological maturity and cost, as well as its overall potential for diffusion and transfer to developing countries.

The Special Report underscores the IPCC's Third Assessment Report's (TAR) acknowledgement that effective reduction of GHGs must be approached with the understanding that until the middle of this century the primary source of energy will continue to be fossil fuels. CCS can serve as a "bridge" to the future while use of renewable energy sources, coupled with increased energy efficiency, is encouraged along with reduced reliance on the use of fossil fuels. *See*, Socolow, *Can You Bury Global Warming?*, SCI. AM., July 2005.

It is estimated that as much as 40 percent of CO_2 emissions in the United States can be attributable to large point sources. This makes CCS especially important in the reduction of GHGs since it is primarily applicable to large stationary sources. These facilities include large fossil fuel or biomass energy facilities, natural gas production, synthetic fuel plants and fossil fuel based hydrogen plants. One of the critical issues in implementing CCS is determining whether the locations of these large stationary sources are near potential GHG repositories. The Special Report outlines several storage methods, including storage in geological formations, such as oil and gas fields, unminable coal beds, deep saline formations, ocean

storage (including direct release into the water column or onto the deep ocean sea floor) and industrial fixation of CO_2 into inorganic carbonates.

According to the IPCC, technology currently available is capable of capturing about 85-95 percent of the CO_2 processed in a capture plant. However, capturing carbon requires approximately 10-40 percent more energy than a plant with equivalent output that does not capture carbon. The majority of this additional energy is needed for capture and compression. Thus, the net result is 80-90 percent reduction in CO_2 emissions as compared to a power plant not using CCS technology.

There are several different types of CCS technologies currently available, including post combustion capture, precombustion capture and oxyfuel combustion capture. According to the Special Report, all of these are economically feasible under most circumstances.

Transportation mechanisms for captured CO_2 include pipelines for large amounts and trucking facilities for smaller amounts, or ships for overseas disposal destinations. Ideally, the CO_2 would be captured and stored in repositories close to the generating facilities, thus reducing additional energy costs and GHG emissions.

Currently, there are three industrial scale CCS facilities in the world, one in Norway, another in Canada and one in Algeria. The Norway facility has been in use since 1996, resulting in approximately one million tons of CO_2 being stored annually from the offshore gas field, Sleipner West. This project has resulted in the capture of 2 percent of Norway's total GHG emissions. This project offers a real world example on the application and efficacy of carbon capture and storage in geologic formations. To date, there have been no signs of leakage from the Sleipner repository.

According to the Special Report, CO_2 can be injected into saline formations or oil or gas fields at depths below 800 meters, resulting in physical and geochemical trapping mechanisms (a cap rock), preventing migration to the surface. Other possible geological repositories include coal bed storage at shallower depths, which relies upon CO_2 being absorbed by the surrounding coal. One of the potential drawbacks of this repository is the inherent permeability of the coal bed.

The Special Report notes, and it is important to point out, that CO_2 storage could be used along with enhanced oil recovery (EOR), a longstanding oil field technology. EOR involves the injection of CO_2 into petroleum beds which forces the oil to the surface. Appropriate technology could be used to then cap or secure the CO_2 once its efficacy has been exhausted.

Another possible technology involves injecting and dissolving CO_2 into the hot water column of the ocean through a fixed pipeline or moving ship. Another option would be depositing CO_2 through a fixed pipeline, or an offshore platform, to the seafloor at depths below 3,000 meters. According to the Special Report, CO_2 would form a "lake" thus delaying the CO_2's dissolution into the surrounding environment. This type of disposal offers certain legal impediments, such as international treaties, and the technology is far behind other available technology due to insufficient research and practical application. *See*, McGuire, Surviving Armageddon— Solutions for a Threatened Planet Ch. 4 (Oxford University Press 2005), for a discussion on deep ocean disposal and other innovative technologies for dealing with GHGs.

