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Rethinking Reform of Electricity Markets

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I. INTRODUCTION

The reform of regulation of electricity markets has the potential to cause substantial changes in the way in which consumers receive and use electricity. Reform-minded actors, particularly the Federal Energy Regulatory Commission ("FERC"), have used their regulatory powers to restructure electricity markets to rely on competition in generation markets to promote lower prices and innovation. Other jurisdictions have been deterred by the significant legal, policy, and political issues associated with reform efforts. California's horrendous experience with electricity deregulation[1] and the calamitous electricity blackout in the northeastern United States[2] have added to the political, if not policy, challenges of achieving reform. The editors of the *Wake Forest Law Review* have dedicated this issue to understanding how these recent experiences have affected efforts to reform the regulation of electricity markets.

Reform efforts reflect a growing rejection of the "Traditional Model" of electric utility regulation, and we agree that this model has reached the end of its useful life. Such being the case, then, what should replace it? Going where angels fear to tread, but fools do not, we argue that the United States should pursue a "Smart Model" of electricity generation that addresses a primary limitation of current efforts to restructure electricity markets. While current efforts seek to establish a competitive generation market, these efforts do little or nothing to address the significant environmental problems that are associated with the generation of electricity and

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1. *See* Steven Ferrey, *The Eagles of Deregulation: The Role of the Courts in a Restructured Environment*, 32 ENVTL. L. 297, 299-306 (2002).

2. *See* Antonio Regalado & Gary Fields, *Blackout a Reminder of Grid's Vulnerability to Terror*, WALL ST. J., Aug. 15, 2003, at A4.

that will remain in restructured electricity markets.

In our view, the Smart Model has two components that fill this gap.[3] On the generation side, there would be increasing reliance on renewable energy sources and on making the electrical grid more efficient and more reliable. On the consumption side, the price of electricity to each consumer would be based on the marginal cost of producing it.

Our analysis proceeds in four stages. Part II describes the negative impacts on the environment associated with the generation of electricity and the production of energy used to generate electricity. While progress has been made reducing these impacts, they are still significant and require additional attention.

Part III describes the birth, life, and death of the "Traditional Model." For the last three or more decades, federal and state regulators have been engaged in widespread deregulation of significant parts of the Traditional Model.[4] While we recognize the significant advantages of this effort, it does not address reducing the pollution and other environmental problems caused by relying on fossil fuels, particularly coal, to generate electricity. Our analysis of the disintegration of the Traditional Model reveals that we now have an opportunity to remake electricity markets along the lines suggested by the "Smart Model," but this agenda has not received the attention it deserves from regulators, politicians, and the public.

Part IV describes a Smart Model of electricity generation composed of four elements. A Smart Model would rely on both distributed generation, which is composed of small-scale sources of electricity generation that are environmentally friendly, and solar- and wind-generated electricity because they are renewable sources of energy. A Smart Model would also utilize energy portfolios or regulatory standards that require electricity generators and sellers to obtain a certain percentage of their electricity from renewable sources. Finally, a Smart Model would employ a "Smart Grid" or a

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3. *See* Elizabeth Thomas et al., *Unlocking Regulatory Barriers to Sustainable Energy Systems*, 19 NAT. RESOURCES & ENV'T, Fall 2004, at 51, 51 (recognizing the two components of the Smart Model).

4. Paul L. Joskow, *Deregulation and Regulatory Reform in the U.S. Electric Power Sector, in* DEREGULATION OF NETWORK INDUSTRIES: WHAT'S NEXT 113 (Sam Peltzman & Clifford Winston eds., 2000); Richard D. Cudahy, *Electricity Deregulation After California: Down But Not Out*, 54 ADMIN. L. REV. 333, 336-37 (2002); Alfred E. Kahn, *The Deregulatory Tar Baby: The Precarious Balance Between Regulation and Deregulation, 1970-2000 and Henceforward*, J. REG. ECON., Jan. 2002, at 35, 53 (2002); Joseph D. Kearney & Thomas W. Merrill, *The Great Transformation of Regulated Industries Law*, 98 COLUM. L. REV. 1323, 1324 (1998); John S. Moot, *Economic Theories of Regulation and Electricity Restructuring*, 25 ENERGY L. J. 273, 274-78 (2004).

system of distribution that relies on new technologies that make the electricity grid more reliable and efficient.

Unfortunately, however, many elements of the Smart Model of electricity generation are not ready for prime time because they are not cost-effective as compared to traditional methods of electricity generation and distribution. Although the government should sponsor and is sponsoring projects that are intended to spur the development of the Smart Model, we do not anticipate the widespread adoption of the model until there is a more substantial market demand for it.

