A Review of

"The Future of the Grid–Evolving to Meet America's Needs" Report by the GridWise Alliance and U.S. Department of Energy, Office of Electricity (December 2014)

"Unfortunately, this government and industry funded report on the future of energy and electricity in America misses or avoids what are perhaps the most significant factors emerging today–the dramatic growth of rooftop solar PV and distributed generation and storage–with profound implications for the utility industry's future, even according to its own internal reports."

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"Could it really be that the U.S. federal government is not leading the way on a matter as important to the American people and economy as energy—and instead is propping up an obsolete paradigm?"

The Author

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A REVIEW OF:

"The Future of the Grid: Evolving to Meet America's Needs"—Final Report, by the GridWise Alliance and U.S. Department of Energy, Office of Electricity (December 2014)

A new joint industry/government report, The Future of the Grid, seeks to explore the future of the electric power system over the coming decade and a half. Unfortunately, the report misses or avoids what are perhaps the most significant factors emerging today—the dramatic growth of rooftop solar PV and distributed generation and storage—with profound implications for the industry's future, even according to its own internal reports.

If in 1880, horse and buggy manufacturers and teamsters had been asked to envision the future of road transportation, they might have cited better wagons, buggies, and buggy whips, as well as stronger horse breeds, better horseshoes, and improved manure removal equipment, *etc*. But, with the benefit of hindsight, we know that would have been much too limited a vision. Similarly, today, there is reason to believe that our global energy and electricity systems may be facing a profound transformation. The problem is how to visualize such a transformation.

During 2014, the electricity industry undertook an effort to envision the future of the century-old U.S. electricity grid as it might look by 2030. An industry trade association, the GridWise Alliance, and a government agency, the U.S. Department of Energy, Office of Electricity Delivery and Energy Reliability, jointly convened a series of four regional workshops and a national summit titled "Future of the Grid: Evolving to Meet America's Needs." According to the final report, released in December 2014 bearing the subtitle "An Industry-Driven Vision of the 2030 Grid and Recommendations for a Path Forward," the meetings engaged over 400 individuals representing a "…complete range of stakeholders—including utilities, regulators, policy makers, renewable energy providers, consumer advocates, academia, and third-party innovators…" This report is referred to below as the *FOG* Report.

The workshop methodology was to assign each individual participant to one of four breakout groups for a visioning exercise, each of which explored one of four specific problems or "scenarios" (discussed later below). Each group then considered certain defined "key elements" of "grid evolution" that included grid capabilities, the role of grid operators, new technologies and financial models, policy and regulatory barriers, and the "transition necessary to achieve the future grid."

Findings of the report

Perhaps unsurprisingly, the findings of the final report confirmed that the future would look much like the past, but with some changes and a few added elements. Although the report acknowledged up front that the changes were *fundamental,* "…on a scale not witnessed since the creation of the electric system more than 100 years ago," its emphasis in the end was on a *transition* that was *evolutionary* (*i.e.,* incremental) rather than disruptive or revolutionary.

Essentially, the final *FOG* report described a future grid that would evolve from the conventional centralized model[1] into a combined centralized/distributed model by integrating more new distributed energy resources (DER), while maintaining centralized utility control, coordination, and monitoring. Although the term "DER" is used frequently in the report, it is never defined, except parenthetically late in the report as "(*e.g.,* electric vehicles and energy storage)".[2] This new combined model has been previously referred to (although not specifically referenced in the *FOG* report) by the Electric Power Research Institute (EPRI) as the *Integrated Grid*. According to EPRI, "So far, rapidly expanding deployments of DER are connected to the grid but not integrated into grid operations, which is a pattern that is unlikely to be sustainable."[3] EPRI describes the *Integrated Grid* concept and its role as follows.

> The successful integration of DER depends on the existing electric power grid. That grid, especially its distribution systems, was not designed to accommodate a high penetration of DER while sustaining high levels of electric quality and reliability. The technical characteristics of certain types of DER, such as variability and intermittency, are quite different from central power stations. To realize fully the value of distributed resources and to serve all consumers at established standards of quality and reliability, the need has arisen to integrate DER in the planning and operation of the electricity grid and to expand its scope to include DER operation – what EPRI is calling *the Integrated Grid*. (EPRI, p. 3)

Such a vision assumes that the future grid will be centrally managing and coordinating a two-way flow of both electricity and information, including both utility-scale and small scale resources (*e.g.,* rooftop and community solar arrays, premises energy management systems, thermostats, appliances, *etc.*). Therefore, the report finds that this new integrated system will become even more complex in both its technical and regulatory aspects.

