INTERNATIONAL

United States of America

Before the

Federal Energy Regulatory Commission

Smart Grid Policy Statement

Comments of Michael C. Caramanis, Geoffrey Parker, Richard D. Tabors

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Smart Grid Policy Statement	)	**Docket No. PL09-4-000**
	)	

COMMENTS OF MICHAEL C. CARAMANIS, GEOFFREY PARKER, RICHARD D. TABORS[1]

1. Overview of Response

With this response, we submit our view of the Smart Grid and the policy responsibilities of the FERC with respect to the Smart Grid. In particular, we seek to frame one aspect of the Smart Grid discussion which has been under-recognized in regulatory and policy debates. As concerns for technical interoperability of the Smart Grid is the subject of great attention (including the primary focus of the FERC Proposed Policy Statement), the parallel discussion of market operability is not occurring. In the response that follows, we contend that the market structure required for a successful Smart Grid is best understood by a "platform" framework, and share our view of the interrelationship between that market platform, ultimate customers and power suppliers. It is our conclusion that the Commission need hold a series of Technical Conferences to address these critical market issues. These Technical Conferences should be held on two separate but complementary subjects: 1) to identify the market reforms required to enable the full potential of the Smart Grid platform, and 2) to explore the jurisdictional considerations between Federal and State regulators in an era of Smart Grid.

[1] The comments that follow are those of the authors and do not necessarily reflect the opinions of their academic or research institutions. Michael C. Caramanis is Professor of Mechanical Engineering and Division of Systems Engineering, Boston University. Geoffrey Parker is Associate Professor of Economic Sciences at the A. B. Freeman School of Business at Tulane University. Dr. Richard D. Tabors is Vice President of Charles River Associates and formerly Senior Lecturer, Technology and Policy, at the School of Engineering at Massachusetts Institute of Technology.

2. A Vision for the Smart Grid: The Market Platform

The Federal Energy Regulatory Commission (FERC) has presented a Proposed Policy Statement and Action Plan (issued March 19, 2009) and provided opportunity for comment. The Commission has stated that it

> is issuing this proposed policy statement to articulate its policies and near-term priorities to help achieve the modernization of the Nation's electric transmission system, one aspect of which is "Smart Grid" development. Smart Grid advancements will apply digital technologies to the grid, and enable real-time coordination of information from generation supply resources, demand resources, and distributed energy resources (DER). This will bring new efficiencies to the electric system through improved communication and coordination between utilities and with the grid, which will translate into savings in the provision of electric service. Ultimately the smart grid will facilitate consumer transactions and allow consumers to better manage their electric energy costs. (footnotes omitted)[2]

By providing the Proposed Policy Statement, the Commission acknowledges that dramatic changes are beginning to affect the electric utility system, the utility-customer relationship and market structures worldwide. Developments in the capabilities for sensor and digital control technologies (as opposed to the current analog controls) and improved communication of digital data and information have opened a large range of new options for both the wholesale (transmission) and retail (distribution and behind the meter) segments of the industry.

While in the past, analog devices and expensive communications required that power systems control be highly centralized, these new capabilities and their economics now create the potential for a paradigm shift in the electric power industry. That shift allows for distributed decision and control through direct customer choice and involvement in the power system "equation" (e.g., through demand response mechanisms and/or distributed energy resources such as rooftop solar installations.) These technological changes will allow for the evolution of a genuine integrated market in electricity – one in which the demand and supply sides interact in a fully functional market.

The objective of our comments is to focus beyond the instant question of interoperability of hardware to that of the operability of the markets and commercial platforms that are required

[2] Smart Grid Policy, 126 FERC ¶ 61,253 (2009).

for the coordination of supply and demand – the economics of the market for energy and most specifically electricity. In this respect, we embrace the Commission's interest in the "modernization of the Nation's electric transmission system,"[3] but urge the Commission to adopt a far broader view of its role in enabling the market structures required for this modernization to take place.

Complex markets do not simply happen. As we have painfully found in electricity and, more recently, the financial sector, markets must be thoughtfully designed, their structures vetted, and the end product regulated by entities that are thoroughly committed to their efficient operation.

The Smart Grid today is a collection of ideals and ideas, of commercial and near-commercial technologies, and of market economics and governmental subsidies. It is an environment in which competing platforms bid for adoption, in which entrepreneurs bid for start-up funding, and in which the ultimate consumer has so far been assumed but not directly addressed.

Utilities understand their business of delivery of electricity to end-use consumers and are justifiably proud of the achievements they have made in the near-universal delivery of reliable power. What they have had little incentive to develop, however, is a detailed characterization of their retail customers in the particular as opposed to their customers in the aggregate. While economic dispatch (and the underlying economic theory of it) reflects the realities of the moment-to-moment costs of generation and delivery, the concept that these costs can and should be directly related to the prices seen by customers is totally missing in the current environment. The current system is reminiscent of the old "Ma Bell" telecommunications system where innovation occurred safely behind the walls of the local telephone exchange.