We propose in Part V that a Smart Model of electricity consumption is a more viable reform. The price of electricity in this model is based on the marginal cost of producing and delivering electricity. By comparison, consumers currently pay for electricity based on its average cost. We recommend regulators require utilities to install electrical meters that measure the time of day during which electricity is consumed because this step would permit the price of electricity to be based on the cost of generating and distributing it. Once some form of marginal cost pricing is used, consumers would have an incentive to conserve electricity during periods of high demand, such as the hottest hours of the hottest days in the middle of the summer in warm states.

Although we are hardly the first to recognize the merits of this step,[5] this recommendation has not received the attention it deserves, perhaps in part because of the daunting task of installing electrical meters that permit marginal cost pricing in millions of American homes and businesses. This is unfortunate in light of the potential of marginal cost pricing to protect the environment. Moreover, once electricity is priced on the actual cost of producing and delivering it, there should be additional market demand for smart methods of electricity generation and delivery. Finally, but hardly least of all, some basic calculations strongly suggest that the installation of new meters is cost-effective and may be far less costly than efforts to add new generation and transmission capacity to electrical markets if demand continues to grow at current rates.

II. ELECTRICITY AND THE ENVIRONMENT

The generation of electricity is one of the leading causes of environmental problems in this country. According to Environmental Protection Agency ("EPA") data, electric utilities are

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5. *See, e.g.*, Richard J. Pierce, Jr., *How Will the California Debacle Affect Energy Deregulation?*, 54 ADMIN. L. REV. 389, 407 (2002); Severin Borenstein et al., *An Open Letter from 11 Energy Experts: The Time Has Come for Real-Time Pricing*, PUB. UTIL. FORT., July 1, 2003, at 28, 28-29.

the biggest polluters in the United States, with emissions far exceeding those of other industries such as chemical manufacturing and refining.[6]

Many of the threats to the environment are from the release of sulfur dioxide ("SO_2") and nitrogen oxides ("NOx") into the atmosphere when electrical energy is generated.[7] Electricity generated using coal produces most of the total SO_2 emissions in the United States and a large percentage of the total NOx emissions.[8] These emissions create a number of environmental and health problems, including the following:

- Emission of SO_2 and NOx gases can form fine particles, or soot, when they react with the atmosphere, and coal-fired power plants also emit soot directly from their smokestacks.[9] According to one estimate, this form of pollution may be associated with as many as 64,000 premature deaths from cardiopulmonary causes.[10]
- NOx emissions react with volatile organic compounds ("VOCs") and sunlight to form ground level ozone or smog.[11] "Millions of Americans live in areas that do not meet the health standards for ozone."[12] Recent scientific research with laboratory animals, clinical subjects, and human populations has identified "a cascade of adverse health effects from ozone at levels common in the United States," including increased respiratory symptoms, damage to cells of the respiratory

6. CLEAR THE AIR: THE NAT'L CAMPAIGN AGAINST DIRTY POWER, TOXIC POWER: WHAT THE TOXICS RELEASE INVENTORY TELLS US ABOUT POWER PLANT POLLUTION 1 (2000) [hereinafter CLEAR THE AIR, TOXIC POWER], *available at* http://www.cleartheair.org/tri/complete_report.pdf.

7. EPA, Acid Rain: What Society Can Do About Acid Deposition, *at* http://www.epa.gov/airmarkets/acidrain/society/index.html (last updated Jan. 6, 2004). Sulfur, which is present in coal as an impurity, reacts with air when the coal is burned to form SO_2. By comparison, the burning of any fossil fuel forms NOx. *Id.*

8. *Id.*

9. CLEAN AIR TASK FORCE, NO ESCAPE: CAN YOU REALLY EVER "GET AWAY" FROM THE SMOG? A MIDSUMMER LOOK AT OZONE SMOG IN 1999 (1999), *available at* http://www.catf.us/publications/reports/No_Escape.pdf.

10. DEBORAH SHEIMAN SHPRENTZ, NATURAL RES. DEF. COUNCIL, BREATH-TAKING: PREMATURE MORTALITY DUE TO PARTICULATE AIR POLLUTION IN 239 AMERICAN CITIES (1996), *excerpted at* http://www.nrdc.org/air/pollution/bt/btinx.asp.

11. EPA, Six Common Air Pollutants: Chief Causes for Concern, *at* http://www.epa.gov/air/urbanair/nox/chf.html (last updated Jan. 6, 2005).