> With all of the new entities and energy resources, managing and optimizing the system will become increasingly challenging, even with all of the new tools and technologies available to grid operators. It is highly likely that the tools and technologies will be deployed ahead of the regulations that will govern their use, which will add to this complexity. (*FOG*, p. 8)

Thus, the *FOG* report relies heavily on regulators and on an "evolution of regulatory models" to shape the future integrated grid. This vision relies on and is entrenched in the predominant regulated monopoly paradigm—along with the ongoing assumption that the industry will continue to be structured largely as a protected monopoly. Is this a reasonable assumption? Is it possible that emerging distributed energy technologies, such as rooftop solar, are opening the possibility of a simpler and less regulated, not more complex, grid that does not rely on centralized generation and management? Is "integrated" in this context just another word for "captured"? These emerging technologies are part of "what is missing from the report," as discussed below.

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[1] The conventional centralized model consists of the chain of generation–to transmission grid–to distribution grid–to user. It relies primarily on *baseload* generation (*i.e.,* large *utility scale* fixed output coal or gas-fired thermal, nuclear, or hydro) for stable and efficient operation.

[2] In utility speak, the term *DER* is centralized utility jargon that may often refer to solar and wind generation, and other non-*utility*-owned facilities. It also may be an intentionally-vague euphemism that reflects a preference for utility-scale generation rather than customer-scale (e.g., rooftop solar), while allowing non-utility readers to interpret the term differently.

[3] *The Integrated Grid: Realizing the Full Value of Central and Distributed Energy Resources*, EPRI, February10, 2014, p. 1

But, is it the regulatory model that is inadequate, or is it the regulators themselves? Better regulatory policies or models will not fix the inherent failures and afflictions of the current regulatory institutions. The report claims "New regulatory models must balance the public good with the needs of individuals." (*FOG*, p. 15) Does this refer to "individuals" or groups that may be inclined to defect from the grid in some way? It is not clear. Is this a way of saying that some individuals, by installing their own rooftop generation, are acting adversely to the public good and must be controlled by regulators? *Regulatory capture* and *public choice* theory both show how regulators inevitably come to serve the interests of those they regulate—or of themselves—rather than the interests of the public.

The report puts a confident and smiley face on the vision and pending transition, while at the same time offering cautionary recognition of significant technical, organizational, and other challenges. However, the fact that the report has such serious shortcomings and omissions suggests the possibility that, at least in part, it's purpose may not be so much to discover a vision, but to advocate and justify a vision that has already been established at the top levels of its governmental and business sponsors (*i.e.,* including its "thought leaders" (*FOG*, p. 3)). The previously mentioned emphasis on regulators and "regulatory models" is but one example. Following are some others of even greater significance.

What is missing from the report?

A number of important elements are conspicuously absent from the 45-page report. Perhaps the most obvious thing that is missing is any recognition of what is actually driving the grid transformation. The most notable drivers include 1) loss or decline of industry economies of scale (*e.g.,* with renewable generation, storage, and related small-scale technologies), and 2) climate change and environmental pollution.

The first element, the dependence on large economies of scale and related large capital investments in generation and transmission (that have from its inception characterized the electricity industry), has now abruptly vanished from the horizon. New technologies have emerged (*e.g.,* solar PV technology, and also wind, small-scale hydro, and other renewable energy technologies) that tend to be equally or more efficient, more scalable[4], and less dependent on conventional utility capital. As a result, the surging growth of small-scale distributed generation is threatening to destroy the conventional rate-of-return and cost-recovery economics of the regulated utility industry.[5] Every user can now also become a producer.

The second element, global climate change, has become a world-wide concern as well as a major and accelerating public motivation for changing the economy of energy and moving to renewable and sustainable, de-carbonized generation, and to energy efficiency.

The report neglects to mention the trend of declining demand for electricity that has resulted from the success of energy efficiency, and from slower economic growth. There also is no mention of the spectacular growth of rooftop solar, battery, and inverter technology that has resulted in major utility push-back before their regulators in several states against net metering tariffs.

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[4] *scalable* means that they tend to enjoy essentially the same efficiency regardless of scale, *i.e.,* that there is little or no advantage in building large "utility-scale" capital-intensive facilities.

