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Electricity Grids, Energy Efficiency and Renewable Energy: An Integrated Agenda

The U.S. electric utility industry is poised to invest $1.5 to $2 trillion in energy resources and grid enhancements over the next 20 years.[1] Amid a cacophony of proposals for expending a small fraction of that sum on federal subsidies for electricity ''infrastructure,'' as part of state or federal ''stimulus'' legislation,[2] the enduring question is how best to deploy the industry's own capital budgets for the combined benefit of its customers and investors. And, of course, responses must be guided in part by urgent imperatives to minimize both utility bills and global warming pollution.

Start with the widely embraced but still distant goal of ''all cost-effective energy efficiency,'' with the various opportunities to get more work out of less energy at last competing successfully against power generation for access to most utilities' procurement budgets.[3] Also in need of urgent attention are aging and inadequate North American electricity grids, which are insufficiently prepared to accommodate a host of proposed new generators and technology innovations, creating bottlenecks to a clean energy future. Increased investment in both long-distance and local grids could yield significant environmental, economic, and reliability benefits, although we need a portfolio of grid enhancements extending well beyond more and larger poles and wires. In particular, large-scale renewable energy additions and integration will require significant transmission enhancement and financing, and the environmental community must now aggressively help identify and support the best available siting solutions. Also needed are much stronger incentives for utilities to invest productively in building renewable generation and integrating it into much larger power systems.

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Initiatives designed to cut peak electricity use can very usefully complement energy efficiency efforts, whose primary purpose is to reduce overall consumption. Be wary of claims that demand shifting by itself will yield automatic environmental dividends, because most of the environmental damage from power plants reflects their operation, and on-peak generators are not invariably dirtier than off-peak generators (particularly as regards carbon dioxide emissions, and particularly for load-shifting approaches that raise total generation needs).

The discussion below and five concluding recommendations address these issues in greater detail.

Issue #1: National Grid versus Regional Grids

The U.S. is now divided into three giant regional power grids, covering (1) the Western part of North America, (2) the Northeast/Midwest/Southeast regions, and (3) most of Texas. Each has its own system of reliability oversight and its own entrenched and extended institutional traditions. Each has abundant access to renewable resources; in particular, each has a giant untapped wind resource, thanks in particular to the

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collective potential impact of Montana, Wyoming, Kansas, North Dakota, South Dakota, and Texas, comprising a vast wind-rich area that is equitably shared by the three regional grids. Each of these grids is more than large enough and diverse enough in geography, demand, and system resources to finance renewables and find low-cost integration solutions for those with variable output.

The regional grids retain many flaws, but inadequate geographic scope is not one of them. Advocates of a national grid have been heard to point out that T. Boone Pickens can't sell his Texas wind to New York, and that California solar can't reach Maine. But that does not matter in any material way. Neither Pickens nor California solar will lack for markets if local and regional grids get upgraded and their utilities are conducting fair and open resource procurement competitions. Those should be the priorities. Putting aside the endless, inevitable wrangling over management and siting issues, extending North America's high-voltage power lines to allow cross-continental deliveries would likely mean greater transmission-related power losses and reduced system reliability.

On the other hand, within the regional grids, hour-to-hour system management responsibilities are unnecessarily divided among more than 130 discrete ''control areas,'' which unnecessarily complicate power transfers and resource planning. Consolidation of many of these control areas would reduce the negative impacts of balkanized transmission ownership and help minimize the reliability and cost impacts of integrating resources with variable hourly output, like wind and solar.

Issue #2: Smarter Grids versus Bigger Grids

There's nothing inconsistent about trying to increase backbone grids' transfer capacity and to make local grids ''smarter'' by establishing sophisticated interactions with the myriad devices that use electricity in homes and businesses. But advocates need to be sensitive to institutional issues. The interstate backbone grids are overseen by the Federal Energy Regulatory Commission (except for Texas, which has elected for most purposes to remain a self-regulated electricity island); local grids and their connections to electricity users are the province of state regulators (for investor-owned utilities) and the boards of publicly or cooperatively owned utilities. Federal hegemony might be more efficient, but we will not see it in our lifetimes. We need to work with all these institutions, not try to wish or legislate some of them away. In particular, further efforts to expedite transmission by overriding state authority are likely to reinforce opposition and increase delays.

