COMPETITIVE SMART GRID PILOTS: A MEANS TO OVERCOME INCENTIVE AND INFORMATIONAL PROBLEMS

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INTRODUCTION

Smart Grid offers theoretical benefits for optimizing the production and consumption of electricity, yet it has become a polarizing topic as consumers consider hefty price tags for implementation. The federal government and many state legislatures have urged or mandated utilities to implement Smart Grid, with particular emphasis on aspects that are consumer-facing and designed to affect consumer demand for electricity.[1] In contrast, many consumer groups have objected to Smart Grid's considerable expense, despite its unproven benefits.[2] Other issues that have divided the public on Smart Grid include environmental benefits, economic efficiency through innovation, and privacy concerns.[3] The difficult task of balancing these diverging interests falls to state regulators, in most states called public service commissions (PSCs) or public utility commissions (PUCs).[4]

1. *See, e.g.*, UNITED STATES DEPARTMENT OF ENERGY, THE SMART GRID: AN INTRODUCTION (2008) HTTP://ENERGY.GOV/SITES/PROD/FILES/OEPROD/DOCUMENTSANDMEDIA/DOE_SG_BOOK_SINGLE_PAGES%281%29.PDF (stating that modernization of the electric grid is a colossal task but must be done); CAL. PUB. UTIL. CODE § 8360 (stating that it is the policy of California to achieve all listed characteristics of a smart grid).

2. *See, e.g.*, *Consumers Should Have a Choice About Smart Meters*, THE UTILITY REFORM NETWORK, http://www.turn.org/article.php?id=1473 (last visited Apr. 1, 2012).

3. *See generally* Elizabeth Hartman & Kaleb A. Sieh, *State Regulatory Opportunities and Impediments to Smart Grid*, Report No. 10, The Silicon Flatirons Roundtable Series on Entrepreneurship, Innovation, and Public Policy (Apr. 25, 2010), http://www.silicon-flatirons.org/documents/publications/report/StateRegulatoryOpportunitiesandImpedimentstoSmartGrid.pdf; Elias L. Quinn & Adam L. Reed, *Envisioning the Smart Grid: Network Architecture, Information Control, and the Public Policy Balancing Act*, 81 U. COLO. L. REV. 833, 844-45 (2010) (privacy concerns).

4. Public Utility Commission and Public Service Commission are the most common terms for the state utility regulator, though some states such as Massachusetts use different names.

Given uncertainties in the costs, benefits, new technologies, and implementation of Smart Grid, most state regulators have favored experimental pilots to gain more information before full deployment. State regulators have largely relied on utilities to design and implement these Smart Grid pilots. Utilities have an extraordinarily important role in testing and implementing Smart Grid, but designing innovative cost-efficient systems using nascent technologies to interact with consumers is not a utility core competency. However, under cost-of-service regulation, utilities have fundamental incentives to overbuild (or "gold plate") to increase their return and to avoid reducing the demand for electricity. Public relations risk creates mixed incentives because utilities may overspend to avoid errors but may also underspend to avoid denial of cost recovery for unpopular Smart Grid experiments. A utility also has far more information than its regulator about its motivations for choosing specific designs for Smart Grid systems. Regulators are unlikely to overcome these extreme problems of incentive misalignment and asymmetric information by using utility-implemented pilots alone.

Some theorists have advocated a competitive market for consumer-facing Smart Grid.[5] Competition theoretically offers large economic benefits, but it is important to not underestimate the complexities of designing electricity markets and the importance of continued utility involvement. Attempts to introduce competition into retail electricity markets have had mixed results in many states, including price spikes, limited consumer interest in switching providers, and market manipulation by Enron and others.[6] A competitive Smart Grid market also may not offer the powerful value propositions of the Internet and smart phones, to which Smart Grid is often compared.

Additionally, utilities have an important role to play, even if they are not ideally suited for technological innovation. Utilities have the best understanding of their service territories, and their input is crucial for selecting appropriate consumer subsets for Smart Grid pilots. Also, experienced, well-resourced utilities are better positioned to prioritize consumer and grid safety than the thinly capitalized emerging technology companies that might not be sufficiently risk-averse to those dangers.

This Note does not advocate for either full market competition in

5. *See* ASHLEY BROWN & RAYA SALTER, GALVIN ELECTRICITY INITIATIVE, SMART GRID ISSUES IN STATE LAW AND REGULATION 7-8 (2010), *available at* http://www.galvinpower.org/sites/default/files/SmartGridIssuesInStateLawAndRegulation_Whitepaper_Final(1).pdf; *see also* Roy Perry & Kenneth Wacks, *Creating a Robust Market for Residential Energy Management through an Open Energy Management Architecture*, CABLELABS 8 (Feb. 2010), http://www.cablelabs.com/downloads/pubs/residential_energy_management.pdf.

6. *See generally* FRED BOSSELMAN ET AL., ENERGY, ECONOMICS AND THE ENVIRONMENT 713-18 (3d ed. 2010).

consumer-facing Smart Grid or utility implementation. Rather, it suggests that introducing competition at the pilot stage is a tool that regulators and utilities can use to understand the likely costs and benefits of Smart Grid. By requiring competitive experimental pilots, ideally with multiple third-party technology companies playing roles of Smart Grid system designers, regulators can test what Smart Grid components are necessary and what demand-side benefits are achievable. By entrusting utilities with the role of double-checking the work of the designers, regulators can also reduce risks to consumers and the grid. Furthermore, regulators can preserve the option to choose either market competition or utility implementation for full Smart Grid deployment. Competitive pilots would benefit utilities by reducing the public relations risk of Smart Grid experiments being perceived as failures. Consumers would also benefit because they will no longer be the primary source of risk capital; Smart Grid designers and their investors would share some of the risk. Finally, technology companies would act as system designers in the competitive pilot structure, rather than mere vendors to utilities. This structure would send stronger market signals to technology companies by clarifying if their success depends more on providing cost-efficient service to individual consumers or on providing value to the utility and grid as a whole.[7]

Section II of this Note provides a historical overview of the growing interest in Smart Grid and the recent backlash from electricity consumers. Section III begins with a description of the physical components of consumer-facing Smart Grid and then identifies two key challenges of consumer-facing Smart Grid that distinguish it from traditional utility investments: 1) the necessity of consumer behavioral change, and 2) the incorporation of nascent technologies. Section IV frames the problems of misaligned incentives, informational asymmetries, and the inherent uncertainty of cost-of-service regulation. It then describes how the two key challenges of consumer-facing Smart Grid exacerbate those informational problems. Section V outlines the traditional legal doctrines that utility regulators have used to mitigate the informational problems of cost-of-service regulation and gives examples of how these doctrines have led to widely divergent guidance in recent Smart Grid decisions. Section VI highlights both arguments and counter-arguments for market competition as an alternative to cost-of-service regulation for consumer-facing Smart Grid. Finally, section VII proposes that regulators consider incorporating competition into Smart Grid pilots to gain information about the potential costs and benefits of Smart Grid, thereby preserving options for full deployment and reducing risks to

7. *See* Hartman & Sieh, *supra* note 3, at 7 (noting that vendors are unsure whether their customer is the utility or the end-user).

consumers and utilities.

I. RECENT HISTORY OF SMART GRID

In the last few years, the concept of Smart Grid has received an aggressive push from the federal government and some states, followed by a similarly aggressive backlash, largely from consumer groups. Approximately a decade ago, technical experts began to examine the potential for applying information technology to the electricity grid as a way to improve reliability and eliminate wasted power.[8] The California energy crisis of 2000 underscored the need to increase the price of electricity during times of peak use as a way to curb demand.[9] The high-profile Northeast Blackout of 2003 further spurred efforts to improve grid reliability.[10] These efforts focused on utility-facing technologies to view and control grid operations in real-time.

The federal Energy Policy Act of 2005 drew attention to smart meters, requiring all states to consider mandating utilities to install time-based meters to enable time-based electric rates.[11] In 2007, the Energy Independence and Security Act (EISA) gave an additional boost to Smart Grid. The Act declared, "It is the policy of the United States to support the modernization of the Nation's electricity transmission and distribution system . . . ."[12] Significantly, EISA emphasized consumer-facing technologies such as smart meters, smart appliances, electric vehicles and timely information and controls for consumers, alongside more traditional utility-facing technologies for control of grid operations.[13] Following EISA, the Department of Energy (DOE) and the Electric Power Research Institute (EPRI)[14] each funded a handful of Smart Grid demonstration projects.[15] Finally, the 2009 American

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8. *See Bringing Power to the People*, PAC. NW. NAT'L LAB.: ELEC. INFRASTRUCTURE OPERATIONS CTR., http://eioc.pnnl.gov/research/gridwise.stm (last visited Apr. 3, 2012).

9. ERICA CARERE ET AL., THE CALIFORNIA CRISIS AND ITS LESSONS FOR THE EU 3 (2001), *available at* http://www.brattle.com/_documents/UploadLibrary/Upload419.pdf.

10. *See* U.S.-CANADA POWER SYSTEM OUTAGE TASK FORCE, FINAL REPORT ON THE AUGUST 14, 2003 BLACKOUT IN THE UNITED STATES AND CANADA: CAUSES AND RECOMMENDATIONS 159-60 (2004), *available at* https://reports.energy.gov/BlackoutFinal-Web.pdf (recommending that DOE increase research into reliability related technologies).

11. Energy Policy Act of 2005, Pub. L. No. 109-58, § 1252(e)(3)(i) (codified as amended in various sections of 16 U.S.C.).

12. Energy Independence and Security Act of 2007, 42 U.S.C. § 17381 (2006).

13. *Id.*

14. The Electric Power Research Institute (EPRI) is a non-profit research and development organization whose membership represents 90% of the electricity generated and delivered in the United States. ELECTRIC POWER RESEARCH INSTITUTE, www.epri.com (last visited July 11, 2012).

15. ELECTRIC POWER RESEARCH INST., METHODOLOGICAL APPROACH FOR ESTIMATING THE BENEFITS AND COSTS OF SMART GRID DEMONSTRATION PROJECTS 1-2 to 1-4 (2010), *available at* http://www.smartgridnews.com/artman/uploads/1/1020342EstimateBCSmartGridDemo2010_1_.pdf.

Recovery and Reinvestment Act (ARRA) provided more than $4 billion for Smart Grid investments and demonstration projects.[16]

Aggressive advocacy for Smart Grid has accompanied federal support. For example, the DOE, in a non-technical brochure, proclaimed, "[a]sk not what the grid can do for you. Ask what you can do for the grid—and prepare to get paid for it."[17] President Obama, discussing ARRA's emphasis on Smart Grid, criticized the "century-old technology" of the current electric grid that "wastes too much energy, . . . costs us too much money, and [is] too susceptible to outages and blackouts."[18] The DOE also advised technology providers that "[y]our company has little time to lose" to capture a piece of the $200 billion Smart Grid market.[19] High profile investors have echoed this enthusiasm for Smart Grid.[20]

The backlash against Smart Grid has been similarly aggressive. In 2009, consumers in California filed a class action lawsuit against Pacific Gas & Electric (PG&E) when electricity bills spiked following installation of smart meters.[21] Although an independent audit found that the smart meters were accurate and that the price spikes were due to hot weather,[22] vocal opposition groups continue to resist smart meter rollouts.[23] Groups such as the AARP have voiced concerns that vulnerable consumers may be hardest hit by time-based electricity rates because they have less ability to benefit from time shifting incentives.[24] Industrial electricity consumers are also virulently opposed to expensive Smart Grid investments, which they view as driven by utilities rather than by the real needs or wants of customers.[25] As one advocacy group

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16. *Id.*

17. THE SMART GRID: AN INTRODUCTION, *supra* note 1, at 19.

18. BARACK OBAMA, REMARKS BY THE PRESIDENT ON RECOVERY ACT FUNDING FOR SMART GRID TECHNOLOGY (Oct. 27, 2009), *available at* http://www.whitehouse.gov/the-press-office/remarks-president-recovery-act-funding-smart-grid-technology.