The most viable and effective use of CCS would be for large point sources that are near major industrial and urban areas. The Special Report notes that by 2050, as much as 40 percent of global fossil fuel CO_2 emissions could be captured, including 30-60 percent of electricity generation and 30-40 percent of industrial CO_2 emissions. Unfortunately, there is still limited information regarding whether these sources are near potential storage sites. Proximity to repositories is a key economic ingredient for large scale implementation of CCS in the power generating industry.

The Special Report also contains an analysis of the costs for CCS. Based upon 2002 conditions, the IPCC estimates that adoption of CCS would result in one to five cents per kilowatt hour of increased electricity generation costs. The Special Report is careful to note that these costs depend on the fuel and

the specific technology in use, as well as the location of the facility. These costs can be reduced where benefits such as EOR are implemented along with the CCS system. One of the key missing ingredients in determining these costs is the possible effect of government incentives for implementing CCS systems. CCS costs could be reduced based upon research and technological developments and economies of scale, but the Special Report does not specifically address government incentives. The Special Report also does not address the possibility of implementing a broad based carbon trading system in conjunction with CCS, which could also be a factor in reducing costs.

The Special Report notes that the lack of a clear legal framework and public acceptance is likely to result in CCS having a lower economic potential than other mitigation options. According to the Special Report, the health, safety and environmental risks associated with CCS are expected to be similar to, or lower than, those currently posed by hydrocarbon pipelines. While a sudden and large release of CO_2 might present significant risks to human health and safety, the likelihood of these events is low based on past experience. Moreover, siting facilities would likely take into account large population areas to reduce these risks even further. Drawing on the experience of hydrocarbon storage and transport would serve as a good knowledge base for developing CCS systems with reduced risks to human health and the environment. Thus, the IPCC concludes that a properly selected and managed geological repository will likely result in a retention factor exceeding 99 percent for over 100 years, and 99 percent over 1,000 years.

The promise of CCS is unlikely to be realized on a significant scale until a legal and regulatory framework in the United States, as well as other countries, is adopted. There are statutory and regulatory analogues in the United States such as the Underground Injection Control Program (UIC) that could be modified to incorporate CCS, and allow for permitting such facilities. Now that the Special Report has been issued, it is up to governments to consider the potential offered by CCS in reducing GHGs.

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SMART BUILDINGS: CAPTURING THE OPPORTUNITIES FOR ENERGY SAVINGS IN COMMERCIAL REAL ESTATE

Michael J. Zimmer

Introduction

In the United States, commercial real estate as an industry is an enormous consumer of energy using more energy in that sector than any other country in the world, except for China. Commercial properties include office buildings, university campuses, shopping malls, retail establishments, apartment buildings, hospitals, museums, theaters, restaurants and more. Almost 40 percent of U.S. energy and 70 percent of all U.S. electricity is consumed in commercial property. At a time of rising energy prices and shrinking profit margins for property holders as interest rates rise and the real estate market cools, property owners need to examine ways of lowering their electricity expenditures. In 2002, the 4.8 million commercial and government buildings spent $26 billion on energy. Current national commercial electricity prices average more than $2.00 per square foot per year annually and can approach $2.50 per square foot in capacity constrained areas like Boston, New York, California and southwestern Connecticut.

National energy legislation (H.R.6) enacted on Aug. 8, 2005, recognizes the important challenge of finding ways to lower electricity and fuel expenditures. For the first time energy efficiency and sustainability provisions almost equal the fossil fuel and electricity supply provisions of national energy policy. Though traditionally viewed as a fixed cost, electricity expenditures can be managed and reduced in a number of ways. Some of these include:

- Smart or green buildings to take advantage of energy efficient building techniques;
- Efficient use of power—lighting, insulation and other energy efficiency equipment and efficient operations and maintenance (O&M) practices;
- Real-time metering and pricing to focus energy usage to off-peak hours;
- Cogeneration or distributed generation; and
- Load aggregation or aggregation of energy commodities.