In her recent book "Deregulation, Innovation and Market Liberalization: Institutional Change in the Energy Sector," Lynne Kiesling captured the essence of the current utility structure when she stated that the structure of supply without demand response was the equivalent of "one hand clapping."[4] Kiesling accurately and effectively presents the current condition of the industry and its regulatory structure as being based on a static view of the world: utilities

[3] Id.

[4] Kiesling, Lynne. Deregulation, Innovation and Market Liberalization: Institutional Change in the Energy Sector. Routledge: New York, 2009. (111).

supply all consumer demand at a flat rate that is independent of both individual customer preferences and the cost of energy at a specific location in anything close to real time. By this design, the electric utility logic for decision and control is unidirectional.

Dr. Kiesling has correctly pointed out that "this failure to acknowledge agent heterogeneity [individual customer differences] in the rate structure accounts for the extreme price inelasticity of demand that has historically held in the industry."[5] She challenges, and we agree, that with technological development the paradigm can and must change to one that is dynamic, marked by decentralized coordination and adaptive institutions, and achieves a better match of marginal costs to marginal demand.

Advanced technologies under the umbrella of Smart Grid provide the opportunity to alter the one-sided decision and control structure by moving – distributing – the decision and control to individual consumers. The key concept is that the decision to consume is a distributed decision based upon the welfare of the individual consumer. The aggregate of these individual decisions determines the quantity, cost and quality of electricity provided (by location and time) to the consumer.

However, the individual elements of the Smart Grid do not stand on their own. Utilities, developers, and vendors assume that these individual elements will function as part of an interactive, integrated system, and the elements will come together in different ways over time and at different locations within the electric grid. The implication of this currently disparate environment is that a key missing element of the vision is the signal; that is to say, the information that can be used on "platforms" to allow the logic of the applications to make "smart" decisions on when to run, charge, or discharge, which will result in individual benefit from commensurate system cost reductions.

The concept of a platform or set of platforms in the Smart Grid market suggests the adaptation to energy of the evolution that took place within the communications industries, where a set of tools that match service providers to customers with complex markets is defined as a platform. This model has proven useful in describing markets for products such as personal computers, computation services, cell phones, gaming systems, streaming

[5] Kiesling (41).

media, and telecommunications infrastructure. In these markets developers build applications on top of a platform. As we have seen in multiple industries, such systems have become an important way in which firms organize innovation. However, for platform innovation systems to function, the market rules (and regulations) governing access and intellectual property must be carefully analyzed, designed, monitored and enforced.

We propose that the "platform" is a useful framework with which to understand how Smart Grids will evolve. Further, it is a convenient analytic paradigm to use in order to avoid the pitfalls that might otherwise stall the development of an important and socially beneficial industry.

We share a common concern that enthusiasm for new Smart Grid systems could lead to the premature adoption of standards that might enable a few important applications, but would be inflexible to unexpected innovations that hold the potential for increased profit and social benefit. Realizing the full potential of Smart Grid benefits is particularly important given the unique qualification of the Electric Power Industry to conserve fossil fuels – heat pumps are much more efficient than burning fuel for heat – and to substitute CO_2 emitting oil in the transportation sector with clean power generation. Will the Smart Grid be instrumental in mitigating the cost of investment in the physical Power System infrastructure that is required to handle clean generation intermittency and increased transportation sector loads? We believe that there is an appropriate balance of investments in the Cyber-Physical components of the Smart Grid platform and an appropriate utilization of these investments that can help to facilitate an affordable and sustainable energy future. The key issue is how to achieve this potential. We argue that this potential can be achieved in a market environment that accommodates multiple competing developers and multiple competing users and service-providers.

Our experience in other industries that have gone through the transformation facing the electricity industry today indicates that few firms are able to provide a full complement of service applications for their platforms. Once the initial applications of efficiency, price response, and distributed generation are accommodated, what else might we expect to see on the Smart Grid platform? If the history of platforms like Apple's iPhone is any guide, then we might be surprised. At first, the iPhone provided telephony and multimedia functionality supplied only by Apple. However, once the platform was opened to developers, a thriving developer-led ecosystem grew quickly to deliver thousands of applications in diverse

categories of business productivity, news, and games. Firms have learned that it is economically beneficial to rely on developer pools to extend their platforms' functionality. However, for the developers to participate, there must be access, not only in an engineering sense, but also in an open contractual sense.

