BRACING FOR AN UNCERTAIN ENERGY FUTURE: RENEWABLE ENERGY AND THE US ELECTRICITY INDUSTRY

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A long-standing critique of the U.S. electricity system is that environmental, social and security costs associated with nuclear and fossil fuel generation are not internalized in electric prices. Commodity electricity (i.e., kWhs) from nuclear and fossil fuel plants appears to be cheaper than generation from cleaner, renewable resources, in part because of these externalized costs. As a result, most utilities may not purchase wind energy, solar energy, or biomass energy unless mandated to do so by law.

In recent years, however, analysts have begun to use a variety of methods to estimate these costs. Some have shown that if risks associated with fossil and nuclear energy systems are reflected in electricity prices, utility investment in renewable energy becomes far more economical (e.g., Awerbuch, 2003). This is because the risk profiles of renewable technologies differ significantly from those of fossil fuel and nuclear plants. In particular, use of renewable energy options generally pose little or no environmental, fuel price or security risks. Renewables can thus be used to diversify existing utility resource portfolios, counterbalance the risks from conventional fuels and minimize price fluctuations and increases (Biewald et al., 2003). In this article, we review several risks associated with conven-

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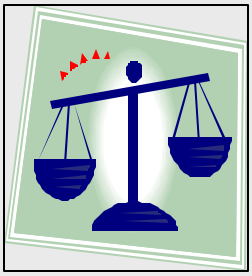

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tional energy, and discuss ways that utilities can use renewable energy as a risk management strategy.

Environmental and Health Risks

Air emissions from fossil fuel generators pose serious threats to both public health and natural ecosystems, while greenhouse gases from the electricity sector threaten to destabilize the climate with catastrophic consequences. As concern over these impacts grows, companies that own or purchase fossil fuels will increasingly face the risk of regulation, litigation, and declining investment. Utilities already face air pollution compliance costs under the Clean Air Act. New regulation, especially for carbon dioxide, could increase compliance costs in the near future. Under the recently ratified Kyoto Protocol, Europe, Canada and Japan plan to reduce greenhouse gases below 1990 levels by 8%, and 6% respectively.

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RISK MANAGEMENT IS FUNDAMENTAL TO THE SUCCESS

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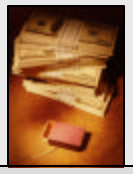

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The US government has rejected the Kyoto Protocol, but regional and state climate change regulation is underway. Oregon, for example, requires new power plants to offset their carbon emissions, while nine northeast states are collaborating to design a greenhouse gas emissions trading system by April 2005 (Pew Center, 2004). Recognizing that climate regulations are inevitable, some companies like Cinergy have called for a national CO_2 cap-and-trade system to provide more regulatory certainty in the near-term (Ball, 2004).

In addition to regulation, companies also face the risk of litigation. Energy companies continue to be sued under the Clean Air Act, and climate change could usher in a new era of costly legal action (Allen & Lord, 2004). Already, eight states and New York City are suing five utilities to reduce CO_2 emissions. A failure to address these environmental risks could also diminish the ability of the electricity industry to secure investment and financing. There is a movement in investment circles towards air pollution and climate risk disclosure. Energy companies that do not properly account for and mitigate environmental risks could face a decline in private investment, shareholder value, and competitiveness (CERES, 2003). To better position themselves in an increasingly dynamic regulatory environment, a number of energy companies are beginning to integrate low- or zero-emissions renewables into their generation portfolios. Renewable energy technologies will re

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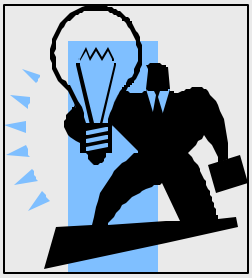

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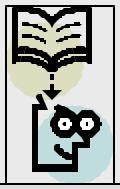

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BRACING FOR AN UNCERTAIN ENERGY FUTURE: RENEWABLE ENERGY AND THE US ELECTRICITY INDUSTRY..CONTD

duce these companies' exposure to mounting environmental and health costs and improve their competitive position in the coming years (Hanson & Ranganathan, 2003).

Some have championed nuclear power as a remedy for the current electricity system's environmental problems (see e.g., National Energy Policy Development Group, 2001). While the operation of nuclear power plants does not release CO_2, a steady stream of long-lived radioactive wastes accompany its use (Schobert, 2002: 387-426). The special difficulty of assessing nuclear power's risks has been shown (e.g., Shrader-Frechette, 1980) and the even greater difficulty of responding to them has been documented (e.g., Byrne and Hoffman, 1996; and Perin, 2004). As a result every country in which nuclear

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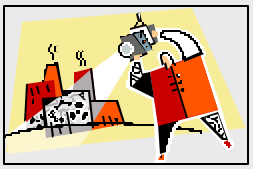

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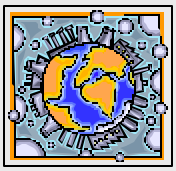

Every country in which nuclear power plants operate has been forced to develop liability exemptions..

