ELECTRIC INDUSTRY RESTRUCTURING AND ENVIRONMENTAL SUSTAINABILITY

Bruce Biewald
Synapse Energy Economics, Inc.
101 Chilton Street, Cambridge, MA 02138
617-661-3248 • biewald@world.std.com

paper prepared for the 17th North American Conference of the
United States Association for Energy Economics and the
International Association for Energy Economics,
in Boston, Massachusetts, October, 1996.

Whether electric industry deregulation can be consistent with environmental sustainability depends critically upon the operating economics of existing power plants and upon the set of policies that are adopted to prepare for the future. Each type of electricity resource -- fossil, nuclear, renewable and efficiency -- presents a different set of economic and environmental considerations. Deregulation of electric generation, if done without attention to sustainability concerns, will most likely cause increased reliance upon fossil fuels with the associated resource depletion and environmental impacts, entrenchment of uneconomic nuclear generation without adequate funding for decommissioning, and inadequate development of renewable resources and energy efficiency technologies leaving us with limited resource options in the next century. On the other hand, it is possible to restructure the electric industry and simultaneously move toward a sustainable energy system, by including policies that explicitly constrain markets:

- For fossil generation, restructuring should include strict regulations on air emissions, either in the form of cap and trade systems, taxes or provisions for phasing older plants up to new plant standards.

- Restructuring should include an incentive framework that encourages nuclear power plant operators to make rational decisions about plant retirement and to control decommissioning costs. Realistic plans should be put in place to set aside adequate funds during each unit’s expected remaining operating life.

- Restructuring should include specific provisions for commercialization of renewable generating technologies and for diversity of the electric system resource mix. This could include funding for renewables in a system benefits charge and/or a renewables portfolio standard.

- Energy efficiency programs should be continued, delivered by regulated electricity distribution companies and others, and funded through a system benefits charge.

None of these policies is “inconsistent with the market.” Rather, policies to constrain and guide market forces are entirely consistent with deregulation, and indeed are necessary components of restructuring if it is to serve the public interest.

SUSTAINABILITY

Sustainability is a widely used term among energy and environmental planners and policy makers. It is generally considered a reasonable, or even necessary, goal for our energy system, although what one means by the term is often ambiguous or unspecified. The Dictionary of the Environment (Allaby, 1989) defines sustainable development as “Economic Development that can continue indefinitely because it is based on the exploitation of renewable resources and causes insufficient environmental damage for this to pose an eventual limit.”

Daly and Cobb (1989) provide a good discussion of concepts to be included in defining and measuring “sustainability,” such as the consideration of defensive expenditures (e.g., pollution control and clean up) and depletion of natural capital, as well as more radical notions. Environmental externalities, social costing and methods for implementing sustainability concepts in energy planning are addressed by Bernow, Biewald and Raskin (1994), Rader and Norgaard (1996) and others.

Because our electricity system is currently so far from any notion of sustainability, it is sufficient for purposes of this paper to take a pragmatic approach. That is, without getting into specific definitions of strong or weak sustainability, we can safely say that a transition to, or even movement toward, sustainable electricity would involve reductions in air emissions and other impacts of power generation, rational treatment of nuclear power costs, commercialization of promising renewable technologies, and implementation of energy efficiency measures.

FOSSIL-FUEL POWER PLANTS

It has been accurately observed that new power plants will have air emission rates that are a small fraction of the emission rates for typical existing plants, many of which began operation in the 1970s and before, and have not been required to comply with current environmental standards for new plants. It follows that if market forces would lead to the construction of new, clean generation, and the retirement of existing facilities then competition may have some significant environmental benefits. On the other hand, if the existing plants are economic, on an operating cost basis, compared with new generation, then competition will only cause the existing plants to operate for even longer lives, perhaps at higher capacity factors. While this is largely a matter of competition in wholesale generation markets, it is conceivable that retail electricity competition could hasten or amplify the market pressures. Whether and to what extent existing plants will be competitive is largely a matter of their running costs.

Analysis of operating costs for 678 existing power plants in the U.S. (see Figure 1) indicates that the vast majority of fossil fuel plants are currently economically attractive compared with new generation, and that there is considerable room for cost increases due to tighter environmental regulations before these become uneconomic (see Biewald, 1996, for data on the U.S. fleet; and Tellus Institute, 1996 for analysis of plants in the Mid-West). This analysis takes high and low cases for the costs of new gas combined-cycle generation as the competing new resource. It also involves a comparison of the operating costs of the existing plants with the full cost of the new generation -- reflecting the fact that construction costs of the existing units are sunk and unavoidable. That is, if the market will not support full recovery of the embedded capital costs of existing units then the owners must either obtain stranded cost recovery or take a write off, but it seems unlikely that units that are economical to operate will be shut down in a competitive market.