19. UNITED STATES DEPARTMENT OF ENERGY, TECHNOLOGY PROVIDERS 4 (2009), *available at* http://www.oe.energy.gov/SmartGridIntroduction htm.

20. *See* Press Release, Kleiner Perkins Caufield & Byers, Kleiner Perkins Caufield & Byers Leads $75 Million Investment in Silver Spring Networks, Smart Grid Technology Leader, KLEINER PERKINS CAUFIELD & BYERS (Oct. 7, 2008), *available at* http://www kpcb.com/news/10/press_release ("Implementation of the Smart Grid is one of the most important clean technology initiatives of the coming decade.").

21. *Lawsuit Filed Against PG&E for Smart Meter Overcharges*, SMARTMETERS (Nov. 11, 2009), http://www.smartmeters.com/the-news/682-lawsuit-filed-against-pgae-for-smart-meter-overcharges html.

22. Martin LaMonica, *Audit Finds PG&E Smart Meters Accurate*, CNET (Sept. 2, 2010), http://news.cnet.com/8301-11128_3-20015475-54 html.

23. *See e.g.*, *Smart Meters: A Dumb Idea*, THE UTILITY REFORM NETWORK, http://www.turn.org/article.php?id=875 (last visited March 16, 2012).

24. Chris Carroll, *Wise Up About the Smart Grid*, AARP (July 26, 2010), http://www.aarp.org/politics-society/environment/info-07-2010/wise_up_about_the_smart_grid.2 html.

25. *See* Press Release, Statement of John Anderson, President, in Response to the Order

argues, consumers will be charged billions of dollars for smart meters and must spend more on in-home devices to see any benefits, yet consumers can already take low-tech actions such as changing thermostat settings and using efficient light bulbs to save electricity and money.[26]

This retrenchment has been reflected at state public utility commissions. As the president of the National Association of Regulatory Utility Commissions (NARUC) asserted, utilities and regulators have focused too much on consumer-facing Smart Grid technologies, which have less immediate value than upgrades to the distribution grid.[27] In the summer of 2010, the Maryland PSC's outright rejection of Baltimore Gas & Electric's full smart meter deployment, even though the utility had obtained a federal grant covering a portion of costs, signaled a cooling attitude towards Smart Grid at state commissions.[28] After questions surfaced regarding cost overruns in Xcel's SmartGridCity, the Colorado PUC opened a docket to gather more information before approving new Smart Grid proposals.[29]

II. CONSUMER-FACING COMPONENTS AND TWO KEY CHALLENGES

This section first describes the physical components of consumer-facing Smart Grid—Advanced Metering Infrastructure ("AMI") and the Home Area Network (HAN). The section then describes two demand-side benefits that these components enable: reducing overall energy consumption and shifting the time of load. AMI and HAN enable those benefits through two mechanisms—automating the consumer premises and providing feedback to consumers.

This section then describes two key challenges to regulation of consumer-facing Smart Grid: consumer behavioral change and nascent technologies. In contrast to utility-facing Smart Grid components, which enable system operators to monitor the grid and maintain reliable electricity supply, consumer-facing Smart Grid components allow consumers to interact with the grid to change their electricity demand.

of the Maryland Pub. Serv. Comm'n Denying BGE's Application to Deploy a Smart Grid Initiative, ELECTRICITY CONSUMERS RESOURCE COUNCIL (ELCON) (June 24, 2010), http://www.elcon.org/release_statements html.

26. *Smart Meters: A Dumb Idea*, *supra* note 23.

27. Nat'l Ass'n of Regulatory Util. Comm'rs, Initial cmts. on NPB Public Notice No. 2 - "Implementation of Smart Grid Technology" 5-6 (2009), http://www naruc.org/SmartGrid/.

28. *See* Balt. Gas & Elec. Co., 101 Md. P.S.C. 149, *9 (Md. P.S.C. June 21, 2010) (order).

29. Smart Grid and Advanced Metering Technologies, *Order Stating Preliminary Conclusions and Requesting Further Comments*, Colo. PUC Dkt. No. 10I-099EG/C10-1077 (Oct. 1, 2010), [hereinafter *Smart Grid Preliminary Conclusions Order*], *available at* https://www.dora.state.co.us/pls/efi/EFI homepage (follow "search"; then search "10I-099EG" under "Proceeding Number").

This difference presents two key challenges to traditional cost-of-service regulation. First, realizing demand-side benefits requires consumers to change their energy use behavior. Second, consumer-facing Smart Grid incorporates nascent technologies on the consumer premises with which utilities and their regulators are unfamiliar.

A. *Physical Components of Consumer-Facing Smart Grid*

Consumer-facing Smart Grid investments can be divided into two physical components: Advanced Metering Infrastructure (AMI) and the Home Area Network ("HAN"). The first component, AMI, consists of digital smart meters that record and transmit utility usage data in increments of one hour or less, plus back-end systems for data transmission, storage, and analysis.[30] Electric meters have been an instrumental part of utility infrastructure since Samuel Insull, the pioneer of the electric utility business model in the United States, instituted them at the start of the 20th century.[31] However, older electromechanical meters record only cumulative and peak electric usage data in order to function as the utility's "cash register." Smart meters still act as the cash register but also record time-of-use data and add two-way information flow. The meters transmit time-based usage data to utilities and send price signals to consumers via wireless technology that communicates with in-home devices or appliances.[32] Smart meters are not strictly essential for transmitting price signals to consumers or for measurement of real-time electricity usage because these functions can be accomplished through bolt-on technologies using existing analog meters.[33]

The second component, the Home Area Network (HAN), consists of on-premises displays and load control devices that enable communication between the electric grid, the consumer, and on-premises appliances or machines.[34] Typically, a HAN includes a central unit that

30. ELEC. POWER RESEARCH INST., PROD. ID 1014793, ADVANCED METERING INFRASTRUCTURE (AMI) (2007), *available at* www.epri.com (search for "1014793").

31. Harold L. Platt, *The Electric City*, *in* BOSSELMAN ET AL., *supra* note 6, at 569-70 (3d ed. 2010).

32. U.S. DEP'T OF ENERGY, THE SMART GRID: AN INTRODUCTION 11 (2008), *available at* http://energy.gov/oe/downloads/smart-grid-introduction-0 (noting that AMI sends price signals to in-home energy controllers or end-use devices).

33. U.S. DEP'T OF ENERGY, COMMUNICATIONS REQUIREMENTS OF SMART GRID TECHNOLOGIES 15-16 (2010), *available at* http://energy.gov/gc/downloads/communications-requirements-smart-grid-technologies.

34. EPRI's definition of the HAN is slightly ambiguous; EPRI describes both the HAN and the "HAN central unit" as devices that display information and communicate with appliances. *See* ELEC. POWER RESEARCH INST., PROD. ID 1018985, ADVANCED METERING INFRASTRUCTURE (AMI)/ HOME AREA NETWORK (HAN) ECONOMIC BENEFITS ANALYSIS FOR UTILITIES 1-1 (2009), *available at* www.epri.com (search for "1018985").

may simply display information or may control appliances either by issuing commands to appliances or by passing along signals that allow the appliances to make their own decisions.[35] Load control devices include shut-off switches installed on appliances and electrical outlet plugs ("smart plugs") that control electricity flow. Load control devices would be superfluous for "smart" appliances, which have built-in communications and control capabilities.[36] For clarity, this Note defines the HAN to include load control devices only if they are designed to communicate with the central unit or smart meter, as opposed to being controlled remotely by the utility.[37] Also, smart appliances, which may communicate with the smart meter or other in-home devices, are not part of the HAN. Finally, the HAN central unit is not technically required because Smart Meters are equipped with wireless technology for direct communication with smart appliances.[38]

B. Demand side benefits enabled by AMI and HANs

Utilities and their regulators often justify the cost of AMI and HAN investments on the basis of the two demand-side functions that they enable: reducing overall electricity consumption and shifting the time of day at which consumption occurs. Consumers may reduce overall consumption either through energy efficiency, by receiving the same "service" from more efficient appliances or machines, or through conservation, by using less of a machine's "service."[39] Reducing overall energy consumption results in both cost savings to consumers from decreased power purchases and reduced carbon emissions.

In contrast, shifting the time of day at which consumption occurs, also known as demand response or load shifting, primarily lowers system costs by reducing the use of expensive peaking plants and avoiding transmission congestion during times of peak load.[40] Load shifting does not necessarily reduce overall electricity consumption, and it can either

35. *See id.*

36. *See, e.g.*, Jeff St. John, *Whirlpool Plans 1M Smart Dryers by 2011*, GREENTECH MEDIA (Sep. 28, 2009), http://www.greentechmedia.com/articles/read/whirlpool-plans-to-make-1m-smart-dryers-by-2011/.

37. For example, Xcel's air conditioning "Saver's Switch" is installed on the outside of the building and controlled remotely by the utility. http://www xcelenergy.com/colorado (follow "Programs & Resources" under "Residential"; then follow "Saver's Switch").

38. *See* Jeff St. John, *RF Mesh, Zigbee Top North American Utilities' Smart Meter Wish Lists*, GREENTECH MEDIA (June 5, 2009), http://www.greentechmedia.com/articles/read/rf-mesh-zigbee-top-north-american-utilities-smart-meter-wish-lists/.

39. *See* PAC. NW. NAT'L LAB., PNNL-19112, THE SMART GRID: AN ESTIMATION OF THE ENERGY AND CO_2 BENEFITS 3.7 (2010).

40. Peaking plants are fueled by natural gas and run for less than 100 hours per year. The plants are costly because the capital cost of the plant must be recovered from the small annual volumes of energy sales. FCC, NATIONAL BROADBAND PLAN § 12 (2010), http://www.broadband.gov/plan.

increase or decrease carbon emissions depending on the fuel used to generate electricity at different times.[41] AMI and HANs may also provide benefits other than demand-side benefits. For example, AMI allows utilities to read meters remotely, thereby reducing operational costs. Similarly, real-time information about energy use can allow utilities to adjust operation of the grid for better performance. These ancillary benefits tend to be more easily quantifiable than demand-side benefits.[42]

C. Mechanisms and price signals to enable demand-side benefits

AMI and HANs enable these two demand-side benefits—reduced consumption and load shifting—through two mechanisms: automation of the consumer premises and feedback to consumers. In automation of the premises, consumers "set it and forget it," meaning that Smart Grid systems automatically regulate energy consumption based on preset consumer preferences for cost, use, and possibly environmental impact.[43] In contrast, feedback works by giving information about energy use and cost to consumers who change their energy use in response. In general, more immediate and detailed feedback produces a greater customer response than delayed feedback such as end-of-month billing.[44]

For load shifting to occur, consumers must receive time-based price signals. Time-based pricing means that the price of electricity to the consumer corresponds, at least roughly, to the cost of generating and delivering that electricity, which fluctuates within a single day and between seasons.[45] Large commercial and industrial consumers have used time-based pricing for many years; Smart Grid enables this type of pricing for residential and small commercial customers. By matching the price of electricity to the cost of generating it at a particular time, market mechanisms can function more effectively to curb demand during peak prices. Time-based price signals are not necessarily highly granular; for example, many pricing schemes use only two daily rates: peak and off-peak.[46] Time-based pricing can also take the form of a "peak-time

41. *See id.* § 4 (discussing the relative benefits to utilities, consumers, and the environment from reduced consumption and load shifting).