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Two additional caveats are in order. Transmission planners who advocate more and bigger lines need to overcome the well-justified public suspicion that the planners knew the answer before they began exploring the question (''if all you have is a hammer, every problem looks like a nail''). Planners need to understand and evaluate the full range of technology solutions to transmission congestion and reliability problems, including targeted demand reductions, clean ''distributed'' generation, and more sophisticated control systems; an industry exemplar is the Pacific Northwest's Bonneville Power Administration and its incorporation of ''non-wires solutions'' into bulk transmission planning.[4] Planners need also, of course, to consider environmental concerns as well as technology solutions when they evaluate transmission alternatives.

As to how best to make grids ''smarter,'' a fiercely competitive struggle is underway among multiple vendors with huge proprietary stakes in the outcome. Investment in more communications and interactivity is needed, not least because it will reduce the cost of integrating renewable resources with variable output characteristics, but ''smart grid'' advocates should stay out of trying to determine who should get the contracts or what technology pathways are best. More utility investment in R&D would help

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deliver the efficiencies and reliability benefits that the ''smart grid'' promises.[5]

Issue #3: Renewables versus Fossil Generation

Many environmental advocates understandably want to focus solely on transmission enhancements that will be used wholly or largely by renewable resources. For large interconnected systems, there is one important respect in which grid operation makes this difficult if not impossible: generation spreads instantaneously and is felt through every part of an integrated power grid, following complex physical laws rather than contractual or legal provisions. Morereliable grids with added transfer capacity cannot limit their benefits to particular generators. Moreover, the Federal Power Act does not authorize FERC to limit access based on generation technology. This is not an argument against transmission enhancement, but rather a warning that it must be accompanied by other specific measures to limit CO_2 emissions in order to avoid unintended consequences in the ongoing competition between conventional fossil and cleaner generation sources.[6]

Issue #4: Shifting Demand and Reducing Demand

Smarter grids will make it easier to signal to users the high cost of demand at particular times, or physically to control and shift patterns of electricity use. While this will yield significant economic savings by lowering fuel costs, whether it will yield environmental benefits depends on whether overall electricity use goes up or down as a result of the demand shifts. Integrated programs of demand shifting and demand reduction are the best assurance of such benefits; be skeptical of claims that simply changing the timing of demand will automatically improve environmental quality by ''reducing the number of power plants needed'' or ''raising customer awareness.'' Fewer are not necessarily better, particularly if this result is achieved by running old coal plants harder in order to meet higher off-peak demand. And results of ''raising awareness'' through peak shifting programs have been mixed, in terms of impacts on overall energy use.

Issue #5: Access Rules

Clean technology advocates often complain about ''inconsistent state access rules.'' Although monopoly transmission owners have a history of acting to suppress new entrants, the Federal Energy Regulatory Commission clearly has the authority to insist on an open and non-discriminatory system. In recent years, FERC has moved aggressively to remove barriers to renewables integration, by outlawing discriminatory penalties against variable-output resources and authorizing favorable financing regimes for transmission (including urgently needed permission to utilities to charge all customers for new links to remote renewable-energy sites, with the renewable generation sponsors paying back their share of those costs once they build their plants and start producing power). On transmission access and financing, the solutions are at hand (albeit not always self-executing). An urgent priority now for many renewable energy advocates is a more rational and rigorous way to allocate scarce transmission among competing applicants with widely varying seriousness and merit.