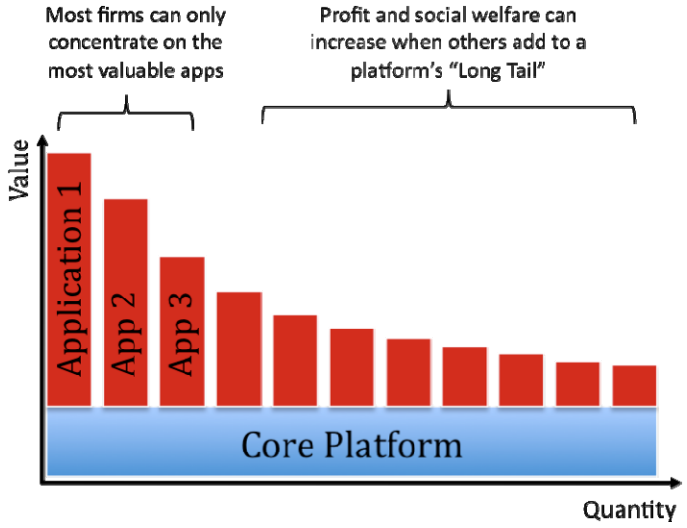

Figure 1: Platform value can increase when 3rd party developers add applications.

Having the flexibility to mix and match the elements of the Smart Grid works best when the individual technical elements and their markets can operate on a known platform or platforms with a set of rules and regulations that reflect "good" economics. These are the signals that hold the system together both logically – the economics – and structurally – the regulation. Innovation is market driven; applications are market driven; consumer response is market driven. Market demands have driven the applications that we find on the open platforms of the Internet. Expectations of available platforms and markets are driving the Smart Grid applications available today. What appears to be missing is an agreement or even a discussion of the regulated market signals that will provide the information for socially efficient consumption, valuation of renewables when and where delivered, values for carbon emissions when and where emitted, and the trigger for charging and discharging of distributed storage.

3. Three Pillars of the Smart Grid

We argue that there are three interrelated elements of the Smart Grid that directly affect the consumer end of the system.

The first of these is what we would call the "Smart Customer." That is the set of technologies that exists or are under development by which electricity consumers will be able to observe, directly control, or allow silicon to control their electricity consumption.

The second is the "Smart Utility." That is the utility that is implementing sophisticated monitoring, digital controls and locational pricing, as well as reaching out to its customers with programs and plans for "smarter" consumption.

The third element is the "Smart Market." That is the structure of the market that allows for the integration of the technologies, decision logics and information at the customer and the utility end to create an economically efficient solution in the new dynamic paradigm that the digital technology has created.

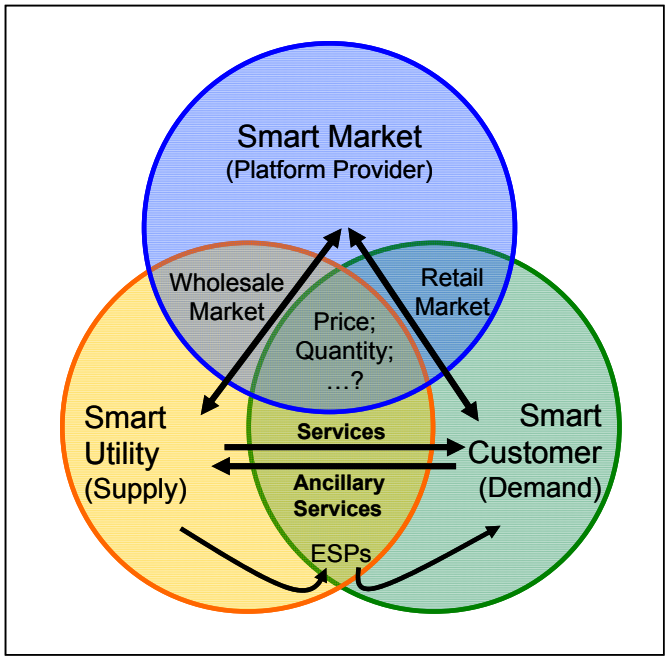

Figure 2: Defining the overlap of these elements will determine the character of the Smart Grid.

The Smart Customer is being bombarded with technology to assist them in operating their homes and commercial facilities more cost effectively. That there is a need for these

technologies to be interoperable is without argument. Whether wired or wireless, the ability for information to be exchanged between devices is critical to their (individual or collective) ability to make rational decisions on energy consumption or supply of energy to the grid. But in order to be "smart," the customer will rely on a choice of products – or applications – to simplify and communicate their choices for consumption. Such products, whether offered by a utility or a third-party Energy Service Provider (ESP), require the market to exist and the platform to be defined.

The Smart Utility is also being bombarded with new technology but at two levels. At the transmission level there is increased pressure for advanced monitoring and new sensing and control devices, from phasor monitoring units to variable frequency transformers. At the customer level there is increased pressure for AMI and AMR (Automatic Metering Infrastructure and Automatic Meter Reading) devices that can receive price information, report consumption, and respond to control signals.