42. *See Smart Grid Preliminary Conclusions Order*, *supra* note 29, at 7.

43. *See generally* KAREN EHRHARDT-MARTINEZ ET AL., AMERICAN COUNCIL FOR AN ENERGY-EFFICIENT ECONOMY, RPT. NO. E105, ADVANCED METERING INITIATIVES AND RESIDENTIAL FEEDBACK PROGRAMS: A META-REVIEW FOR HOUSEHOLD ELECTRICITY-SAVING OPPORTUNITIES 25-33 (2010), *available at* http://www.aceee.org/research-report/e105.

44. *Id.* at iii.

45. *See generally* ELEC. POWER RESEARCH INST., PROD. ID 1005945, CUSTOMER RESPONSE TO ELECTRICITY PRICES: INFORMATION TO SUPPORT WHOLESALE PRICE FORECASTING AND MARKET ANALYSIS, at xvi (2001), *available at* www.epri.com (search for "1005945").

46. *See* SmartGridCity Pricing Pilot, *Decision Approving Settlement with Modifications*,

rebate" for decreased consumption during peak times relative to historical usage or "critical peak pricing," which increases prices on only a handful of days with the highest electricity demand throughout the year.[47] Several other time-based pricing permutations are also possible.

In addition, both demand-side benefits require general consumer education. Three-quarters of Americans know little or nothing about the Smart Grid or smart meters.[48]Consumers need instruction on how they can use and benefit from time-based pricing and what risks are entailed.[49] Moreover, as Pacific Gas & Electric discovered, ignoring customer concerns and skepticism about new meters and failing to explain time-based rates can result in significant backlash.[50]

D. Consumer-Facing Smart Grid Contrasted with the Utility-Facing Grid

Consumer-facing Smart Grid components can be contrasted with components of the utility-facing transmission and distribution grids. Utility-facing grid components are largely invisible to consumers, but they prevent adverse reliability events ranging from momentary voltage sags to regional blackouts. Utility-facing Smart Grid investments include super-efficient cables, better voltage sensors and controls, and communication systems that convey the grid's operational status to the system operator.[51] Investments in transmission and distribution have been the traditional purview of utilities since the early 20th century.[52]

Colo. PUC Dkt. No. 09A-796E/C10-0491, at 3 (Apr. 27, 2010), [hereinafter *Xcel Energy Pricing Pilot Decision*], *available at* https://www.dora.state.co.us/pls/efi/EFI homepage (follow "search"; then search "09A-796E" under "Proceeding Number"); Experimental Rate Schedule Classifications, *Finding and Order*, Ohio PUC Dkt. No. 10-424-EL-ATA, 2010 WL 5055079, ¶ 2 n. 2 (Dec. 1, 2010) (slip copy).

47. *See Finding and Order*, 2010 WL 5055079 at 3-4.

48. *Smart Grid and Smart Meter Technologies Little Understood Support for the Energy-Saving Technologies High When Explained* [sic], PR Newswire (Dec. 14, 2010), http://www.prnewswire.com/news-releases/smart-grid-and-smart-meter-technologies-little-understood-support-for-the-energy-saving-technologies-high-when-explained-111845179 html; *see also* Smart Grid and Advanced Metering Technologies, *Order Stating Conclusions and Next Steps*, Colo. PUC Dkt. No. 10I-099EG/C11-0406, ¶ 17 (Apr. 19, 2011) [hereinafter *Smart Grid Final Conclusions Order*], *available at* https://www.dora.state.co.us/pls/efi/EFI homepage (follow "search;" then search "10I-099EG" under "Proceeding Number") (noting research by the Smart Grid Consumer Collaborative).

49. *See Xcel Energy Pricing Pilot Decision*, *supra* note 46, ¶¶ 7, 13.

50. *See PG&E Advanced Metering Assessment Report*, STRUCTURE CONSULTING GRP., LLC (Sept. 2, 2010), *available at* http://www.cpuc.ca.gov/PUC/energy/Demand+Response/solicit html.

51. *See* ELEC. POWER RESEARCH INST., METHODOLOGICAL APPROACH FOR ESTIMATING THE BENEFITS AND COSTS OF SMART GRID DEMONSTRATION PROJECTS 1-1 (2010) (listing specific Smart Grid investments at the transmission and distribution levels).

52. James Trefil, *A Scientist in the City*, *in* FRED BOSSELMAN ET AL., *supra* note 6, at 564-65.

Utilities and their regulators evaluate the need for such investments by weighing the costs of upgrades against the quantified system benefits from improved reliability. Many utility-facing Smart Grid investments in transmission and distribution infrastructure can be justified solely on the basis of this cost-benefit analysis.[53]

E. First Regulatory Challenge: Consumer Behavioral Change

The first key challenge to traditional cost-of-service regulation of consumer-facing Smart Grid is that consumer-facing investments require behavioral change from consumers to realize demand-side benefits. Utilities traditionally have considered consumer demand as an uncontrollable variable that can only be addressed by dispatching sufficient electricity generation.[54] Investments in the transmission and distribution grid generally provide for reliable electricity supply to meet that demand, without requiring consumers to change their behavior.

The necessity of consumer behavioral change also sets Smart Grid investments apart from older Demand-Side Management ("DSM"), an umbrella term for utility efforts to reduce overall demand or shift load. Utilities have engaged in DSM since the late 1970s in response to regulatory incentives.[55] For residential customers, DSM has typically taken the form of rebates to consumers for actions such as purchasing a new water heater or insulating a building. Such programs do not transform the market for energy because the effects cease when the rebate is no longer offered.[56] Direct load control is another form of DSM, where the utility remotely controls appliances such as the consumer's central air conditioning unit, and the customer gets a rebate or price break in return. For example, Xcel Energy's "Saver's Switch" program requires no action from the consumer. The utility installs the equipment outside the home and triggers the switch remotely when needed for grid operations; the consumer may not even notice any effects.[57] Furthermore,

53. *Smart Grid Preliminary Conclusions Order*, *supra* note 29.

54. *Testimony of Suedeen G. Kelly, Comm'r, FERC, Before the Energy and Env't Subcomm. of the H. Comm. on Sci. and Tech.*, 111th Cong. 2 (2009), *available at* http://www ferc.gov/media/cong-affairs/111.asp (follow "Commissioner Kelly's Testimony" under "July 23, 2009").

55. FRED BOSSELMAN ET AL., *supra* note 6, at 975.

56. Interview with Jeffrey Ackermann, Section Chief, Research & Emerging Issues, Colo. PUC, in Denver, Colo. (Dec. 22, 2010); *see also* Strategic Issues Related to DSM Plan, *Order Granting Application with Modifications*, Colo. PUC Dkt. No. 10A-554EG/C11-0442, ¶ 92 (Apr. 26, 2011) [hereinafter *DSM Order*], *available at* https://www.dora.state.co.us/pls/efi/EFI.homepage (follow "search"; then search "10A-554EG" under "Proceeding Number") (defining market transformation as strategies to remove barriers to the adoption of energy efficiency measures and to effect a permanent shift in the market).

57. Boyd Huppert, *Xcel Energy Customers Saving Money with 'Saver's Switch'*, KARE11.COM, (Aug. 11, 2010), http://www.kare11.com/news/news_article.aspx?

there is no uncertainty about what the utility has "bought" because customers must buy the water heater or sign up for the program before receiving the rebate.[58]

In contrast, the demand-side benefits of Smart Grid require consumer behavioral change, an entirely new variable for utilities. Behavioral change can take the form of habitual changes such as air-drying clothes, infrequent but inexpensive behaviors such as installing fluorescent bulbs, or infrequent and relatively expensive behaviors such as purchasing new smart appliances.[59] Even automation of the consumer premises, which does not require ongoing attention from the consumer, requires an initial purchase of the prerequisite devices or appliances.

F. Regulatory Challenge: Nascent Technologies

A second key challenge of consumer-facing Smart Grid is that it involves nascent technologies, with which utilities and regulators have very little experience. Robust communications networks are one such new technology. Utilities have traditionally built private, narrowband networks for critical grid applications, and those networks do not communicate with customers.[60] In contrast, consumer-facing Smart Grid requires two-way communication so consumers can receive time-based prices and the consumer premises can send usage data back to the grid. Sophisticated on-premises consumer interfaces are a second example of technology that is a new phenomenon for utilities and regulators. Interfaces are crucial because the interface prompts the customer to change energy usage. However, utilities have almost no experience in this domain.

The nascent technologies present an accounting challenge as well. Smart meters, in-home devices, and communications networks may become technologically obsolete before the end of their useful physical lives. These technologies differ from transmission and distribution assets that have more predictable useful lives over which they can be depreciated.[61] Thus, regulators must balance between rapid depreciation to keep pace with innovation and slower depreciation to lessen the burden on consumers.

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storyid=865094.

58. *See* Database of State Incentives For Renewables & Efficiency, http://www.dsireusa.org (last visited Mar. 15, 2012) (describing energy efficiency programs by state).

59. *Id.*

60. NATIONAL BROADBAND PLAN, *supra* note 40, § 12.1.

61. BROWN & SALTER, *supra* note 5, at 7-8.

III. CONSUMER-FACING SMART GRID EXACERBATES INFORMATIONAL PROBLEMS

This section first clarifies that this analysis of consumer-facing Smart Grid investments applies at the state level, and only where states use cost-of-service regulation for those investments. It then details the problems of misaligned incentives, information asymmetry, and uncertainty inherent in traditional cost-of-service utility regulation. Next, the section describes how the two key regulatory challenges described in the previous section—consumer behavioral change and nascent technology—exacerbate informational problems. Finally, the section notes an important trade-off that is difficult for regulators to scrutinize because of informational problems. Specifically, where utilities prioritize load shifting over reduced consumption of electricity, the trade-off alters the relative benefits to utilities, consumers, and the environment.

A. State Regulation and Retail Competition

As an initial legal matter, states have jurisdiction over the implementation of consumer-facing Smart Grid because both AMI and HANs involve the retail sale of electricity, over which the federal government has no jurisdiction under the Federal Power Act.[62] Therefore, the implementation of consumer-facing Smart Grid is being shaped at the state level.

The presence of retail competition in some states adds another wrinkle to the implementation of consumer-facing Smart Grid. Generally in retail competition states, the distribution of electricity (the "wires" business) is still a regulated monopoly, but retail marketers compete to broker electricity between generators and customers.[63] In some retail competition states, such as Texas, the state commission has authorized the distribution utility to install AMI and recover costs through a distribution surcharge, essentially mimicking investments under cost-of-service regulation.[64] However, it is also possible for the retail marketer to provide a meter that meets distribution specifications, or even for the customer to purchase the meter.[65] This section addresses the challenge of using traditional cost-of-service regulation for AMI and HAN

62. Federal Power Act, 16 U.S.C. § 824(b), (d) (2006) (providing for federal jurisdiction over the regulation of sales of electricity for resale in interstate commerce but not for "any other sale of electric energy"); Fed. Power Comm'n v. S. Cal. Edison Co., 376 U.S. 205, 212-14 (1964) (explaining the bright line rule that states have exclusive jurisdiction to regulate retail electricity sales).