Smart or Green Buildings

Smart buildings or green buildings use resources such as energy, water and design materials more efficiently than buildings just built to minimum code standards. This strategy not only creates a more environmentally sustainable building, but also adds significant value to the commercial property. With rising energy rates, green buildings offer a form of demand-side management and lowered operating life-cycle costs that reduces energy expenditures and costs. This result reduces congestion in load pockets in more dense urban settings, thereby lowering prices for the entire electricity grid and creating residual value in the building for capture at resale or refinancing. A modest capital investment of 2-3 percent of the total construction or renovation cost can reduce operating costs on a life cycle basis. On average, green buildings use 30 percent less energy than conventional buildings. This cost reduction effectively raises the net overall income (NOI) and cap rate of the building and underlying value of the property. There is also a branding value associated with the public's perception that the building's owners are sensitive to the environment for the tenants or residents.

Efficient Use of Power and O&M Practices

There are numerous ways to save energy by using efficient lighting; heating, ventilating and air conditioning (HVAC) systems; automatic controls; windows; and other efficient materials, as well as using power efficiently. It is important to contract with property managers or asset managers who understand energy savings issues and how to operate and maintain buildings efficiently. New design requirements in The EPACT of 2005 (H.R.6) for commercial and government buildings will only accelerate that process with new commercial tax incentives that can reach $1.80 per square foot. U.S. Green Building Council LEED (Leadership in Energy and Environmental Design) certification is supporting that transition, but the approval process is detailed and complex. Some commercial users are considering bulk plant submissions or master plans for new designs seeking volume certifications from LEED. This will need to be weighed with maintaining the integrity of the highly rated LEED certification process.

Real-time Pricing

There are peak and non-peak times of day for energy use and purchase. Energy is much more expensive during peak hours than non-peak hours. Therefore, *when* energy is consumed is often as important, or more important, than *how much* is used. Under normal circumstances, energy users pay a price that is the daily average price without regard to peak or off-peak periods. However, if energy usage could be altered to take advantage of the delta between peak and off-peak prices, the savings could be substantial for building owners. Knowledge of state regulations, utility tariffs, contracting and finance are implicated.

Real-time pricing uses advanced metering technology to record when energy is used and price such energy according to the relevant peak or off-peak rate. Utility rates are structured whereby there are significant pricing incentives associated with using power during off-peak hours. Real-time metering can be utilized in conjunction with cogeneration to arbitrage the time-of-use market by using the electricity produced by the cogeneration unit during peak hours and purchasing power off the grid during off-peak hours. This strategy, known as peak shaving, is one of many that can be employed, and will be reviewed nationwide by state public service commissions over the next 18 months because of provisions in H.R.6.

Cogeneration

Distributed generation or cogeneration—by contracting with an outside provider, an end user can install on-site

generation powered by natural gas or fuel oil. Operating an on-site generator can allow a building owner or operator to obtain significant savings off of standard rates (due to the elimination of the transmission and delivery components of electricity prices) and reduce exposure to blackouts or sabotage. The contract can be structured as a purchase or a lease, depending on the disposition strategy of the property owner or manager. Structuring the contract as a lease has the advantage of eliminating any capital expenditures as the price of leasing the generator is financed through a portion of the energy savings. The advantage of purchasing a generation unit is that the unit, once paid off, offers greater savings in the long term. Form of contracting, financing, state and federal energy regulation, risk management and allocation, and environmental regulation are essential to succeed.

Aggregation

Load aggregation is the joining together of energy users to form a purchasing group to achieve energy cost savings, usually in the form of a wholesale price rather than a retail price. Examples include residents of a building organizing into a purchasing entity to amalgamate their load into a single purchase under a utility's commercial tariff, rather than individual residential purchase or an asset manager buying for a suite of properties rather than separately for each individual building. In order to succeed, there must be individual meters in each unit as well as a master meter so that the proper amount of energy may be purchased in a block and then distributed to the individual units. One caveat: if a property owner or manager is using load aggregation to arbitrage electricity prices by purchasing power in bulk and reselling it to individual tenants or residents, care must be taken to structure such a transaction. The owner or manager does not want to create a retail sale under state law and, thus, subject itself to state commission regulation as a public utility.