[5] From the days of its founders, Thomas Edison and J.P. Morgan, until recently, the electricity industry was among the most capital-intensive of all, requiring four dollars of investment for every dollar of revenue.

Interestingly, such prominent words frequently found in public discourse today on energy, such as *clean*, *carbon*, *climate*, and *sustainable*, are essentially absent from the report. In fact, *sustainable* is used but three times, and only in a business sense—not an environmental sense. *Solar* is only mentioned merely in passing five times, and *rooftop* is mentioned twice.

Also concerning, there is no mention of the seminal 2013 report, *Disruptive Challenges,* [6] from the industry's own think tank, the Edison Electric Institute (EEI), that initiated much of the current grid transformation discussion, or of the term, "utility death spiral" coined in that report—or of the term "grid defection" that came from a subsequent influential follow-up study from the Rocky Mountain Institute (RMI).[7] The EEI report urged utilities to avoid the death spiral by re-thinking their business model and considering moving to a distribution service-oriented model—instead of the past focus on generation, transmission, and the commodity sale of electricity. But, investor-owned utilities have generally resisted this advice, and instead relied regulatory protection and on political influence. Is there a way for utilities to share the distribution grid environment with their customer's own generation? The answer is not clear.

The stresses of such disruptive challenges and of grid defection, are beginning to be seen in solar adoption in Hawaii and in parts of California, and also in civic protests over net metering in Arizona. In Hawaii where electricity rates are especially high (i.e., ~35 ¢/kWh), solar PV penetration is reaching or exceeding 10%. Technical and political stresses on electric utilities are reaching the breaking point as utilities and regulators are facing many unanswered questions.

> At what PV penetration rate does a residential utility circuit become unsafe? Who pays for the upgrades to handle the new hardware needs of a bidirectional grid? Does high DG [distributed generation] penetration, along with net energy metering, threaten the utility business model as well as its engineering model? How will solar installers fare amidst this market growth and regulatory regime on the island? [8]

There is no mention of this problem or any responses to it in the *FOG* report. It seems to have missed a key defining factor of the future grid. Also, there is essentially no mention of electric vehicles, widely recognized as another key element of any future electricity system.

Stuck in an obsolete paradigm

The leading assumptions embedded in the workshop scenarios reveal a certain commitment to the dominant industry paradigm. The way one poses a question constrains the range of the answers. Following are the four scenarios, identifying some possible unstated assumptions that may have influenced the conclusions of the workshop:

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[6] *Disruptive Challenges: Financial Implications and Strategic Responses to a Changing Retail Electric Business*. Peter Kind. Edison Electric Institute. January, 2013 <http://www.eei.org/ourissues/finance/Documents/disruptivechallenges.pdf>

[7] *The Economics of Grid Defection: The When and Where Distributed Solar Generation Plus Storage Competes With Traditional Utility Service.* Peter Bronski *et al*, Rocky Mountain Institute. February, 2014 <http://www.rmi.org/electricity_grid_defection#economics_of_grid_defection>

[8] "How Much Solar Can HECO and Oahu's Grid Really Handle? Testing the limits of a large island's electrical grid with 10 percent PV penetration", Eric Wesoff, *GreentechSolar,* February 10, 2014 <http://www.greentechmedia.com/articles/read/How-Much-Solar-Can-HECO-and-Oahus-Grid-Really-Handle>

- *Scenario: Balancing Supply and Demand as Grid Complexity Grows*

  Unstated Assumption: 1) that complexity will grow, and 2) balancing supply and demand is tied to complexity

- *Scenario:* Involving Customers and Their Loads in Grid Operations and Planning for Empowered Customers

  Unstated Assumption: customers only offer "loads" and not "generation," or "storage"

- *Scenario:* Higher Local Reliability through Multi-Customer Microgrids

  Unstated Assumption: microgrids are "customers" of the utility

- *Scenario:* Transitioning Central Generation to Clean Energy Sources—Large Wind, Large Solar, and Large Gas

  Unstated Assumptions: 1) clean energy sources are or should be "centralized", and 2) clean energy sources are or should be "large" to be efficient (economy of scale)

The above scenarios framed the problem around the conventional large, centralized utility model and its customer relationship. Biased results are predictable and unsurprising.

Has the "Integrated grid" replaced the "smart grid"?