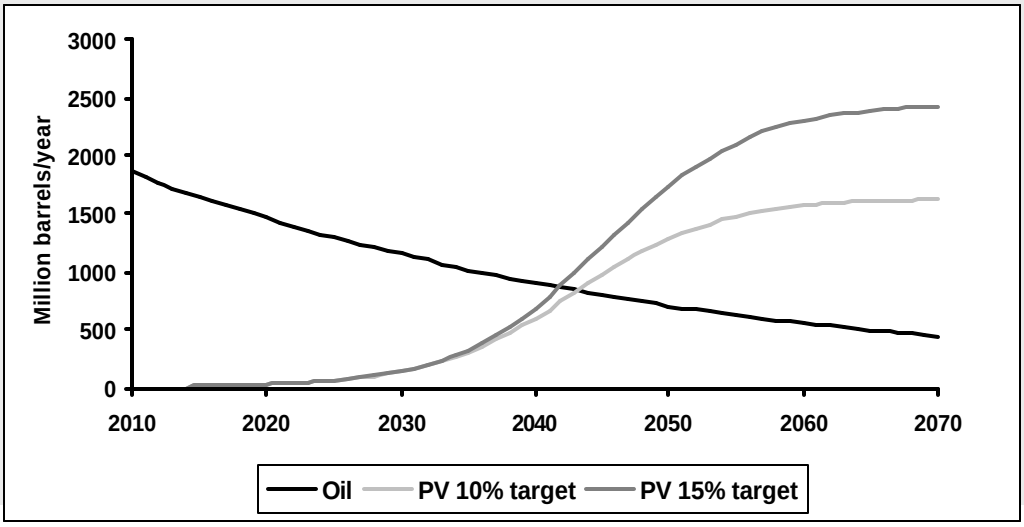

Figure 1. Projections of U.S. Energy Supply from Photovoltaics (PV) and Domestic Oil Reserves. Source: Byrne et al, 2004.

BRACING FOR AN UNCERTAIN ENERGY FUTURE: RENEWABLE ENERGY AND THE US ELECTRICITY INDUSTRY..CONTD

power plants operate has been forced to develop liability exemptions and limits for environmental and health risks associated with this technology's use (Byrne and Hoffman, 1996). Even so, litigation remains a persistent source of challenge to the spread of nuclear power. By contrast, renewable energy companies do not require extraordinary legal protection from the health and environmental consequences of their operations.

Fuel Price Risk

Renewable energy technologies such as wind and solar rely on "free" fuel and purchasers incur only capital and maintenance costs. As a result, these technologies can serve as a direct hedge against fossil fuel price volatility. Natural gas has become a significant concern for the U.S. utility industry as prices spiked to well over $6 per MMBTU in 2004 (EIA, n.d.). The electricity industry is increasingly exposed to natural gas price volatility because most new generation in recent years has been gas-fired, and the amount of electricity generated by gas has increased by 62% since 1997 (Henning et al., 2003). Utilities typically seek to hedge their natural gas investments through the use of financial contracts such as futures and options. Financial contracts, however, offer incomplete protection against sudden price spikes or sustained increases.

Renewable energy resources, on the other hand, provide a more complete physical hedge against natural gas price variation because they are not exposed to the systematic

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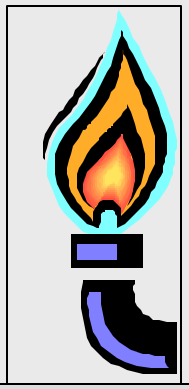

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BRACING FOR AN UNCERTAIN ENERGY FUTURE: RENEWABLE ENERGY AND THE US ELECTRICITY INDUSTRY..CONTD

risks of the fuel markets (Bolinger et al., 2004). Besides serving as a direct hedge against price variability, renewable energy development can also be a source of downward pressure on gas prices by displacing and decreasing peak demand for natural gas generation (Elliott et al., 2003). The National Renewable Energy Laboratory recently concluded that this price reduction effect can be significant, with a price reduction of up to 2% for each 1% of demand displaced (Wiser et al., 2005).