Conclusion

The most important steps that can be taken to foster the development of energy efficiency and cost savings in commercial real estate are:

- *Educating* the industry on where value in energy management can be added. The new energy legislation will accelerate that process;
- *Recognizing* that, in addition to smart building, there are many ways to save money on energy management, including load aggregation, real-time pricing, on-site generation and efficient energy operation and maintenance practices and capital projects. Contracting, rates, tariffs and regulatory knowledge are critical to success;
- *Understandin*g that, in a world of escalating energy costs, saving energy in commercial property is not just about environmental altruism; it lowers life cycle operating costs, reduces emissions and it is good business;
- *Recognizing* that energy management requirements will become the next ADA-like obligation imposed upon commercial buildings; and could be integrated with shifts in construction, climate change management, tax assessments, appraisals and insurance underwriting in the real estate industry; and
- *Retaining* good energy counsel or consultants—this is the best way to take advantage of existing and developing energy management opportunities. This step is also critical to managing risks, supporting proper transaction structuring, and effective operating results while securing the best commercial terms in contracting to achieve commercial and financial goals.

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WIND ENERGY: AT THE CONFLUENCE OF ENVIRONMENTAL AND ENERGY POLICY

Matthew L. Kuryla
Thomas C. Jackson

For many years, advocates of greater environmental protection have supported increased investment in renewable energy resources as a way of limiting the impacts on the environment that are often associated with energy facilities that rely on fossil fuels. At the same time, in the post-9/11 world renewable energy has been touted as part of the long-term solution to enhancing the nation's energy security; by increasing the amount of energy produced from renewable resources, the United States will be less dependent on foreign sources of oil and natural gas. Thus, despite the decision of Congress not to adopt specific targets for renewable energy sources as part of the recently enacted Energy Policy Act of 2005, renewable energy today is often viewed as advancing both environmental and energy security goals. Consistent with this view, Congress has provided incentives for a wide range of renewable energy sources, including wind energy, solar power, hydropower, geothermal energy and biofuels. At a time of rapidly rising energy prices in the wake of Hurricanes Katrina and Rita and forecasts for sticker shock on home heating bills this winter, Congress will undoubtedly feel pressure to provide even greater incentives for the production of renewable energy.

One form of renewable energy that has received particular attention in recent years has been wind energy, which has been the fastest-growing segment of energy generation worldwide over the last 15 years. Numerous "wind farms" have been built across the United States and more projects are in the planning and design stages. According to the Government Accountability Office (GAO), at the end of 2004 the total generating capacity of wind energy in the United States stood at 6,740 megawatts—enough to satisfy the energy requirements of 1.5 to 2.0 million average American households. GAO, Wind Power: Impacts on Wildlife and Government Responsibilities for Regulating Development and Protecting Wildlife (Sept. 2005). Over 4,200 megawatts of this capacity was added between 2000 and 2004, resulting in a doubling of the nation's capacity during that short period. Projects representing over 2,000 megawatts of additional capacity from wind energy projects are currently under construction or in the permitting and entitlement stage. Wind energy facilities currently in operation are found throughout the country and proposals have been made to site facilities in offshore areas.

According to advocates of wind energy, these facilities have minimal impact on the environment, making wind power a "green" technology. These proponents of wind power state that wind energy facility operations do not produce air pollutant emissions or discharges of water pollutants and do not result in the generation of hazardous waste. They claim that wind energy helps prevent global warming by avoiding the carbon dioxide emissions associated with other forms of energy generation and reduces health care costs by eliminating emissions of particulates that are often associated with respiratory problems such as asthma. These aspects of wind energy have led some prominent environmental groups to support specific wind power projects and increased reliance on wind energy nationwide.

Like other forms of renewable energy, wind energy can serve to advance other national policies as well. Because wind energy—like other renewable energy sources—is derived from an inexhaustible domestic resource, wind energy has been viewed as a way to reduce U.S. dependence on foreign oil and promote the nation's energy security. Moreover, because wind farms are predominantly found in rural areas, wind energy is seen as a way to boost rural economies by providing farmers and other rural landowners with a new "cash crop" in the form of wind turbines that can provide annual royalty payments to landowners.