63. *See* BOSSELMAN ET AL., *supra* note 6, at 686-87.

64. *See* Electric Meters, Customer Facts, PUB. UTIL. COMM'N OF TEXAS (Aug. 2011), http://www.puc.state.tx.us/consumer/facts/factsheets/elecfacts/meter.pdf (noting that distribution utilities, not retail electric providers, are responsible for meters).

65. BROWN & SALTER, *supra* note 5, at 26.

investments because that approach is the most common across states.

B. Misaligned Incentives, Informational Asymmetries, and Uncertainty

The informational problems inherent in cost-of-service regulation have long been recognized and are well-documented. Under cost-of-service regulation, the regulator attempts to determine, through administrative proceedings, the fixed and variable costs to the utility of providing the service.[66] The utility recovers its costs plus an administratively-set rate of return on only the fixed-cost portion through electricity rates. In recent years, utilities have also sought a variety of special rates and riders outside of fixed and variable costs as a more guaranteed way to get dollar-for-dollar cost recovery.[67]

Under cost-of-service regulation, utilities have a basic incentive to spend money on capital investments and to sell more power. As long as the utility can justify the investment to its regulator, the utility's rational economic choice is to spend more than necessary or "gold-plate" investments because it earns a rate of return on any capital spent.[68] However, utilities have a countervailing incentive to be cautious because regulators allow recovery only of "prudent" investments.[69] Furthermore, as advocates of conservation and energy efficiency have long noted, utilities have a fundamental incentive to sell more power to earn more revenues or to spread the costs of investments over more units of power.[70] Thus, utilities have a strong incentive to ignore any demand-side efficiencies that might result in loss of power sales.[71] This problem can be remedied, albeit at the cost of significantly shifting risk towards consumers, by restructuring incentives for utilities.[72] Most states have implemented incentives for utilities to pursue demand response or energy efficiency programs, and some states have "decoupled" revenue from power sales to make utilities indifferent between selling more power and curbing demand.[73]

Regulators also face informational asymmetries when trying to

66. *See* Stephen Breyer, *Analyzing Regulatory Failure: Mismatches, Less Restrictive Alternatives, and Reform*, 92 HARV. L. REV. 549, 562-64 (1979).

67. *See* Lino Mendiola, *The Erosion of Traditional Ratemaking through the use of Special Rates, Riders, and other Mechanisms*, 10 TEX. TECH. ADMIN. L.J. 173, 173-74 (2008).

68. Alan Devlin, *Antitrust in an Era of Market Failure*, 33 HARV. J.L. & PUB. POL'Y 557, 577 (2010).

69. *See infra* Part V.

70. Sandra Levine & Katie Kendall, *Energy Efficiency and Conservation: Opportunities, Obstacles, and Experiences*, 8 VT. J. ENVT'L L. 101, 104 (2006-07).

71. BROWN & SALTER, *supra* note 5, at 8.

72. *See* Mendiola, *supra* note 67, at 185-87.

73. *See generally* Pamela G. Lesh, *Rate Impacts and Key Design Elements of Gas and Electric Decoupling: A Comprehensive Review*, 22:8 THE ELECTRICITY J. 65, Oct. 2009.

regulate utility investments. The utility knows far more about its investment options and costs than a regulator can ascertain through an administrative proceeding. Thus, a regulator will always be at a disadvantage relative to the utility in determining whether an investment is optimal and whether the utility is ignoring externalities. For example, a utility may have a choice between two vendors to construct a transmission line. The utility could argue that the more expensive vendor should construct the line, arguing that the expensive vendor does higher quality work. The informational asymmetry between the regulator and the utility would prevent the regulator from knowing whether the utility is motivated more by the difference in quality or by the increased cost, which boosts the utility's return. Furthermore, to the extent that the utility itself suffers from an informational asymmetry with the vendor, for example, where the utility does not know that the vendor plans to cut corners on quality to boost its profit margins, the regulator will also suffer that asymmetry.

Uncertainty also plagues both regulators and utilities. Regulators can know historical utility costs, but they face uncertainty about future costs, such as fuel, labor, unforeseen mechanical issues, and changes in compliance standards for environmental, workplace safety, or other regulatory regimes. They also face uncertainty about future demand for electricity, including the effects of future weather, new and untested demand-side programs, and larger economic trends. For example, Public Service Company of Colorado, a subsidiary of Xcel Energy, recently had an unexpected year-to-year decline in overall energy consumption, the first such decline in many decades.[74] While these uncertainties in cost and demand are not different in kind than those faced by sellers in a competitive market, cost-of-service regulation shifts the risk of error from the owners of the business to its consumers. In addition, the utility industry requires massive capital investment to build infrastructure with a decades-long useful life. The long time horizon requires utilities and regulators to plan for needs far in the future, while the large capital investment increases the stakes.

Utilities also face regulatory uncertainty, especially regarding cost recovery, so utilities often seek pre-approval from their regulators in the form of a prudence determination.[75] Commonly, utilities will seek a legislative bargain to ensure cost recovery. For example, if a utility can secure a statutorily guaranteed return for particular kinds of investments like renewable energy generation, it can avoid the uncertain process of

74. Interview with Mary Fisher, Vice Pres., Strategic Technology, Xcel Energy, in Denver, Colo. (Nov. 23, 2010).

75. BROWN & SALTER, *supra* note 5, at 10.

the state regulator's cost-benefit analysis for those investments.[76]

C. *Consumer Behavioral Change Exacerbates Informational Problems*

The first key challenge of consumer-facing Smart Grid—the necessity of consumer behavioral change for demand-side benefits to be realized—exacerbates the informational problems of cost-of-service regulation. Utilities have a strong core incentive for demand-reduction programs to succeed only marginally, and adding consumers to the equation magnifies information asymmetries and uncertainty. In demand-reduction programs, utilities have an incentive not to overshoot mandates or regulatory incentives for reduced demand because doing so would reduce electricity sales and profits. In traditional DSM programs, it is comparatively easy not to overshoot mandates because the utility spends a finite dollar amount to procure a fixed number of efficiency retrofits, efficient hot water heaters, or other easily quantifiable reductions in demand. In consumer-facing Smart Grid, reductions in demand result from consumer behavioral change. The utility has a strong incentive not to prompt widespread behavioral change that could grow uncontrollably and reduce future power sales. Unfortunately, informational asymmetries prevent regulators from knowing whether the utility has chosen the most cost-effective methods to induce behavioral change. Regulators and utilities also face considerable uncertainty about how consumers will behave in response to various prompts. Consumer behavior is far more uncertain than traditional utility investments, such as the way that a transformer on the distribution grid will function over time.

Consumer education campaigns about Smart Grid are a good illustration of these issues. For example, National Grid proposed a potpourri of consumer education activities for its Smart Grid pilot in Worcester, Mass., including "neighborhood block parties, house parties, contests, school programs, badges of honor, smart breakfast series, and super users."[77] Though the pilot is required to attempt a 5-percent average reduction in electricity use under the Massachusetts Green Communities Act,[78] the utility's incentive to meet (or exceed) the mandate may not be particularly strong because the utility will recover its costs regardless of outcome. On the other hand, utilities have a tremendous interest in maintaining strong relations with their

76. Interview with Ray Gifford, former Comm'r, Colo. PUC, in Denver, Colo. (Dec. 22, 2010); *see also* Mendiola, *supra* note 67, at 174, 181 (noting the increasing prevalence of special legislative and regulatory deals that guarantee cost recovery or profits before investments are made).

77. In Re Mass. Elec. Co., 2010 WL 3200339, *26 (Mass. D.P.U. July 27, 2010) (order).

78. BROWN & SALTER, *supra* note 5, at 48.

ratepayers.[79] However, the informational asymmetries are an enormous hurdle for the regulator to discern whether National Grid is spending the funds, $2 million in this case, to promote behavioral change or to meet the utility's branding and public relations needs. Because of the extraordinary uncertainty in consumer behavior change and how best to achieve it, benchmarking National Grid's results will be difficult no matter how well the utility executes the pilot.

D. Nascent Technologies Exacerbate Informational Problems

Utilities' and regulators' unfamiliarity with the nascent technologies of consumer-facing Smart Grid also poses extreme informational problems.[80] Utilities have a powerful incentive to recover their investment costs plus a rate of return. With nascent technologies, utilities face several downsides. The potential for technological obsolescence means that the allowed depreciation schedule for the asset may be inadequate.[81] The regulator may also disallow cost recovery if the technology fails.[82] At the same time, the upside is capped because the utility will not be able to earn more than the regulated rate of return, even if the technology is wildly successful.[83] As a result, the utility's technology choices will prioritize the likelihood of cost recovery over the technology's performance or cost. In addition, the Smart Grid market is diverse and rapidly evolving; given the informational asymmetries, it would be difficult to know whether the utility is purchasing a "Cadillac" when a cheaper option would do. Furthermore, because the "market" price for Smart Grid components is determined by regulation, an informational asymmetry exists with vendors, who may charge the maximum that regulators appear willing to approve for cost recovery.[84] Finally, utilities and regulators face tremendous uncertainties in performance, cost, and product evolution of Smart Grid components.

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79. Interview with Jeffrey Ackermann, Section Chief, Research & Emerging Issues, Colo. PUC, in Denver, Colo. (Dec. 22, 2010).

80. *See, e.g.*, Request for Approval of Advanced Metering System Deployment Plan, *Order*, Tex. PUC, Dkt. No. 36928, ¶ 87, 2009 WL 5013965 (Dec. 17, 2009) ("The size, novelty, complexity, and duration of AEP Texas' AMS deployment plan, and other causes beyond AEP Texas' reasonable control, make it impossible to precisely estimate the final reasonable and necessary cost . . . .").

81. BROWN & SALTER, *supra* note 5, at 7-8.

82. *Id.* at 9.

83. *Id.*

84. *See, e.g.*, Request for Approval of Advanced Metering System Deployment Plan, *Order*, *supra* note 80, ¶¶ 41, 47 (stating without explaining that the average installed costs of residential meters, at $161 and $176, are reasonable and requiring only the submission of executed contracts if the utility chooses different meters in the future); *see also* Compliance Filing for Advanced Metering Status Reports, *Filing*, Appx. A, Tex. PUC, Dkt. No. 36928, Control No. 37907, 2011 WL 5890673 (Nov. 15, 2011) (showing two different unit costs for meters of $99 and $216).

Rapidly changing technology injects uncertainty about when to invest, a consideration that is not as pronounced for improvements in distribution grid technology.