Thus, integrating renewable energy into generation portfolios not only helps utilities control costs, it also can reduce gas prices and lower consumer electricity bills. In recognition of this, several utilities have increased the amount of renewable energy in their portfolios, and now offer fixed-price renewable energy products to their customers (Bird & Cardinal, 2004).

Fuel Supply Risk

The US energy system is heavily reliant on imports to meet current oil and natural gas demand. As a result, the US is vulnerable to disruptions in international trade, as was dramatically illustrated by the oil crises of the 1970s. However, renewable resources are inherently domestic and supply disruptions are typically temporary and local (mainly involving issues of intermittency – see below). More importantly, these risks are not related to the systematic risks associated with the international fuel markets. As a result

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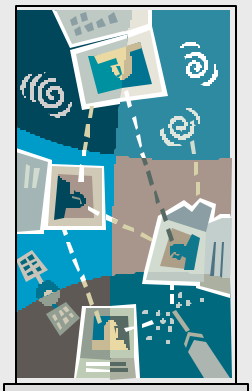

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BRACING FOR AN UNCERTAIN ENERGY FUTURE: RENEWABLE ENERGY AND THE US ELECTRICITY INDUSTRY..CONTD

, renewable resources can be used to balance fossil fuel supply disruptions (Bachrach et al., 2003).

In the longer term, renewable technologies can also hedge against the risk of resource exhaustion. While the world's recoverable fossil fuel resources are expected to decline during this century, installed renewable capacity is projected to grow rapidly. The Center for Energy and Environmental Policy recently projected the growth of solar energy supply in the US and compared it with estimates of domestic oil reserves and use schedules. As can be seen in Figure 1, solar energy's contribution to US primary energy supply is expected to surpass that of domestic oil around 2040 at the latest. With states in the U.S. actively encouraging the development of PV and other renewables (e.g., 19 states and the District of Columbia have passed legislation to require a minimum percentage of electricity generation from solar, wind and other clean energy sources over the next 10-15 years – see DSIRE, n.d.), policy action is supporting the rising role of these energy options as forecasted in Figure 1.

Security Risks

Fossil fuels and nuclear power facilities present a range of security risks, especially ones that can threaten national security. Oil refineries, pipelines for oil and natural gas, and large-scale power plants fired by coal, oil and natural gas are potential terror targets that require public in

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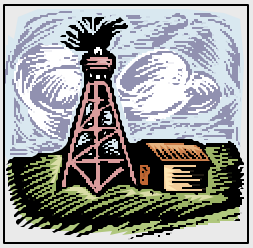

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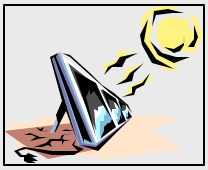

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BRACING FOR AN UNCERTAIN ENERGY FUTURE: RENEWABLE ENERGY AND THE US ELECTRICITY INDUSTRY..CONTD

vestment in specific security precautions as a condition of their use by society (Lovins & Lovins, 1982). Nuclear power plant and waste sites, the uranium enrichment process and the plutonium waste generated by these plants are all potential terror targets and, moreover, create significant risks for nuclear weapons proliferation (Bergeron, 2004). Even research facilities exploring nuclear power options (such as the American energy laboratory system) must be tightly secured to prevent both materials and knowledge from being accessed by terror groups.

Renewable energy sites, the materials used in technologies to harness these sources, and the pursuit of knowledge about improved renewable energy performance are not associated with national security risks. Moreover, because renewable energy is often best utilized by distributed or decentralized technology networks (Lovins et al., 2002; and Byrne et al, 2004), its inclusion in a society's energy portfolio could actually lower national security risks (Lovins & Lovins, 1982).

Outage Risks

One of the principal criticisms of renewable systems is that power is provided intermittently and is not able to meet "dispatchable when needed" criteria (which conventional generators can). Such a comparison tends to ignore the vulnerabilities of centralized generation, while downplaying several important renewable energy design characteristics.

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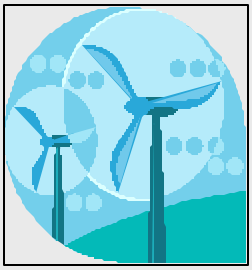

Renewable technologies can be installed quickly

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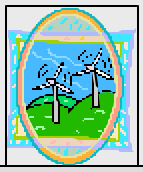

Renewable energy installations tend to be modular, small, and distributed

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Renewable energy installations tend to be modular, small, and distributed. As a result, they avoid the problems associated with large, centralized generation projects. First, renewable technologies can be installed quickly and incrementally, while conventional plants can take years to construct and must be oversized to anticipate future demand. Renewables can be deployed at the same pace that demand grows and can reduce the risks of lengthy construction, overbuilding, and underutilized assets (Hoff & Herig, 1997). Second, the mechanical simplicity and distributed nature of renewable systems makes them less likely to cause large-scale power outages. Renewable energy technologies such as wind and solar power have technical reliabilities between 97-99%, and they can be rapidly repaired in the event of mechanical malfunction. Large conventional generators, by contrast, had an average availability of 85% in the 1990s, and have considerably longer repair periods (Lovins et al., 2002). Furthermore, the failure of a single 1.5 megawatt wind turbine poses a significantly smaller risk to the integrity of the electricity grid than the failure of 1,000 MW coal plant.