The advantages of wind power have led Congress to provide continued incentives for the generation of wind energy, including financial subsidies that help to offset the higher costs of producing electricity through wind turbines. For example, the recently enacted Energy Policy Act of 2005 includes a provision extending the Production Tax Credit for wind energy through the end of 2007, a move that is expected to encourage the financing of new wind farms. The act also resolved

one of the key issues that had created uncertainty for offshore wind farms by authorizing the secretary of the Interior to lease areas of the Outer Continental Shelf to private entities for wind farm use. The Bush administration is likewise promoting the use of wind energy through the Wind Powering America initiative, which is designed to dramatically boost the use of wind energy in order to increase rural economic development, protect the environment and increase energy security. The Department of Energy (DOE) has stated that "with large untapped wind energy resources throughout the country and declining wind energy costs, the United States is now moving forward into the 21st century with an aggressive initiative to accelerate the progress of wind technology and further reduce its costs, to create new jobs, and to improve environmental quality." DOE's goal is to have five percent of the electricity generated in the United States derived from wind farms by 2020, as compared to the current level of less than one percent.

Thus, wind energy potentially offers a number of advantages and can be viewed as advancing both environmental and energy goals. Indeed, wind energy is in many ways a "win-win." However, it has often been said that there is no such thing as a free lunch, and energy production is no exception, even when it comes to something as seemingly innocuous as the modern version of the windmill. While wind energy would seem to combine the best of the energy and environment worlds, proponents have had to overcome a number of hurdles to gain widespread acceptance of wind energy and issues continue to be raised that these proponents must address.

In addition to concerns about cost-competitiveness and reliability (given the intermittent nature of the wind resource), wind energy has also generated concerns in some quarters because of potential impacts on the environment. Chief among these concerns has been the deaths of birds and bats as a result of collisions with the rotors of wind turbines. Many of the areas (such as ridge tops) that offer the best wind energy potential due to sustained winds serve as "flyways" for migratory birds. A number of incidents have been reported in which significant numbers of dead birds and/or bats have been found in the vicinity of wind turbines, particularly in California. For example, a recent study showed that over 1,000 raptors are killed at wind power facilities in Northern California each year, with the Altamont Pass Wind Resource Area receiving particular scrutiny at a site at which a number of raptors have been killed. Another recent study showed that over 2,000 bats were killed at a wind farm in the mountains of West Virginia over a period of seven months.

Recent evidence suggests that these incidents may be limited to a few areas of the country. In addition, the number of bird kills associated with wind turbines is infinitesimal when compared with those associated with stationary building and vehicle collision. However, as the GAO noted in its recent report, there is still substantial uncertainty regarding the effects of wind turbine operations on birds and bats. Relatively few studies have been conducted to monitor the effects of operating wind farms on bat and bird populations, and until very recently there had been virtually no such studies conducted to assess the potential impacts on bird species of wind farms located in coastal waters. Moreover, there is significant uncertainty regarding the factors—such as topography and turbine spacing and design— that may influence the degree of risk that a particular wind farm poses for birds and bats. While it found that wind power does not appear to be responsible for a significant number of bird deaths nationwide, the GAO has stated that the uncertainties regarding bird and bat interactions with wind turbines are a cause for concern in light of the large-scale expansion of the wind energy industry that is expected in the coming decades. In the short term, these uncertainties are affecting the approval of some proposed projects as federal and state regulators push for site-specific studies to assess potential impacts. For example, the U.S. Fish and Wildlife Service has called for significant additional studies of the potential impacts on avian populations of a proposed offshore wind farm to be located in Nantucket Sound.

Both the regulators and the regulated community have taken steps to address these issues. The Fish and Wildlife Service has prepared voluntary guidelines that are designed to minimize bird and bat deaths through the application of project siting and design

considerations. The Service has also initiated a study in conjunction with the U.S. Geological Survey to study bird migration patterns in order to allow wind farms to be sited in areas that may minimize interactions with birds. For its part, the American Wind Energy Association is co-sponsoring research with the Fish and Wildlife Service and others regarding interactions between bats and wind turbines. Individual project proponents are also conducting studies at a number of individual sites to address site-specific concerns.