The communications network "before the meter" in AMI investments is a good example of how Smart Grid technology exacerbates informational problems. For example, Xcel Energy's SmartGridCity pilot cost $44.8 million, triple the original estimate.[85] Much of the cost overrun resulted from laying fiber optic cable, a fast and reliable type of communications network, but much more expensive than using wireless mesh technologies or commercial communications networks.[86] Utilities have a financial incentive to invest in expensive private communications systems as long as regulators approve;[87] however, they also have strong regulatory and public relations incentives to ensure that communications systems do not compromise the security or reliability of the grid. Thus, what the public perceives as overspending or delay may actually reflect appropriate caution on the part of utilities.[88] In the case of SmartGridCity, the informational asymmetries make it difficult to weigh Xcel's contention that there was no viable alternative to broadband-over-power line,[89] or that Qwest's DSL was insufficiently robust,[90] against the possibility that Xcel proceeded when the project was over budget merely to maintain its franchise with Boulder, Colo., or to improve its public perception.[91] In addition, the broad, and vaguely articulated, purpose of the project, "to test the feasibility of smart grid technologies and to provide a platform for testing future concepts," offers little certainty about the investment required to maintain grid reliability.[92]

85. Mark Jaffe, *Xcel Says Costly SmartGridCity Pilot Project in Boulder Won't be Repeated or Expanded*, DENVER POST, (Aug. 24, 2010), http://www.denverpost.com/business/ci_15872574.

86. Jeff St. John, *Xcel's SmartGridCity Can Thank Fiber For Ballooning Costs*, GIGAOM (Feb. 9, 2010), http://gigaom.com/cleantech/xcel's-smartgridcity-can-thank-fiber-for-ballooning-costs.

87. NATIONAL BROADBAND PLAN, *supra* note 40, § 12.2.

88. Interview with Mary Fisher, Vice Pres., Strategic Technology, Xcel Energy, in Denver, Colo. (Nov. 23, 2010) (describing Xcel's need to test vendor HAN equipment when some equipment demonstrated inadequate performance or security).

89. SmartGridCity CPCN, *Public Service Company of Colorado's Response to Exceptions*, Colo. PUC Dkt. No. 10A-124E, at 24 (Nov. 30, 2010), *available at* https://www.dora.state.co.us/pls/efi/EFI.logon.

90. *See* Anne Butterfield, *Butterfield: Boulder's SmartGridCity is Looking Dim*, DAILY CAMERA, (Feb. 21, 2010), http://www.dailycamera.com/ci_14435209.

91. SmartGridCity CPCN, *Exceptions of the Colorado Office of Consumer Counsel to the Recommended Decision*, Colo. PUC Dkt. No. 10A-124E, at 13 (Nov. 16, 2010), *available at* https://www.dora.state.co.us/pls/efi/EFI.logon.

92. *See Public Service Company's Response to Exceptions*, *supra* note 89, at 8.

E. Reduced Consumption versus Load Shifting

One very important manifestation of informational problems at the core of Smart Grid's purported environmental and consumer benefits is the extent to which a Smart Grid design prioritizes load shifting over reduced overall electricity consumption. These two demand-side capabilities provide very different utility, consumer, and environmental benefits, and informational problems make it difficult for regulators to scrutinize utilities' choices. Reducing overall energy consumption results in both cost savings to consumers from decreased power purchase, and reduction of CO_2 emissions. The Smart Grid has the potential to reduce electricity consumption and CO_2 emissions by double-digit percentages by 2030.[93] However, reducing overall electricity use is counter to regulated utilities' basic incentive to sell more power. Utilities might be interested in some reductions of overall use where generation resources are constrained, but most utilities are currently "long" on generation.[94]

Load shifting, on the other hand, is primarily a strategy to lower system costs by reducing the use of costly peaking plants and to avoid transmission congestion during peak load times.[95] Utility-implemented Smart Grid pilot programs have shown a reduction in peak load of 3-20%, increasing to 27-44% when in-home devices are used.[96] This smoothing of the load curve over daily cycles usually appeals to utilities because of the potential for improving grid stability and asset utilization. However, load shifting does not generally reduce energy consumption.[97] Furthermore, it can either reduce or increase carbon emissions, depending on the generation mix dispatched by a particular utility; shifting to more efficient intermediate plants during the "shoulders" before or after peak demand may decrease carbon emissions,[98] whereas

93. PAC. NW. NAT'L LAB., *supra* note 39, at 4.6-4.7 (comparing the PNNL study with three others and finding a range of approximately 3% to 18% reductions below the Energy Information Agency 2030 base case).

94. Interview with Ray Gifford, former Comm'r, Colo. PUC, in Denver, Colo. (Dec. 22, 2010).

95. Peaking plants are fueled by natural gas and run for less than 100 hours per year. Peaking plants are costly because the capital cost of the plant must be recovered from the small annual volumes of energy sales. *See* NATIONAL BROADBAND PLAN, *supra* note 40, § 12.

96. *Id.* (citing AHMAD FARUQUI & SANEM SERGICI, HOUSEHOLD RESPONSE OF DYNAMIC PRICING TO ELECTRICITY—A SURVEY OF THE EXPERIMENTAL EVIDENCE (2009)).

97. Some load shifting may actually increase energy consumption; for example, pre-heating or pre-cooling a room or volume of water consumes slightly more energy. *See* PAC. NW. NAT'L LAB., *supra* note 39, at 3.8-3.9.

98. Peaking plants are generally single-cycle gas turbines, which are not much more efficient than coal plants in terms of the percentage of fossil fuel converted to electricity. Off-peak natural gas plants are usually combined-cycle gas turbines, which are more efficient. The actual carbon savings will vary with the mix of peak and off-peak generating plants, but California quantified 10 to 20 percent carbon savings from load shifting. *See id.* at 3.22-3.23.

shifting to coal plants during off-peak use may increase emissions.[99]

Utility AMI proposals often claim to offer both types of demand-side benefits, yet utilities have stronger incentives for load shifting than for reducing consumption. Reducing energy consumption is the cheapest and most effective means to reduce carbon emissions in the United States.[100] Providing real-time use and price information to consumers has the potential to reduce energy consumption by 5 to 15 percent.[101] However, there appears to be a trade-off: feedback to consumers that focuses on load shifting achieves less overall reduction in energy use.[102] Given uncertainties in the industry about how to integrate the two benefits, regulators will be hard-pressed to ascertain whether utilities have given sufficient weight to reducing energy consumption. Smart Grid energy savings targets set by state legislatures do not resolve this uncertainty; there is no reason to think that legislatures are in the best position to know the cost and performance potentials for Smart Grid investments. Furthermore, even when a utility vigorously claims that both benefits will occur, informational asymmetries may prevent regulators from knowing whether utility-chosen designs prioritize load shifting over overall energy savings benefits.

IV. STATE UTILITY COMMISSION RESPONSES

This section describes the traditional legal doctrines that utility regulators have used to address the problems of misaligned incentives, informational asymmetries, and uncertainty. In applying these doctrines, state regulators have varied widely in their willingness to approve consumer-facing Smart Grid investments. The variation owes in part to differing legislative mandates across states, different stages or magnitudes of Smart Grid deployment, and evolving public opinion.

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99. For example, levelizing the load curve in Colorado would likely increase carbon emissions because coal-fired plants provide over seven-tenths of Colorado's electricity. Coal is almost always a baseload source of energy, so shifting use to off-peak times would increase coal consumption. *See Colorado: Analysis*, U.S. ENERGY INFO. ADMIN., http://www.eia.gov/state/state-energy-profiles-analysis.cfm?sid=CO (last updated Oct. 2009) (proportion of Colorado electricity from coal).

100. PETER FOX-PENNER, THE BRATTLE GROUP, RETURN OF THE ENERGY SERVICES MODEL: HOW ENERGY EFFICIENCY, CLIMATE CHANGE, AND SMART GRID WILL TRANSFORM AMERICAN UTILITIES 1 (2009), *available at* http://www.brattle.com/_documents/UploadLibrary/Upload767.pdf.

101. ELEC. POWER RESEARCH INST., THE GREEN GRID: ENERGY SAVINGS AND CARBON EMISSIONS REDUCTIONS ENABLED BY A SMART GRID 7-2 (2008) (citing SARAH DARBY, ENVTL. CHANGE INST., UNIVERSITY OF OXFORD, THE EFFECTIVENESS OF FEEDBACK ON ENERGY CONSUMPTION: A REVIEW FOR DEFRA OF THE LITERATURE ON METERING, BILLING AND DIRECT DISPLAYS (2006), *available at* http://www.smartgridnews.com/artman/uploads/1/SGNR_2009_EPRI_Green_Grid_June_2008.pdf).

102. EHRHARDT-MARTINEZ, *supra* note 43, at 64-68.

However, the variation also reflects the inadequacy of traditional cost-of-service regulation given the extreme informational problems of consumer-facing Smart Grid.

A. Traditional Utility Regulation Doctrines

The Takings Clause of the Fifth Amendment, as applied to the states through the Fourteenth Amendment, requires that regulated rates for electricity be just and reasonable.[103] When setting rates, regulators must balance investor and consumer interests.[104] Rates can neither be so low as to be confiscatory to utilities and their investors, nor so high as to be exploitative to consumers.[105] Most state regulation of utility rates also incorporates a statutory "just and reasonable" standard.[106] The just and reasonable standard entails considerable uncertainty for utilities and consumers because a wide range of results is possible. On one hand, neither regulation nor the Constitution guarantee utilities a right to profits;[107] on the other hand, consumers may pay high retail prices where regulators approve expensive utility actions.[108]

Two additional doctrines, "prudent investment" and "used and useful," guide the allocation of risks and costs between utility investors and consumers. A regulator's determination that an investment was prudent when made gives the utility greater certainty that it will be able to recover costs incurred.[109] Alternately, a regulator's determination that an investment is not "used and useful" to the public, meaning that it was never placed in service, generally precludes cost recovery of the investment.[110] In a concurring opinion to *Jersey Central Power and Light*, Judge Starr argued compellingly that "prudent investment" and "used and useful" are two countervailing doctrines that help courts and regulators to balance the utility's need for certainty in investment decisions with consumers' legitimate interest in not paying for

103. *See* Fed. Power Comm'n v. Hope Natural Gas Co., 320 U.S. 591, 607 (1944) ("[T]here are no constitutional requirements more exacting than the [just and reasonable] standards of the [Natural Gas] Act . . . .").

104. *Id.* at 603.

105. *See* Jersey Cent. Power and Light Co. v. Fed. Energy Regulatory Comm'n, 810 F.2d 1168, 1180 (D.C. Cir. 1987) (citing *Hope Natural Gas Co.*, 320 U.S. 591).

106. BOSSELMAN, *supra* note 6, at 74.

107. *See e.g.*, Fed. Power Comm'n v. Natural Gas Pipeline Co. of Am., 315 U.S. 575, 590 (1942).

108. *See e.g.*, Alexandra I. Metzner, *Were California's Electricity Price Shocks Nothing More than a New Form of Stranded Costs?*, 52 AM. U. L. REV. 535, 541 (2002) (noting that consumers ultimately reimbursed utilities for losses through very high retail rates).

109. *See Jersey Cent. Power and Light*, 810 F.2d at 1181 (suggesting that a utility should not have to bear a disproportionate amount of a failed investment if the investment was prudent when made).