Issue #6: Realigning Utilities' Incentives

We won't get renewable energy in the needed quantities at the lowest prices without strongly motivated utility partners. Renewable energy sponsors need long-term purchase commitments from utilities, and the lowest-cost solutions to integrating renewables with variable output (like solar and wind) will come from diversified utility systems with access to multiple storage options, including load management among thousands or millions of customers. Utilities that exploit all cost-effective energy efficiency and renewable energy opportunities (including on-site ''distributed'' renewable resources) should be more profitable than utilities that do not. This ideal is almost universally unrealized and needs far more attention from all stakeholders; typically electric utilities' financial health

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today is tied directly to increases in their retail electricity sales, yielding automatic barriers to significant distributed renewable energy development and energy efficiency improvements. And utilities are rarely if ever rewarded for adroit renewable energy procurement and integration; at best they are allowed to pass these costs through to customers.

Issue #7: On-Site Generation Issues

Controversy has arisen recently over the issue of ''excess generation'' from on-site solar and wind facilities; the major issue is whether and how to compensate those who produce more than they use and feed it back into the local grid. At the extremes are the options of (1) letting utilities absorb this generation without paying anything for it, and (2) forcing them to pay the same relatively high guaranteed rates that effectively apply to electricity consumed on-site. A reasonable middle ground is for utilities to pay the same wholesale rate for any annual ''excess generation'' that they pay for other power production.

PRINCIPAL RECOMMENDATIONS

- Focus on upgrading our giant regional grids and connecting them to untapped renewable energy resources, rather than confronting the manifold technical and institutional barriers to a single interconnected ''national'' or North American grid.
- Within the regional grids, consolidate control areas to reduce the negative impacts of balkanized transmission ownership and help minimize the reliability and cost impacts of integrating resources with variable hourly output, like wind and solar.
- At state and regional levels, transmission planners need to understand and evaluate the full range of technology solutions to grid congestion and reliability, rather than turning first to new high-voltage lines and federal preemption of state land use authority. For local grids, environmental advocates should avoid trying to pick the best new ''smart'' technologies, but should generally support investment in the enhanced communications and interactivity that underpin ''smart grid'' initiatives, while also encouraging more R&D investment in such technologies.
- Transmission enhancement must be accompanied by other specific measures to limit CO_2 emissions in order to avoid unintended consequences in the ongoing competition between conventional fossil and cleaner generation sources.
- Renewable energy sponsors need long-term purchase commitments from utilities, and the lowest-cost solutions to integrating renewables with variable output (like solar and wind) will come from diversified utility systems with access to multiple storage options, including load management among thousands or millions of customers. Utilities that exploit all cost-effective energy efficiency and renewable energy opportunities (including on-site ''distributed'' renewable resources) should be more profitable than utilities that do not; most states still have not adopted the straightforward regulatory reforms needed to ensure this result. ■

1. See, e.g., The Brattle Group, *Transforming America's Power Industry: The Investment Challenge 2010–2030* (Edison Foundation, Nov. 2008).

2. For example, the Apollo Alliance recommended inclusion in the next federal stimulus bill of $10 billion and $1 billion, respectively, for transmission expansion and ''smart grid'' initiatives. *Green Group Stimulus Initiatives*, Nov. 26, 2008, at 6.

3. This objective figures prominently in recent agreements announced by the Natural Resources Defense Council and the four major U.S. utility trade associations. Joint Letter to the National Association of Regulatory Utility Commissioners by Edison Electric Institute and NRDC, Nov. 2008; Memorandum of Understanding between NRDC and the American Public Power Association, June 2008; Joint Statement of the American Gas Association and NRDC, May 2008; Memorandum of Understanding between NRDC and the National Rural Electric Cooperatives Association, Feb. 2008.

4. See http://www.transmission.bpa.gov/PlanProj/Non-Wires_Round_Table.

5. Congress has encouraged state utility commissions to expedite consideration of ''smart grid'' investments. See, e.g., The Energy Independence and Security Act of 2007 (H.R. 6, 110th Congress, or ''EISA''), section 1301.

6. Examples of such policies include California's SB 1368 (2006) and Washington State's SB 6001 (2007), which establish specific greenhouse gas emissions performance standards for all new or existing baseload generation seeking long-term utility investment, regardless of location.

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