In addition to impacts on birds and bats, other concerns have also been raised regarding the impact of wind farms on the environment. These concerns include the aesthetic effects of placing wind turbines in landscapes or seascapes that may otherwise have a very different look and possible impacts on property values. Such concerns are prominent in settings such as Nantucket Sound. In many instances, such "viewshed" issues are the primary reason for opposition to wind farms. Concerns have also been raised in some cases about the noise from wind turbines that may be introduced into rural environments.

In a climate marked by rising concerns over the availability and price of fossil fuels, wind energy appears to offer the potential to let us have our cake and eat it too, providing abundant energy with minimal impacts on the environment. However, this vision remains only partially realized and the wind energy industry will need to continue to address a variety of issues—environmental and otherwise—in order to attain a more prominent place in American's energy future.

COMMERCIALIZING NEW ENERGY TECHNOLOGIES TO REDUCE GHG EMISSIONS IN DEVELOPING COUNTRIES: SOME EXPERIENCE AND LESSONS LEARNED

Alan S. Miller

One of the most pressing challenges to reducing the long term growth of greenhouse gas emissions is the more rapid adoption of modern energy technologies by the developing nations, particularly China and India—the two most populous nations, with rapidly growing economies, abundant quantities of low cost coal and large unmet needs for modern energy services. Without an internationally focused effort on technology transfer, it is likely that these countries will dramatically increase their use of fossil fuels. There is one established international donor funded program focused on accelerating adoption of relevant technologies administered by the Global Environment Facility (GEF). Over the past decade, the GEF has committed in excess of several hundred million dollars—primarily in the form of grants—for fuel cells, concentrating solar power plants and other climate friendly energy technologies. Few of these projects have so far been implemented, but much has been learned and there is some basis for expecting improved results in the future. This article will summarize GEF experience with funding of projects to commercialize new energy technologies and its relevance to recent international climate change deliberations.

Background

According to the most recent projections by the International Energy Agency, in a business-as usual scenario, developing countries' emissions are projected to more than double between 2002 and 2030 (from 8.2 to 18.4 Gt CO_2)—much of this due to combustion of coal and other fossil fuels for electricity. By 2012—the end of the Kyoto Protocol commitment period—the three largest coal producing nations, China, the United States, and India, collectively, plan to build more than 800 new coal plants with combined cumulative emissions exceeding 2.5 billion tons of CO_2. In comparison, the total annual emission reductions required by the Kyoto Protocol are less

than 500 million tons. Yet reducing the rate of growth in developing country emissions confronts the pressing need for increasing energy use to alleviate poverty and promote sustainable development.

This challenge was directly confronted in the G8 Gleneagles Summit this July. In the discussion of climate change, the G8 included representatives from Brazil, China, India, Mexico and South Africa as well as the heads of the International Energy Agency, United Nations, World Bank and the World Trade Organisation. In a statement on climate change, clean energy and sustainable development, the G8 agreed to "work with developing countries to enhance private investment and transfer of technologies, taking into account their own energy needs and priorities." At the concluding press conference, President Bush emphasized the importance of including China and India in order to successfully respond to climate change, noting the opportunity to share new technologies with economic and environmental benefits.

The GEF administers the one significant international effort on commercializing clean energy technologies for greenhouse gas reduction. The GEF is a multilateral donor fund created to help pay for the incremental costs of investments in developing countries that promote global environmental objectives, *e.g.*, the added costs of renewable energy relative to fossil fuels. The GEF serves as the financial mechanism for the conventions on climate change and biodiversity, and also supports activities in support of conventions on ozone depletion, desertification and persistent organic pollutants (POPs). The GEF is not an independent institution and operates by channeling funds through established international organizations, primarily the World Bank (WB), UN Development Programme (UNDP) and UN Environment Programme. (For further information, see www.thegef.org.) For the four-year period ending July 2006, the GEF has $3 billion—much less than these objectives require, but given that funding is available on a grant or highly concessional basis, still quite substantial.