Figure 1 Running Costs by Capacity Factor
(1994 fuel and O&M in mills per kWh)

Finally, it should be noted that capacity factor is crucial to a fair comparison of operating economics. Some analysts have observed that many existing plants have operating costs that are above the full cost of constructing and operating a new unit, and concluded that new, clean capacity will be constructed to successfully compete with the existing units. For example, there are a number of existing oil and coal plants that cost more than 4.5 cents per kWh to operate, and the cost of building and operating a new gas plant is often estimated to be below 4 cents per kWh. While these "facts" are generally accurate, it does not follow that the new units will displace the existing units. The key missing element in this simple comparison is the recognition of capacity factor. All of the existing units with operating costs about 4.5 cents are used at capacity factors less than 40 percent. That is, they serve as peaking or intermediate units. In this niche, the same new gas unit that costs 4 cents per kWh at 60 percent capacity factor would cost more than 5 cents per kWh.

My conclusion is that the vast majority of existing fossil-fueled power plants are economic on an operating cost basis compared with the construction of new capacity, despite the impressive advances that have been achieved with combined-cycle plant efficiencies and costs, and the currently flat gas price projections.

The resulting increases in fossil plant air emissions from unconstrained deregulation could be substantial. However, policies can be implemented as part of a restructuring package to avoid these increases, and even to achieve desired decreases in air emissions. Perhaps the most direct approach is to implement cap and trade systems, such as the SO_2 trading system of the 1990 Clean Air Act Amendments. Caps could cover a number of pollutants including CO_2, NO_x, particulates and air toxics, specifying acceptable levels of emissions, perhaps phasing downward over time as part of a transition policy to a sustainable energy system. The cap might be based upon phasing grandfathered units toward new source standards, or upon ecological or health constraints (see, for example, Gough, et. al., 1994).

NUCLEAR POWER PLANTS

Nuclear power plants present special challenges for sustainability. While they have a role in helping to avoid the negative impacts of fossil-fuel power plants, nuclear plants have their own set of negative environmental and health impacts, over very long time periods. Nuclear "externalities" are addressed in a variety of reports (see, for example, Tellus, 1994) and I will not repeat that discussion here.

As a group, nuclear plants show considerable variation in their operating costs. It seems likely that if subject to market forces, some nuclear plants would be retired. Moreover, the plants that are uneconomical to operate will tend to be the older units. The older units, speaking very generally, do tend to have higher per kWh operating costs. Also, in situations where a unit is facing a major capital investment (say, a steam generator replacement), the economics look particularly bad if there are not many additional operating years over which to amortize the investment.

Operating cost data for 1994 (see figure 1) indicate that some nuclear plants may be uneconomic to operate. Of course, one year of cost and performance is only that -- it does indicate, however, that full cost benefit studies should be done to assess the economics of continued operation of these and some other nuclear plants.

The requirement to decommission nuclear plants in a timely, safe and orderly manner has been a regulatory concern for two decades, addressed primarily through the establishment of funds for decommissioning. This is in the spirit of sustainability -- if the clean-up requirements are inherent with the technology then at least we can set aside the funds for the problem to be adequately addressed later. Money collected from ratepayers during a unit's operating life is placed in a decommissioning fund to be used after plant retirement to dismantle the facility and dispose of its components. Unfortunately, even with these funds, there are significant risks of insufficient funding for decommissioning related to early shutdown of the facility and/or underestimation of total costs.

Figure 2 Nuclear Plant Decommissioning Cost Estimates by Year of Estimate (180 estimates by TLG Engineering 1977-1995)

Decommissioning cost estimates have been increasing much faster than the general rate of price inflation. For example, figure 2 shows a graph of approximately 180 decommissioning estimates done by one engineer since 1976. The trend toward higher cost estimates is obvious, and has several implications for decommissioning policy. Perhaps the most important lesson from the cost trends is that there is considerable uncertainty about the ultimate cost of decommissioning.