110. *See id.* at 1175.

investments that, in hindsight, have not afforded them any benefit.[111] Thus, these doctrines do not give concrete rules for when cost recovery is available; instead they provide frameworks for balancing the interests of investors and consumers. Regulators and legislatures can also shift the likelihood of cost recovery for the utility by explicitly pre-designating certain types of expenditures as prudent (or not) and "used and useful" (or not).[112]

A recent decision by the Michigan PSC illustrates the use of traditional doctrines to decrease informational asymmetries and uncertainty in order to control the risks of consumer-facing Smart Grid investments. Consumers Energy requested approval of $200 million for an AMI pilot in which only 7,000 meters would be installed.[113] The utility also planned a full AMI deployment, which had not yet been approved by the PSC, at a cost of approximately $1 billion in present dollars.[114] The pilot represented 20 percent of full deployment costs, 80 percent of the total IT costs for full deployment, and testing and IT costs that amounted to 100 times the cost of the 7,000 meters.[115] In order to control pilot and full deployment costs, the PSC set several guidelines using the prudence, and used and useful doctrines. First, the PSC indicated that if it did not approve full deployment, any expenses "directly related to full deployment," but incurred during the pilot phase, would not be considered "used and useful," and therefore would not be recoverable.[116] Second, even after approval of full deployment, the PSC would disallow recovery of costs from "imprudent project decisions" and would consider expenditures not used and useful "to the extent that the utility is not able to achieve benefits equal to or greater than lifecycle costs."[117]

The problem with the approach taken by the Michigan PSC is that the use of these doctrines conveys a precision that is probably not possible under cost-of-service regulation.[118] The PSC's formulation depends on its ability to ascertain which costs are related to the pilot and which are related to full deployment. It also requires the PSC to monetize

111. *See id.* at 1190 (Starr, J., concurring).

112. *See generally* Mendiola, *supra* note 67.

113. Application of Consumer Energy Co. for Auth. to Increase its Rates for the Generation and Distribution of Elec. and for Other Relief, *Order*, Mich. PSC Case No. U-16191, 2010 WL 4523792, § III(A)(3) (2010); Initial Brief of the Mich. PSC Staff, to the *Application of Consumer Energy Co. for Auth. to Increase its Rates for the Generation and Distribution of Elec. and for Other Relief*, at *17 (2010) (noting 7,000 meters), *available at* http://efile.mpsc.state mi.us/efile/docs/16191/0277.pdf.

114. Initial Brief of the Mich. PSC Staff, *supra* note 113, at *16-17.

115. *Id.*

116. *Id.* at *17.

117. *Id.*

118. Interview with Ray Gifford, Former Comm'r, Colo. PUC, in Denver, Colo. (Dec. 22, 2010).

the benefits of full deployment, which will occur over a twenty-five year period,[119] then to exclude, retroactively, cost recovery of any lifecycle costs that exceed those benefits. Though the PSC staff contended that this is a "clear and concise regulatory approval policy,"[120] it paves the way for protracted battles over whether costs are related to the pilot or full deployment and how to determine nebulous costs and benefits over a quarter of a century. Given the informational asymmetries, it will be extremely difficult for the PSC to determine whether the utility's ratepayers are "ultimately . . . paying for costs that primarily benefit vendors."[121]

B. *Variation in State Regulator Willingness to Approve Smart Grid Cost Recovery*

State regulators have varied in their receptiveness to consumer-facing Smart Grid proposals. In part because of statutory mandates and federal Smart Grid funds, some regulators have shown remarkable willingness to pass costs and risks through to consumers. As described below, others have firmly rejected Smart Grid proposals because of uncertainty over costs and benefits. Recently, some state commissions have followed a more cautious approach of gathering information and waiting to see how Smart Grid unfolds in states that were early adopters.

A recent decision by the Massachusetts Department of Public Utilities (DPU) on a Smart Grid pilot program submitted by National Grid typifies state regulator willingness to pass on the costs of AMI and HAN to consumers.[122] That willingness certainly owes, in part, to a legislative mandate to Massachusetts utilities to implement Smart Grid pilots.[123] National Grid proposed a pilot program serving approximately 15,000 customers, mostly residential,[124] at a total cost of $56 million.[125] The utility proposed three different levels of HAN implementation in the pilot; customers in the most intensive level would receive in-home display units,[126] automated load control devices that allow the utility to control consumer appliances or HVAC systems, an option for the utility to reduce or shift energy consumption remotely, and "targeted educational content" via the in-home display and text messages.[127] In

119. Initial Brief of the Mich. PSC Staff, *supra* note 113, at *15.

120. *Id.* at *11.

121. *Id.* at *18, § III(A)(3).

122. Mass. Elec. Co., *supra* note 77.

123. *Id.* at *3.

124. These customers, all located in the city of Worcester, represent just over one percent of National Grid's customer base. *Id.* at *25.

125. *Id.* at *4.

126. The in-home display unit is equivalent to the HAN central unit. *See supra* Part III.

127. Mass. Elec. Co., *supra* note 77, at *7.

addition to placing equipment on the customer premises, the utility proposed a $4.3 million marketing plan.[128]

The DPU made little attempt to reduce informational asymmetries or uncertainty regarding the plan. The overall tone of the decision congratulated the utility for its "comprehensive and innovative" plan, though the DPU conditioned final approval on some additional details.[129] The DPU acknowledged that the utility had not explained how it would spend the proposed marketing dollars, but DPU merely suggested that the utility consider options to reduce cost "without diminishing the benefits of its proposed comprehensive marketing approach."[130] Although the state Attorney General urged a cautious approach because of uncertainty about the pilot participants and the nascent HAN technologies and markets,[131] the DPU largely ignored the cost of the pilot, instead offering a conclusory statement that the pilot will "play a key role" in answering questions about Smart Grid.[132] Finally, the DPU wholly ignored the pro-competition principles advanced by one intervener, including consumer ownership and direct access to data at the meter rather than through the utility network.[133]

At the other end of the spectrum, the Maryland PSC flatly rejected a proposal by Baltimore Gas & Electric ("BG&E") for full deployment of an AMI system with over 2 million meters at a cost of $346 million to consumers.[134] The PSC was concerned that consumers would bear all of the risk and that the proposal excluded significant costs, including consumer education, billing systems, and expenditures by consumers on in-home devices.[135] The utility had conducted two test pilots, in which consumers received cycle switches for air conditioners and in-home "[e]nergy [o]rbs" that alerted customers to time-based pricing periods.[136] The utility then described a potential future BG&E initiative that would allow customers to view energy prices and bill information through an in-home display.[137]

The Maryland PSC addressed issues of informational asymmetry and uncertainty largely by rejecting the proposal as presented. For example, the PSC questioned the utility's claim that the deployment would decrease energy consumption by 1 percent, given the lack of such

128. *Id.* at *12.
129. *Id.* at *27, *46.
130. *Id.* at *33.
131. *Id.* at *18.
132. *Id.* at *26.
133. *Id.* at *24, *27-28.
134. Balt. Gas & Elec. Co., *supra* note 28, at *8.
135. *Id.* at *15-16, *18-19.
136. *Id.* at *6-7 (noting peak, off-peak, and critical peak pricing).
137. *Id.* at *16.

results in its pilots or in California's full deployment.[138] The PSC did not request additional pilots, but it did address the informational asymmetry. Specifically, the PSC asked the utility to signal its own belief in the articulated benefits by sharing the financial risk that the benefits would not materialize.[139] Similarly, to reduce uncertainty, the PSC required the utility to make its business case using easily quantifiable benefits, such as operational costs.[140]

Recently, a number of states have taken steps to gather information, preserve options, and slow the process of implementation as a way to reduce problems of uncertainty and asymmetric information. For example the Colorado PUC, in a docket opened to investigate Smart Grid issues, explicitly solicited information on how uncertainties should be addressed where a Smart Grid investment's benefits are justified by consumers' behavioral response.[141] The California PUC, an early adopter of Smart Grid, also has taken steps to gather information and preserve options. In considering federal guidelines for Smart Grid, as required by EISA, the PUC attempted to preserve options for either utility or third-party provision of consumer-facing Smart Grid services by reaffirming its expectation that utilities will provide price and use data to consumers and their third-party designees in near-real time and in machine readable format.[142]

C. Inadequacy of Current Regulatory Approaches

Although the evolving regulatory responses detailed above do address some of the uncertainties and asymmetric information entailed in consumer-facing Smart Grid, they fall short on two important questions. First, what technologies and components of AMI and HAN systems are optimal or even necessary to achieve demand-side benefits? Second, who should implement various elements of consumer-facing Smart Grid?

As noted in the discussion above, state regulators' exploration of optimal components has largely centered on how much on-premises equipment and customer education should be provided. However, regulators have not sufficiently questioned more fundamental assumptions. For example, price signals at the meter may not be necessary at all in order to elicit consumer response to time-based pricing, as broadband Internet connections could perform the same

138. *Id.* at *23.
139. *Id.*
140. *Id.* at *20.
141. *Smart Grid Preliminary Conclusions Order*, *supra* note 29, at 10.
142. Rulemaking to Consider Smart Grid Technologies Pursuant to Federal Legislation, *Order*, Rulemaking Cal. PUC Dkt. No. 08-12-009/09-12-046, 2009 WL 5213258, at *52-53 (Dec. 17, 2009).

function.[143] If some level of load shifting or reduced consumption could be accomplished and quantified through time-based pricing *without* smart meters, then any additional benefit of using smart meters could be weighed against the cost of the investment. This might result in AMI rollouts that are justified on other bases; for example, Homer Electric Power in Alaska installed smart meters for all of its customers to reduce costs of meter reading in sparsely populated areas.[144] Similarly, regulators have not sufficiently questioned alternatives to in-home displays, considering that some consumers ignore or even fail to replace batteries in such displays.[145]

As to who should implement consumer-facing Smart Grid, utilities are the most likely candidates to implement AMI. In particular, integration of AMI with the utility grid will affect the reliable delivery of power, which is squarely within utility domain. Still, some states have considered smart meter provision by third party competitors, possibly financed in part by consumers, in part because the demand-side benefits are specific to individual consumers.[146] Such a market-based approach could allow consumers who are likely to change their behavior to signal this by sharing some of the costs.

For HAN deployments, regulators have generally turned to utilities as the default implementer. For example, the Massachusetts DPU praised the design of National Grid's pilot that included extensive equipment on the customer premises, noting that the pilot would "simulate the actual operating conditions of a full scale deployment."[147] Having utilities implement HANs, even in pilots, poses a considerable possibility of path dependency; to replicate any benefits shown in the pilot, the regulator would likely require the utility to implement the same extensive level of on-premises equipment. Indeed, this same thinking appears to underlie *Baltimore Gas & Electric*, even though the Maryland PSC rejected the proposal. The PSC based its rejection in part on the fact that the proposal for full deployment did not include the aspects of the HANs that were included in the pilots.[148] The PSC also criticized the utility for failing to indicate how it would finance those investments.[149] The clear import of the decision is that the utility bears the responsibility for providing and financing in-home equipment and associated consumer education about

143. *See* Lynne Kiesling, *Recommendations for Smart Grid Policy (Part 5 of 5)*, KNOWLEDGE PROBLEM (Mar. 10, 2009), http://knowledgeproblem.com/2009/03/10/recommendations-for-smart-grid-policy-part-5-of-5.

144. Consideration of adoption of Amendments Under EISA, *Order Inviting Public Comment*, Regulatory Comm'n Alaska Dkt. No. R-09-5, 2010 WL 4655901, ¶ 3.2.

145. EHRHARDT-MARTINEZ ET AL., *supra* note 43, at 25.

146. *See* BROWN & SALTER, *supra* note 5, at 26.