The priorities and eligibility criteria for GEF funding are defined in policies periodically reviewed and revised by its governing body, the GEF Council. One of several programs for reducing greenhouse gas emissions is directed toward commercializing new technologies through investments in projects that promote learning and economies of scale. The focus is on "those technologies that have been proven or demonstrated on a commercial scale but that have not found significant application in recipient countries because of high technology transfer costs, replication costs, or commercial risks associated with the new technologies in new operational environments."

GEF Experience with New Energy Technology Projects

Much of the commitment of GEF funds for new technology commercialization has gone for two technologies—concentrating solar power (CSP) plants and fuel cells. Close to $60 million was proposed for fuel cell bus projects in 5 countries, and almost $200 million for four CSP projects. These projects have struggled to achieve implementation despite the large commitment of grant funds; the majority of the projects most likely will be canceled after five or more years of negotiation. (Status reports are available at the GEF Web site.) Another proposed GEF project would support integrated coal gasification combined cycle (IGCC) in China. This technology has generated considerable interest as it offers the potential for burning coal with greater efficiency and substantially lower emissions of conventional pollutants as well as GHG emissions, and potentially removal and sequestration of carbon to achieve close to zero net emissions. However, the promise of GEF support has so far been insufficient to overcome the myriad obstacles to developing the IGCC project. All the new technology projects were approved as commercialization efforts but arguably most were mainly demonstration programs. Implementation difficulties have been underestimated in past approaches, leading to a let-down on the promise of the GEF in this area, and so far a failure to trigger large scale impacts.

A GEF scientific advisory panel reviewed experience with these projects and concluded that they suffered from several problems related to the large capital investments required, the absence of a supporting policy environment and the lack of a strong local

champion with a substantial commitment to the project. Insufficient response from international technology providers was another common problem. More conventional technologies—or at least those with costs closer to being competitive—are more appealing in the short term as they provide more immediate economic benefit at lower risk. A more general conclusion is that technology commercialization requires much more than grant money, as important as that may be. Two agency reports last year (available at the GEF Web site) expand on this point. In reviewing its experience with fuel cell bus projects, UNDP notes that its projects have identified several features essential for success, including convening disparate parties relevant to the process and facilitating information exchange between countries, private players and other demonstration efforts. A WB review of its experience with CSP projects emphasizes the need for greater linkage to developments within the larger global industry.

While there is merit in closer coordination with development activities in emerging economies, there is also an opportunity for more focused cooperation with private sector innovators. The International Finance Corporation (IFC), the private sector arm within the World Bank Group, has attempted to overcome these challenges through greater emphasis on partnership with private investors. An IFC administered 1 MW grid-connected solar cell project was successfully implemented by a utility in the Philippines, and three stationary fuel cell projects (each about 1 MW) for industrial applications are expected to be awarded by June 2006 and to be fully operational within roughly a year thereafter. A new project approved by the GEF in June 2005 provides $44.5 million for a commercial scale pilot using new technology allowing a substantial increase in power generation from the combustion of sugar cane wastes; the project is structured in two phases such that most of the funding only becomes available if a major private investor and partners with appropriate technological competence are identified.

Conclusion

The recent G8 Gleneagles Communique brought renewed attention to the importance of technology transfer and cooperation with the largest developing countries as a missing element for reducing expected increases in global greenhouse gas emissions. The G8 directed the World Bank and other international financial institutions to work with their client countries to identify appropriate technologies, overcome barriers and provide the financing necessary to make this happen. However, the limited actual experience with GEF projects suggests that while financing is important, even large grants are not necessarily sufficient to bring about major changes in energy technologies.

More attention needs to be given to identifying and engaging credible local champions with a financial stake in project success, ideally forming public-private partnerships that bring together the technical competence and financial resources of international technology providers with the regulatory and economic interests of local authorities and investors. Experience with GEF and other efforts to commercialize new technologies in emerging markets needs to be given greater attention as the basis for much larger efforts essential if the growth in global greenhouse gas emissions is to be curtailed.

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