While the risks of underfunded decommissioning exist with any industry structure, a restructuring in which nuclear units are owned by smaller generating companies that do not have the long-term financial security of today's large, vertically integrated utilities *amplifies* decommissioning risks. For example, a single asset nuclear generating company faced with a retired plant, no revenue stream, and a large unfounded decommissioning liability would have no way of effectively decommissioning the facility.

As one step toward removing subsidies for nuclear power, incremental costs of decommissioning associated with continued operation of the units should be the responsibility of the plant's owner. A specific proposal for allocating responsibility of nuclear decommissioning costs was presented in the Massachusetts Department of Public Utilities hearing on electricity restructuring (Biewald, 1996).

ENERGY EFFICIENCY AND RENEWABLES

If electric industry restructuring moves forward without specific policy attention to energy efficiency programs and renewable generation, then there will be a small market niche for these resources in the future. Some competitive generating companies will offer "green power" or provide a full range of "energy services" including efficiency measures. It seems likely, however, that on the whole the market will take a short-term view, and resources that offer long-run sustainability advantages will be underutilized unless specific policy measures are put in place. Polices to promote "sustainable technologies" in a restructured electric industry can include portfolio standards, system benefits charges, tax policies, grants, net billing, and targeted commercialization efforts. Air emissions cap and trade systems, while not specifically aimed to promote these technologies, can also play a key role in requiring the market to function within societally determined constraints.

In the case of green marketing, the problem is an obvious one: people will "buy green," but in less than societally desirable amounts. In cases where externalities are small, the market outcome may be acceptable. In cases such as the electric generating mix, where the environmental externalities can be enormous, it is simply not possible to ignore externalities and count on the altruism of a few "green" consumers. Sustainability requires policy intervention in electricity markets to limit air pollution, and to promote the development of renewable generating technologies and related infrastructure to provide for our energy needs in the next century. At this point, the amount that customers are willing to pay extra for clean power sources is unknown. Much will be learned about this in the next year or two. It is, however, currently known that people are more inclined to pay extra for clean electricity if they know that it is part of a broad program under which other consumers are contributing to the costs as well. Individual consumers, voluntarily buying green in the absence of a serious policy commitment, will be concerned at some point that they are bearing too much of the burden of a resource strategy that benefits everyone. In such situations, a programmatic approach will serve better.

Utilities in the U.S. have developed and implemented energy efficiency measures as part of their "demand-side management" programs. These programs provide considerable societal benefits -- some directly to the program participants in the form of lower energy bills, some to citizens more generally by avoiding power plants and their impacts. In the last few years, utility programs have been moving away from direct incentives (rebates and subsidies) toward market transformation programs, aimed at changing the product mix available to consumers. With deregulation of generation, there is no reason that these programs cannot or should not be continued. Distribution companies will continue to be regulated by state utility commissions, and could provide these services. Another option is to have other entities be responsible for administering demand-side management programs. A "cleanco," organized as a for-profit or not-for-profit organization might have better incentives to implement effective programs than would a company that is in the business of delivering electricity. Particularly if the distribution company has affiliated generating business, having the distribution company responsible for energy efficiency programs creates problematic opportunities for anti-competitive behavior. In any event, a non-bypassable system benefits charge should be established to provide for the continued delivery of cost-effective energy efficiency programs.

By crafting and implementing a package of policies that address sustainability, we can harness market forces to create a viable and livable future. For example, to develop renewable generating resources as part of the electricity mix, we can follow the lead of the Vermont Department of Public Service. The VDPS's restructuring proposal includes three provisions for renewable resources. The first is a broad renewables portfolio standard (RPS) to include a wide range of renewable resources (including existing small-scale hydro) set initially at today's level of renewables. This will provide for continued renewable resources, including conventional technologies, to play an ongoing role in the system mix, providing diversity and environmental benefits. The second is a narrow RPS to include only specific types of not-yet-fully-commercial resources (wind, photovoltaic, gasified biomass, and fuel cells) set at 4 percent of sales from new resources of these types by the year 2007. This RPS proposal for new renewables was proposed by the Union of Concerned Scientists for New England (Nogee, 1996). This should provide for the sustained orderly development of advanced renewable technologies that will be needed as we move into the next century. Finally, the VDPS's restructuring proposal also includes a modest system benefits charge to be used to fund renewables research and development activities.