In addition to being less prone to technical failure, renewable energy systems can also reduce the risk of widespread grid failure. Solar electric output, for example, corresponds closely to the times of day that electricity demand is at its highest (Perez et al., 1993). Solar panels can therefore

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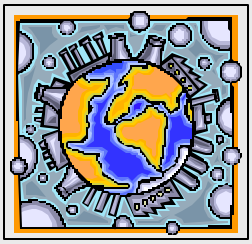

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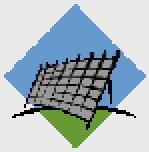

Solar panels can play an important role in shaving peak system demand.

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play an important role in shaving peak system demand, especially when coupled with battery storage (Byrne et al., 1998). A recent study of historical satellite data, for example, concluded the August 2003 US-Canadian blackout could have been prevented if PV systems had been installed in sufficient numbers throughout the affected area (Perez et al., 2004). Additionally, onsite renewable energy systems, coupled with storage, can provide emergency back-up power to risk-averse customers in the event that the grid does fail (Byrne et al., 1997).

The intermittence of some renewable energy systems makes them unsuitable baseload generators, but their modularity, technical reliability, geographic dispersion, and output characteristics contribute to a more resilient electricity system (Lovins et al., 2002). Strategically sited renewables can reduce the risk and damage of power outages, while protecting utility customers from outage costs. In light of these capabilities, it has long been argued that distributed renewable energy resources can improve the resilience of the electricity grid (Lovins & Lovins, 1982).

Conclusion

Given the current uncertainty surrounding international fuel markets, environmental and technical regulation, and liability and security issues associated with fossil fuel and nuclear power use, electricity procurement processes that reject renewable energy tech

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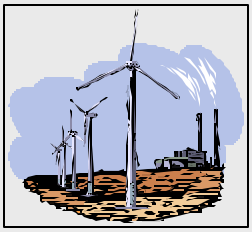

Distributed renewable energy resources can improve the resilience of the electricity grid

Onsite renewable energy systems, coupled with storage, can provide emergency back-up power to risk-averse customers in the event that the grid does fail

Rejecting renewable energy technologies on the basis of cost alone are near-sighted...

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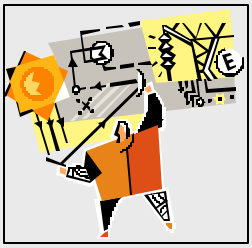
nologies on the basis of cost alone are near-sighted. Shimon Awerbuch and Martin Berger recently commented that least cost procedures "are roughly analogous to trying to identify yesterday's single best performing stock and investing in it exclusively for the next 30 years" (Awerbuch & Berger, 2003). Ignoring the risks inherent in potential investments can be a costly exercise. Renewable energy technologies mitigate a broad range of the risks associated with conventional generation technologies and should be leveraged to diversify utility portfolios. The monetary costs of renewable energy are currently high, but the costs of ignoring renewable energy may one day be measured in adverse health and environmental effects, security risks, and receding competitive advantage.



Renewable energy technologies mitigate a broad range of the risks associated with conventional generation technologies

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The costs of ignoring renewable energy may one day be measured in adverse health and environmental effects.. security

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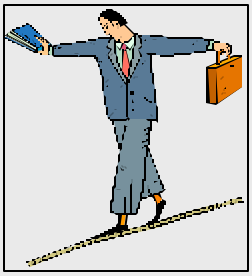

Industry Risk Management

Risk Management is fundamental to Energy Industry's success…..

Choose Pro-active over Reactive

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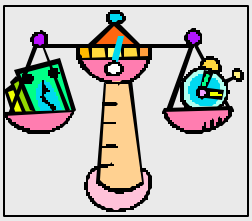

Are we doing enough?

Energy Industry is a huge challenge…

Ignoring the risks inherent in potential investments can be a costly exercise...

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….**contd on page 61**

The intermittence of some renewable energy systems makes them unsuitable baseload generators, but their modularity, technical reliability, geographic dispersion, and output characteristics contribute to a more resilient electricity system

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