Is this "Vision of the 2030 Grid" another self-serving promotion by the utility industry, its vendors, and government agencies to preserve and extend their business? It may bear a similarity to the 2009 promotion of the "smart grid" that ultimately resulted in large part in a bait-and-switch situation, *i.e.,* spending $2 billion of stimulus funding on smart meters that had nothing to do with advancing a smart grid, or with balancing supply and demand, or with renewable integration, or with demand response, or with managing energy. Is the "vision" in part about preserving the regulated utility centralized paradigm (rate-regulation, electricity commoditization, big capital generation/transmission projects, cost recovery and return on capital assets, *etc.*)? In particular, could the *integrated grid* be about trying to maintain centralized control of an inherently decentralized technology—control of the technological transformation where "distributed" may imply a more independent, democratic, community-based, smaller, simpler, and scalable electricity system?

The electricity industry may be facing a crippling or devastating revolution. The use of language in the report about "evolving," "transitioning," or "achieving the vision," may be a strategic way of dampening the anxiety that has resulted from the *Disruptive Challenges* report and the worries about its account of a "death spiral"—especially when there is really no good solution to looming Schumpeterian "creative destruction."

Conclusion

The *FOG* report positions itself as representing an *industry-driven* vision? It is not made clear why it was limited to industry and why a broader perspective was not sought, especially with the co-sponsorship of a government agency. Such a positioning belies the claim that the workshops engaged a "…complete range of stakeholders…" (*FOG*, p. 23) This leaves open the questions of what are the vision of consumers and of society, and of what is the best way to get electricity for the people? Or, was the main concern of the workshops and summit envisioning the best way to preserve the industry and its interests in the face of existential threats?

To its credit, the report does recognize the difference between the electricity system and the electricity grid. However, it does not venture further toward recognizing the full context of the *energy* system. The global crude oil price war that broke out in mid-2014 may have profound implications for the future of the fossil fuel industry itself—and most certainly may influence the future of the electricity grid. What about envisioning the electricity system or grid in the context of collapsing global oil & gas prices, or of climate change?

The 45-page report treats solar and renewables as tangential issues, and it seems uncritically committed to ever more technical and regulatory complexity. Yet there is growing public concern about the risks of excessively complex socio-technical systems. This concern is raising a constituency for the idea that simpler is better—that distributed is simpler and more democratic—that complexity can be unnecessary and self-serving—and that monopoly structures are are obsolete, unnecessary, and unjustified. These are some of the obvious things that have changed from a century ago.

On the positive side, the report offers up a "strawman" starting point for a broader public discussion, and not limited to an *industry-driven* vision. In the group visioning exercises, "…participants were asked to put aside the current legacy system and think about the type of system they would design today if starting anew."[9] (*FOG*, p. 3) This is most certainly not what happened. However, it is what should happen next.

[9] It can be argued that it is highly unlikely that any developing country, or anyone starting anew, would reasonably build a centralized baseload grid system that resembles what we have in the U.S. today. In any case, a critical examination of this question would be a good place to start.

National Institute for Science, Law and Public Policy

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The National Institute for Science, Law and Public Policy (NISLAPP) was founded in 1978 to bridge the gap between scientific uncertainties and the need for laws protecting public health and safety. Its overriding objective is to bring practitioners of science and law together to develop intelligent policy that best serves all interested parties in a given controversy. Its focus is on the points at which these two disciplines converge.

The constantly evolving nature of scientific research, together with the accelerated pace of technological advancement, has drawn into question the reliability of the information on which decision makers in both government and industry rely. Many of the innovations that have led to the development of new products and processes have also raised significant new health, safety, and efficacy issues for consumers. NISLAPP's mission is to help reconcile the historic and political vagaries of the legal process with the absence of "absolute" scientific answers in addressing immediate and long-range consumer concerns. Rather than attempting a definitive resolution of such problems, this approach is aimed at encouraging honest interplay to help promote autonomous arrangements in areas of health and public safety. NISLAPP serves as a source of enlightenment to the consumer movement, industry and public policymakers alike by applying common-sense criteria to common-good concerns. It is NISLAPP's intent to forge dialogue between parties who may see themselves as diametrically opposed to each other's interests, and reconcile legal and scientific concerns in the formulation of intelligent, safe and sensible public policy.

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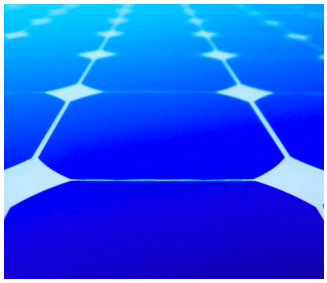

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