147. Mass. Elec. Co., *supra* note 77, at *26.

148. *See* Balt. Gas & Elec. Co., *supra* note 28, at *9.

149. *Id.* at *19.

how and why to use it.

Not all state regulators are assuming the necessity of full AMI and HAN deployments or turning to utilities as the default implementers. For example, the Colorado PUC opened an investigatory docket, questioning the cost-effectiveness of AMI as a way to reduce demand and concluding that smart meters should be deployed first to the most receptive consumer segments rather than across the entire residential consumer base.[150] The Colorado PUC also indicated that consumer education, though critical, must be based on rigorous studies and tied to performance metrics.[151] Pennsylvania has considered options for consumers to buy smart meters from either utilities or third-party providers, as long as the meters meet standard specifications.[152] Moreover, utilities themselves vary in their calculus of whether they want to be "beyond the meter" on the consumer premises.[153]

V. ARGUMENTS AND COUNTERARGUMENTS FOR COMPETITION

As detailed below, some theorists have argued that consumer-facing Smart Grid should be opened to market competition. This section explores arguments and counterarguments for competition in fully deployed consumer-facing Smart Grid. However, this Note does not argue for or against competition at full deployment. Rather, Section VII will argue that regulators can implement competition at the pilot stage to overcome informational problems without having to resolve arguments about competition at full deployment.

A. Arguments for Competition in Consumer-Facing Smart Grid

The demand-side services provided by consumer-facing Smart Grid investments do not have the features of a natural monopoly, which weakens the argument that they should be subject to cost-of-service regulation. Transmission and distribution utilities are natural monopolies because they require massive amounts of capital to build electrical wire networks, resulting in a lower marginal cost when one firm delivers electricity than when multiple utilities compete within the same

150. *Smart Grid Final Conclusions Order*, *supra* note 48, ¶¶ 16, 28.

151. *Id.* ¶¶ 18-19.

152. BROWN & SALTER, *supra* note 5, at 62-63.

153. *Compare* Interview with Mary Fisher, Vice Pres. of Strategic Technology, Xcel Energy, in Denver, Colo. (Nov. 23, 2010) (noting that Xcel is testing on-premises equipment but does not expect to pursue full deployments beyond-the-meter), *with* John Downey, *The Amazon of Utilities*, PORTFOLIO.COM (July 28, 2010), http://www.portfolio.com/companies-executives/2010/07/28/duke-energy-ceo-jim-rogers-wants-to-make-the-company-the-amazon-of-utilities (describing Duke Energy's vision of providing all in-home energy services).

geographic area.[154] Electricity meters, insofar as they perform a "cash register" function for the utility by recording the amount of electricity consumed, have traditionally been considered a part of the "wires," or delivery infrastructure. However, neither the smart meter function of providing price and usage information, nor the HAN function of communicating with consumers and appliances, exhibits natural monopoly characteristics. Delivery of price information to consumers does not require AMI or smart meters, as the information could be delivered over other channels such as the Internet or cellular networks. Similarly, measuring electricity usage and controlling appliances can be accomplished with relatively simple devices that are offered by several companies at retail.[155] Because of the lack of natural monopoly characteristics, consumer-facing Smart Grid should not necessarily be implemented by utilities.

A competitive market for consumer-facing Smart Grid services offers several theoretical benefits. First, a competitive market may be a better judge of technology choices.[156] Utilities tend to be risk-averse with regards to technology because they have significant potential downside risks but limited upside gain.[157] Competitive market participants with a greater appetite for risk are more likely to innovate cost-effective technological solutions to demand-side management. Second, competition would allow innovation by new market participants with expertise and core competencies not possessed by utilities. For example, software and Internet companies such as Microsoft and Google are already leveraging their expertise in customer interfaces to provide home energy management web portals.[158] Similarly, start-up companies applying social gaming concepts have shown dramatic reductions in consumer energy use.[159] Commercial broadband companies could also

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154. *See* BOSSELMAN, ET AL, *supra* note 6, at 52-53; QUINN & REED, *supra* note 3, at 844-45.

155. *See*, *e.g.*, ALTERTME, http://www.alertme.com (last visited Aug. 17, 2012) (describing a voltage sensor that clamps onto the wire attached to the meter and a "smart plug" that can control appliances); BLUE LINE INNOVATIONS, http://bluelineinnovations.com (last visited Aug. 17, 2012) (describing a sensor that scans the utility's meter and calculates electricity usage).

156. *See* PERRY & WACKS, *supra* note 5, at 8.

157. *See supra* Part III.

158. U.S. DEP'T OF ENERGY, *supra* note 33, at 15-16 (noting that a HAN can exist independently of smart meters and requires nothing more than an Internet-connected home); *see also* GOOGLE POWERMETER: A GOOGLE.ORG PROJECT, http://www.google.com /powermeter (last visited Aug. 17, 2012); *and* MICROSOFT HOHM, http://www microsoft-hohm.com.

159. San Diego Gas & Electric consumers who used a social gaming app from Simple Energy saved more than twice as much energy on average as those with smart meters and HAN devices. *SDG&E Celebrates San Diego's Biggest Energy Savers*, PR NEWSWIRE (Jan. 5, 2012), http://www.prnewswire.com/news-releases/sdge-celebrates-san-diegos-biggest-energy-savers-136748638.html.

leverage existing networks, which already cover approximately 98 percent of Americans.[160]

A third theoretical advantage is that competition would put downward pressure on the prices of energy management services. The infrastructure requirements of utility-proposed AMI and HAN deployments are very costly, and regulators may show a willingness to pass the risks of cost overruns through to consumers more quickly than a customer-focused market.[161] Furthermore, through pre-approval of Smart Grid investments, regulators may pass all of the risk to consumers, yet many of the benefits, such as intellectual property or experience, accrue to third-party vendors.[162] Thus, with competition, consumers essentially are providing the risk capital for utility-implemented experiments with Smart Grid.

B. *Counterarguments Against Competition in Consumer-Facing Smart Grid*

There are also reasons to be cautious about competition in fully deployed consumer-facing Smart Grid. First, the mixed result from states' experiments with retail competition creates both a design and a political obstacle. States often relied on the theoretical benefits of competition, but flawed market designs and a lack of consumer education led to some disastrous results, notably the California electricity crisis.[163] Arguably, few states actually experienced retail competition because policymakers distorted the market in trying to protect consumers.[164] However, the experience of retail competition has resulted in a sharp divide between states embracing competition in electricity markets and those adhering to the monopoly model. Because a competitive market for customer-facing Smart Grid services would have features of retail competition, many of the same design and political issues are implicated.

A second argument against competition in consumer-facing Smart Grid is that a viable business model may not exist. The analogy to cell phones and the Internet, often used to illustrate the entrepreneurial potential for consumer-facing Smart Grid,[165] is probably a poor comparison. Unlike cell phones, smart phone applications, and the

160. FCC, *supra* note 40, at 269.

161. BROWN & SALTER, *supra* note 5, at 20.

162. *Id.* at 10, n. 8.

163. *See generally* FOX-PENNER, *supra* note 100.

164. *See* BROWN & SALTER, *supra* note 5, at 22.

165. *See e.g.* U.S. DEP'T OF ENERGY, SMART GRID SYSTEM REP. at iv (July 2009) ("As with the Internet or cell phone communications, our experience with electricity will change dramatically."); FCC, *supra* note 40, at 273-74 (comparing the potential for innovation in Smart Grid to the history of the Internet).

Internet, which provide new communication services for consumers, the Smart Grid essentially delivers an already existing service, electricity supply. In the worst case, Smart Grid service providers might compete to provide lower costs to consumers against an economically efficient incumbent. Thus, if consumers only care about having the lights on at the cheapest price, consumer-facing Smart Grid providers could not charge more than the price of default electricity service. It is possible that a competitive market will create new value for energy consumers, for which Smart Grid providers can earn revenue. However, superficial comparisons to smart phones and the Internet, without more, do not make the case.

More fundamentally, the need to compensate utilities for lost power sales could limit the economic surplus available to a competitive market. Utilities and regulators have significant concerns over erosion of the utility business model because Smart Grid and other demand-side services will require significant capital investments but will cause declines in power sales.[166] Decoupling a utility's revenue from its power sales has become a popular option for addressing the problem.[167] Essentially, this means that as consumers use less electricity, regulators will increase rates to compensate utilities for lost revenue.[168] While individual consumers might gain by reducing their own energy consumption, the surplus remaining after utilities are compensated may not be enough to sustain a competitive market.

A third argument against competition is that third-party competition could cause grid instability. Electricity is a complex system, where supply and demand must be balanced instantaneously. Utilities address this challenge by continuous monitoring and by dispatching power generation to meet demand. A lag in price signals or consumer response could cause erratic changes in energy usage, adversely impacting reliability. Such volatility could lead to severe technical challenges in grid management. Theoretically, instantaneous adjustments in energy use would balance supply and demand, but this is not possible where time-based price signals are not very granular.[169] Highly granular and instantaneous price signals are technologically possible, but only at tremendous infrastructure costs for data storage and transmission.[170] In

166. *See* FOX-PENNER, *supra* note 100, at 1-2.

167. LESH, *supra* note 73, at 65.

168. *See e.g., DSM Order*, *supra* note 56, ¶¶ 29, 32, 41, 42 (summarizing current and proposed financial incentives that allow Public Service Company of Colorado to recover costs of demand reduction through base rates).

169. *See supra* Part III (describing simple time-based pricing schemes with only two prices, peak and off-peak).

170. COMMUNICATIONS REQUIREMENTS OF SMART GRID TECHNOLOGIES, *supra* note 33, at 19-20.

170. *See* BROWN & SALTER, *supra* note 5, at 27.

contrast, direct control by utilities of devices on the consumer premises does allow instantaneous adjustments in energy use at moderate cost.[171]

Several other possible downsides of a competitive market for consumer-facing Smart Grid services exist. Data privacy is an issue of considerable concern, and a market of competing service providers would add some complexity to ensuring privacy of consumer data.[172] However, data privacy has been addressed in many other competitive contexts, so there is reason to believe that regulation of service providers could address privacy concerns. Competitive market participants can also exit the market, leaving consumers stranded with in-home equipment or defunct contracts for obtaining demand-side services.[173] Requiring the utility to assume default service for home energy management would replicate problems with default service design that states encountered in retail competition.[174] Finally, depending on pricing structures, market manipulation could be an issue.[175] If changes in electricity demand can affect prices charged to consumers, a consumer-facing Smart Grid provider with a sufficient customer base could manipulate consumer demand—not to provide benefits to consumers or the electric grid—but to capture additional profits. Because consumer-facing Smart Grid falls under state jurisdiction, state regulatory commissions, which generally do not have the necessary expertise or resources, would have the task of regulating this market conduct.

As the foregoing discussion suggests, the choice is complex between utility provision of consumer-facing Smart Grid services and creation of a third-party competitive market. As previously noted, this Note does not argue for either utility provision or competition at the full deployment stage. Instead, this Note recommends that state regulators consider incorporating competition into consumer-facing Smart Grid at the pilot stage.

VI. RECOMMENDATION: COMPETITION AT THE PILOT STAGE

Consumer-facing Smart Grid's possibilities suggest a need to clarify the boundary between market competition and activity that should be

171. *See supra* Part III (describing Xcel Energy's air conditioning Saver's Switch).