CONCLUSION: POLICIES FOR ENVIRONMENTAL SUSTAINABILITY

Fortunately, we are not faced with a choice between a regulated electric industry on the one hand, and a restructured industry with market forces run amok on the other. Rather, a sensible approach to electricity restructuring includes increased reliance upon market forces along with a set of policies constraining and directing the market. The policy options include: integrated resource planning, additional standards, expanded siting review, performance-based ratemaking, electricity pricing policies, a system benefits charge, new institutions (e.g., a “cleanco”), emission taxes, emission caps with trading, and resource portfolio requirements. Discussion of these policies is provided in recent reports for the National Association of Regulatory Utility Commissioners (Tellus Institute and Regulatory Assistance Project, 1995) and for the National Association of State Energy Offices (Guinn, 1996).

By drawing upon a range of policy mechanisms, specifically, to reduce the impacts of existing fossil-fuel power plants, to remove subsidies for nuclear plants, and to promote renewable electricity generation and energy efficiency technologies, we can have our cake and eat it too, without devouring the cakes of future generations. That is, we can use market forces in an attempt to lower electricity costs while preserving an environmental quality of life for ourselves and our grandchildren to enjoy and prosper.

REFERENCES

Allaby, Michael. 1989. *Dictionary of the Environment.* New York University Press.

Bernow, Stephen, Bruce Biewald, William Dougherty and David White. 1995. "Counting the Costs: Scientific Uncertainty and Valuation Perspective in EXMOD," presented at technical meeting of the International Atomic Energy Agency, Vienna, Austria, Dec. 4-8.

Bernow, Stephen, Bruce Biewald and Paul Raskin. 1994. "From Social Costing to Sustainable Development: Beyond the Economic Paradigm," in *Social Costs of Energy: Present Status and Future Trends*. Proceedings of an International Conference held at Racine, Wisconsin, September 8-11, 1992. Edited by Olav Hohmeyer and Richard Ottinger. Published by Springer-Verlag.

Biewald, Bruce. 1996. “Can the Existing Fleet Compete: Operating Costs of Power Plants in the U.S.,” forthcoming in the Electricity Journal.

Biewald, Bruce. 1996. Testimony in Massachusetts Department of Public Utilities Docket No. 96-100, and MassPIRG’s repines to Second Round Discovery Questions.

Biewald, Bruce, Heidi Kroll and Richard Rosen. 1996. *Potential Costs and Benefits of Electric Industry Restructuring*, prepared for the National Council on Competition in the Electric Industry. Forthcoming.

Biewald, Bruce and Stephen Bernow. 1991. "Confronting Uncertainty: Contingency Planning for Decommissioning," *The Energy Journal*, International Association for Energy Economics, Vol. 12.

Daly, Herman and John Cobb. 1989. *For the Common Good: Redirecting the Economy Toward Community, the Environment and a Sustainable Future.* Beacon Press.

Gough, C.A., P.D. Bailey, B. Biewald, J.C.I. Kuylenstierna and M.J. Chadwick. 1994. "Environmentally Targeted Objectives for Reducing Acidification in Europe," *Energy Policy*, Vol. 22, No. 12. December.

Guinn, Charles. 1996. *Consequences of Electricity Industry Restructuring on Efficiency and Renewable Resources.* Strategic Guidance Associates for the National Association of State Energy Officials. May.

Nogee, Alan. 1996. "Renewables in Utility Restructuring: New England's Fair Share -- A Proposal to Ensure the Sustained Orderly Development of Renewable Energy Technologies," Union of Concerned Scientists. February 1.

Rader, Nancy and Richard Norgaard. 1996. "Efficiency and Sustainability in Restructured Electricity Markets: The Renewables Portfolio Standard," *The Electricity Journal*, July.

Tellus Institute. 1994. *Operational and Risk-Related Environmental Externalities for the Point Beach Nuclear Power Plant.* June.

Tellus Institute and Regulatory Assistance Project. 1995. Promoting Environmental Quality in a Restructured Electric Industry, prepared for the National Association of Regulatory Utility Commissioners. December 15.

Tellus Institute. 1996. A Study of the Impacts of EPA Phase II SO_2 and NO_x Emissions Standards on Electrical Generation Facilities in the ECAR Region. Prepared for the Advisory Committee on Competition in Ontario's Electricity System, Ministry of Environment and Energy.

Vermont Department of Public Service, Position Paper on Electricity Restructuring. 1996. Filed in Vermont Public Service Board Docket No. 5854. March 25.