At all levels, however, there are unresolved questions of exactly what this information will be. In what form will it be exchanged, how frequently and, critically, who "owns" it? Collectively, the outcome to those questions will form the platform on which the Smart Grid develops.

We argue that it is the Smart Market, designed and vetted under the careful eye of the Federal Energy Regulatory Commission and regulated by the Commission that will define and provide the market information – specifically, the price and quantity information – by which both the Smart Customer and the Smart Utility will find mutually beneficial and economically efficient solutions.

4. Action Required: Technical Conferences

As the Smart Grid Customer and the Smart Grid Utility are now receiving a high level of policy attention and public funding, we encourage the Commission to undertake an immediate and concerted effort to initiate a comparable process for the definition and coordination of the Smart Grid Market – the rational extension of "interoperability" to the full operational capabilities of the market. Just as the federal government, through FERC among other agencies, has convened industry stakeholders around development of the technical standards on which the Smart Grid will be designed, the Commission must now take the lead

in convening market participants at all levels to work through the slate of standards required for creation of a Smart Grid market platform.

Critically, that process should be through a series of FERC Technical Conferences in order that the results be public, formal, and "on the record." Doing so will enable all interested parties the opportunity to contribute their ideas and concerns, and in so doing bring to light additional questions that may not yet be fully appreciated or yet articulated. Further, well structured Technical Conferences will allow the Commission to gain from the experience of other consumer-oriented markets. Finally, FERC Technical Conferences will send an important signal to the technology development market that the regulatory and market structures needed for economic success are being framed, thereby setting the stage for greater investment and innovation in the Smart Grid space.

Among other issues due for careful consideration are the development of real-time rate structures (RTP) for both purchase and sale of energy, as required by Congress in the Energy Independence and Security Act of 2007 (EISA)[6]; the translation of utility real-time costs to customer prices; the unbundling of rate structures to allow utilities full recovery of cost; and most significantly, the coordination of wholesale and retail markets.

For these issues, we propose the Commission hold one set of Technical Conferences focused on questions of market reform needed for Smart Grid enablement. These conferences must be clear and focused in that purpose, so as not to drift back to interoperability or other not directly related issues, but broad in their consideration in order to allow all potential market issues to come to the table and receive due consideration. The Commission should consider holding these conferences regionally in order to capture input from the full diversity of geographically-dispersed wholesale market structures that exist.

Another set of issues, related to market reform but significant enough to warrant separate consideration, are questions of jurisdiction. We therefore propose a second set of Technical Conferences to explore Federal-State jurisdictional boundaries, and to identify respective Federal and State regulatory barriers. In that effort, we believe that the existing FERC-NARUC Smart Grid Collaborative could be a valuable framework for having those

[6] Energy Independence and Security Act of 2007, Pub. L. No. 110-140,121 Stat. 1492 (2007) (EISA).

discussions. The Smart Grid Collaborative, however, is illustrative of the general predisposition in Smart Grid policy activity toward technical development at the expense of market enablement. While the Collaborative was established with a general mission of "facilitating the transition to a smart electric grid,"[7] like so much other activity in recent years it has become more narrowly focused on advancing the technical platform for Smart Grid.

In addition to encouraging a broader outlook by the Commission in its Smart Grid policy activity, we identify one specific measure on which attention to market development can focus. Section 1307 of the EISA includes a Real-Time pricing requirement, amended to the Public Utilities Regulatory Policy Act of 1978 (PURPA). More specifically, Section 1307 states that:

> Purchasers and other interested persons shall be provided with information on—(I) time-based electricity prices in the wholesale electricity market; and (II) time-based electricity retail prices or rates that are available to the purchasers. [8]

Furthermore, the law requires that such data be provided on a not less than daily interval, and should include hourly price and use information as well as a day-ahead price projection. Each state regulatory authority was required to commence consideration of these mandates one year following passage of the 2007 law, and shall complete such consideration by the end of 2009.

We view this real-time pricing requirement as a key enabler of the Smart Grid market platform, and one which FERC should take a lead in enforcing. Through the proposed Technical Conferences, FERC and the state regulatory authorities should review efforts underway on real-time pricing consideration, and examine the results due from each state by the end of 2009.

5. Conclusion

We respectfully request that the Commission consider our comments and proposed Action Plan in further considerations of the policy with regard to Smart Grid.

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[7] Federal Energy Regulatory Commission. "Federal, State Regulators Convene Collaborative Dialogue on 'Smart Grid'." News Release: February 14, 2008. (http://www.ferc.gov/news/news-releases/2008/2008-1/02-14-08.asp)

[8] EISA sec. 1307.

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