172. *See generally* U.S. DEP'T OF ENERGY, DATA ACCESS AND PRIVACY ISSUES RELATED TO SMART GRID TECHNOLOGIES 11-12 (2010), *available at* http://energy.gov/gc/downloads/department-energy-data-access-and-privacy-issues-related-smart-grid-technologies.

173. BROWN & SALTER, *supra* note 5, at 27.

174. *See* Jim Rossi, *The Common Law "Duty to Serve" and Protection of Consumers in an Age of Competitive Retail Public Utility Restructuring*, 51 VAND. L. REV. 1233, 1289-90 (1998).

175. Interview with Mary Fisher, Vice Pres., Strategic Technology, Xcel Energy, in Denver, Colo. (Nov. 23, 2010).

subject to cost-of-service regulation. Given the weighty arguments for and against competition, that boundary is not a simple one to draw. Utilities and competitive Smart Grid providers both have important roles to play if Smart Grid is to fulfill its potential consumer, environmental, and grid benefits at reasonable costs.

This section first offers some possible guidelines for incorporating competition into consumer-facing Smart Grid pilots. The section then argues that regulators will gain better information about what results are achievable and what AMI and HAN investments are optimal by incorporating competitive pilots than by relying solely on utility-implemented experiments shaped by traditional cost-of-service regulation. Finally, the section explains why competition at the pilot stage would largely avoid the obstacles and risks that would be entailed in competition at full deployment.

A. Design Recommendations for Competitive Smart Grid Pilots

A first design recommendation is that competitive consumer-facing Smart Grid pilots should allocate roles for both utilities and competitive Smart Grid designers according to each party's strengths. For example, third-party technology companies subject to market discipline are more likely than utilities to design cost-efficient ways to change consumer behavior.[176] Those companies may also draw on business competencies that utilities lack to educate consumers and provide engaging consumer interfaces.[177] Competing system designers would not have an incentive to make massive capital expenditures on AMI and HAN, which are not necessarily the best means to change consumer energy use.

Conversely, utilities are best positioned to know their customer base, to safeguard the grid, and to protect vulnerable consumers. Utilities have detailed information about historical energy use and the costs of servicing portions of their customer base. This information could be a crucial input into choosing subsets of customers for pilots and understanding whether the pilots' results are cost-effective. Similarly, utilities understand the electric grid in a way that consumer-facing technology companies cannot. Utilities have a critical role to monitor the impact of consumer-facing Smart Grid pilots on grid stability and to assess the likely impact of broader deployment. Finally, public utilities, with their duty to serve all consumers and their oversight by regulators,

176. *See e.g.*, OPOWER, http://www.opower.com (last visited Mar. 7, 2012) (company that produces 1.5% to 3.5% average energy savings from low cost monthly energy reports to consumers).

177. *See e.g.*, SIMPLEENERGY, http://www.simpleenergy.com (last visited Mar. 7, 2012) (technology company using social connections and gaming to promote energy savings); *SDG&E Celebrates San Diego's Biggest Energy Savers*, *supra* note 159.

are best positioned to protect vulnerable consumers from the adverse effects of market competition.[178] By allocating roles to both utilities and competitive designers, competitive pilots can expose the parties to each other's business competencies and concerns, which may spur learning critical for full deployment.

A second design recommendation is that competitive pilots should incorporate multiple Smart Grid system designers. By incorporating technology companies as designers, rather than as mere vendors of products such as smart meters, those companies can innovate both product and design to achieve results and cost-efficiencies. Incorporating multiple designers would allow regulators to benchmark the performance and cost-effectiveness of designers against each other, rather than against theoretical targets set by administrative processes. Utilities will likely have important input about what subset of customers should be targeted by each competitive system designer. Depending on the goals of the pilot and the risks to consumers and the grid, system designers could either compete for consumers within a single territory or could implement designs in non-overlapping territories.

A third design recommendation is that the pilots should be structured to allow market competition to work for both customers and competing Smart Grid designers. A critical flaw in states' experiments with retail competition was that regulators tried to protect consumers from the volatility and price spikes that can result when the price of electricity is deregulated.[179] However, the prospect of saving money is a primary motivation for consumers to reduce or time-shift their energy use. To determine what changes in consumer behavior are achievable, both increased and decreased costs may need to be real possibilities.[180] Similarly, market competition should apply to competitive Smart Grid designers who should cover the costs of installing Smart Grid equipment on the consumer premises. Pilots should reward competing designers for their results but should not reimburse costs, which could create perverse incentives to overspend. An added caution is that the possibility of adverse market effects could cause consumer backlash. Therefore, pilot participants should be chosen carefully, for example, via opt-in provisions or based on characteristics suggesting that those consumers will be receptive to behavioral changes.[181]

178. *See* Rossi, *supra* note 174; *Smart Grid Final Conclusions Order*, *supra* note 48, ¶¶ 22-26.

179. *See supra* Part VI (noting failures of retail competition).

180. Pricing experiments commonly guarantee that consumers can save money but will not pay more than they have historically. This limits the effectiveness of the incentive to change behavior.

181. *See e.g.*, *Smart Grid Final Conclusions Order*, *supra* note 48, ¶ 14 (concluding that smart meters and dynamic pricing should be targeted first to the most receptive consumers).

A fourth and critically important design recommendation is that pilots should clearly specify the extent to which the system designer's customer is the end-use electricity consumer versus the utility. In general, when consumers time-shift their energy use, utilities avoid the cost of building expensive peaking plants, so the entire electricity consumer base benefits.[182] In contrast, when consumers reduce their overall energy consumption, the individual consumer benefits, but the utility loses power sales.[183] To the extent that third-party system designers provide system benefits such as the avoidance of building new peaking plants, the utility is the customer and should pay the costs of those benefits.[184] To the extent that an individual consumer benefits from the system designer's services, that consumer is the customer and should pay.

B. Ability of Competitive Pilots to Address Informational Problems

Regulators will more effectively address the extreme informational problems of consumer-facing Smart Grid by using competitive pilots than by using utility-implemented pilots that are constrained only by traditional cost-of-service regulation. As discussed in this Note, the necessity of consumer behavioral change and the nascent technologies of consumer-facing Smart Grid result in extreme problems of misaligned incentives, informational asymmetries, and uncertainty.[185] Traditional cost-of-service doctrines are inadequate to address these problems because those doctrines only provide guidance on costs and results that are deemed acceptable by regulators; cost-of-service doctrines do not determine the minimum costs or maximum results that are achievable.[186] Moreover, cost-of-service doctrines produce widely divergent guidance across states.

Using competitive pilots would address incentive misalignment and informational problems related to the first key challenge of consumer-facing Smart Grid, consumer behavioral change in energy use. Even when regulators provide utilities with incentives to encourage consumers to reduce energy use, utilities have a contrary incentive based on their

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182. *See supra* Part IV.

183. *Id.*

184. Of course, the utility would rationally prefer to build expensive peaking plants over saving money through time-shifting energy use because it earns a rate of return on capital investments. However, the utility can be considered the customer because the entire consumer base benefits from avoided capital costs, and the utility can recover the costs by spreading it across its consumer base.

185. *See supra* Part IV.

186. *See supra* Part V.

core business model to sell more electricity.[187] Competitive Smart Grid designers would not have the same misaligned incentive lurking in the background. As long as competitive designers can capture some economic value from causing consumer behavior change, they will have an incentive to use the most effective means to do so. Utility-implemented pilots also put regulators at an informational disadvantage because regulators must determine the extent to which utilities are overspending or choosing ineffective behavioral change strategies.[188] If competitive designers are rewarded for their performance, rather than reimbursed for their costs, then regulators will need information mainly about easily observed results. As opposed to a utility-implemented pilot, regulators would not need to struggle to determine whether the pilot was designed to spend more or achieve less consumer behavioral change than possible. Finally, regulators will also face less uncertainty about what level of behavioral change is possible because competitive pilots would allow regulators to benchmark designer's performance against each other.

Competitive pilots would also address the incentive and informational problems related to the nascent technologies of Smart Grid. Under cost-of-service regulation, utilities have an incentive to spend as much as regulators will approve on capital investments in order to boost their return.[189] In contrast, if competitive pilots require the Smart Grid designers to pay the costs of equipment that they install on consumers' premises, the designers will have an incentive to control costs to maintain profit margins. For example, innovative designers may be able to achieve results using low-cost mobile and Internet communications rather than expensive AMI or HAN infrastructure. Regulators would not face the same informational asymmetries because they would not need to investigate whether the Smart Grid designers are overbuilding, which would be contrary to the designers' interests. Finally, by incorporating multiple Smart Grid designers and—importantly—requiring those designers to bear the costs of their designs, regulators can gain more certainty about what Smart Grid infrastructure is optimal and whether a viable business model exists for consumer-facing Smart Grid.

C. Competitive Pilots Avoid the Challenges of Competition at Full Deployment

Competition theoretically offers benefits of technological innovation, application of business competencies from other industries to

187. *See supra* Section IV.
188. *Id.*
189. *Id.*

the electricity business, and price competition.[190] At the same time, market competition at full deployment would face political hurdles, has questionable viability, and could cause grid instability.[191]

Because of their smaller scale, competitive pilots would largely avoid the obstacles and risks of implementing competition at full deployment. Because competitive pilots could target the most receptive participants, state regulators would not face political resistance for mandating market competition for all electricity consumers. Furthermore, regulators would face less pressure to tamper with market design to prevent high prices because participants would volunteer or be chosen carefully. In addition, regulators would gain insight into whether a viable market exists based on the willingness of consumers to pay and the extent to which utilities must be compensated for lost power sales. Finally, the effect on the electric grid would be at a small scale, allowing utilities to adjust and plan for larger deployments of consumer-facing Smart Grid.

CONCLUSIONS

This Note has argued that the problems of misaligned incentives, asymmetric information, and uncertainty that are inherent in cost-of-service regulation of utilities are exacerbated by two unique challenges of consumer-facing Smart Grid: consumer behavioral change and nascent technologies. Furthermore, regulators will not overcome these informational problems by relying on traditional cost-of-service doctrines alone. This Note recommends that regulators implement competitive pilots for consumer-facing Smart Grid to gain information about what Smart Grid investments are necessary or optimal, and what results are possible.

Although this Note has focused primarily on the benefits to regulators who are entrusted with balancing various interests, utilities, consumers, and environmental advocates also stand to benefit from competitive pilots. Utilities would face less uncertainty about cost recovery if their role in competitive pilots were limited to selection of appropriate participants or service territory and monitoring safety and grid integrity. Utilities would also gain experience with various technologies and providers, resulting in a stronger negotiating position for future Smart Grid initiatives. In addition, utilities would avoid the kinds of consumer backlash that have occurred in California and Colorado. Finally, utilities might be effective competitors in providing consumer-facing Smart Grid, either in their own service territories or

190. *See supra* Section VI.
191. *Id.*

through subsidiaries in other regions. Interfacing with multiple Smart Grid system designers would allow utilities to build expertise and to identify research or acquisition opportunities.

Electricity consumers should benefit because they would provide less of the risk capital for pilots. Furthermore, consumers would have more certainty about the benefits that they would receive before regulators commit consumers to rate increases to fund full deployments. Finally, environmental advocates should also benefit because Smart Grid pilots could be designed to test the variation in environmental benefits from differing Smart Grid designs.