12. EPA, Six Common Air Pollutants: Health and Environmental Impacts of NOx, *at* http://www.epa.gov/air/urbanair/nox/hlth.html (last updated Jan. 6, 2005) [hereinafter EPA, Impacts of NOx].

tract, pulmonary inflammation, declines in lung function, increased susceptibility to respiratory infections, and increased risk of hospitalization and early death.[13]

- Acid rain is formed when SO_2 and NOx react with water and oxygen in the atmosphere.[14] Acid rain results in the deterioration of cars, buildings, and historical monuments and causes lakes and streams to become acidic and unsuitable for many fish.[15]

Finally, but hardly least of all, one element of NOx, nitrous oxide, is a greenhouse gas, which accumulates in the atmosphere with other greenhouse gases, causing global warming.[16] According to the Sierra Club, the United States emits twenty-five percent of the world's greenhouse gasses, and power plants are responsible for forty percent of these emissions.[17]

Besides these emissions, power plants also produce large amounts of toxic metals.[18] For example, power plants are the largest human-caused source of mercury pollution.[19] Mercury is dangerous to fetal development,[20] which is why pregnant women need to avoid fish caught in many waters in the United States.[21] The potential health consequences of other metals are largely unknown, but the EPA has concluded that some hazardous air toxins pose health risks that require further study, including dioxins, arsenic, and nickel.[22]

In addition, there is considerable environmental damage associated with the sources of fuel used in generating electricity. For example, the production of coal requires disposal of "overburden," a material that must be removed in order to mine coal, without damaging water sources or filling in wetlands. Such

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13. AM. LUNG ASS'N, ANNOTATED BIBLIOGRAPHY OF RECENT STUDIES OF THE HEALTH EFFECTS OF OZONE AIR POLLUTION 1997-2001, at 1 (2001), *available at* http://www.lungusa.org/atf/cf/{7A8D42C2-FCCA-4604-8ADE-7F5D5E762256}/OZONE_HEALTH97-01.PDF.

14. EPA, Impacts of NOx, *supra* note 12.

15. *Id.*

16. *Id.*

17. Sierra Club, Clean Air Factsheet: Dirty Coal Power, *at* http://www.sierraclub.org/cleanair/factsheets/power.asp (last visited Mar. 26, 2005).

18. CLEAR THE AIR, TOXIC POWER, *supra* note 6, at 7.

19. EPA, Mercury: Controlling Power Plant Emissions; Overview, *at* http://www.epa.gov/mercury/control_emissions/index.htm (last updated Mar. 17, 2005).

20. EPA, Mercury: Human Health, *at* http://www.epa.gov/mercury/health.htm (last updated Dec. 1, 2004).

21. *See* EPA, FACTSHEET: NATIONAL LISTING OF FISH ADVISORIES 4 (2004), *available at* http://www.epa.gov/ost/fish/advisories/factsheet.pdf.

22. CLEAR THE AIR, TOXIC POWER, *supra* note 6, at 8.

side effects have been a problem in the past.[23] Further, when mining results in the exposure of pyrite, which is commonly found in rocks containing coal seams, to air and water, it results in the formation of sulfuric acid and iron hydroxide. When rainwater washes over these rocks, the water runoff, which becomes acidified, can harm the soil, rivers and streams.[24] Abandoned mines are also a considerable problem. There are environmental problems caused by abandoned mines in each of the twenty-nine states and tribal lands with coal mines.[25]

All of these environmental threats and others are subject to government regulation intended to reduce or mitigate them. Nevertheless, environmental advocates contend that the magnitude of current problems is greater than it would be if there were more effective laws and enforcement.[26] While we agree with that conclusion, we also think that continued reliance on the Traditional Model of electricity generation and distribution is a culprit and that efforts to reform the Traditional Model are unlikely to improve the situation. To understand why this is the case, we turn next to the rise and reformulation of the Traditional Model.

III. THE TRADITIONAL MODEL

The electricity industry—like other network industries, such as telecommunications and natural gas—has exhibited a discernable historic pattern.[27] That pattern is the result of a combination of technological developments, economic theory, and supporting government regulations.[28] Regardless of the particular network industry, these three elements have given rise to an industrial structure and a regulatory regime with remarkable persistence. Indeed, United States energy policy is dominated by that industrial

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23. Envtl. Literacy Council, Coal Mining, *at* http://www.enviroliteracy.org/article.php/1122.html (last updated Mar. 31, 2004).

24. *Id.*

25. *Id.*

26. *See, e.g.*, Natural Res. Def. Council, Dirty Skies: The Bush Administration's Air Pollution Plan, *at* http://www.nrdc.org/air/pollution/qbushplan.asp (last revised Sept. 5, 2003).

27. *See generally* JOSE A. GOMEZ-IBANEZ, REGULATING INFRASTRUCTURE: MONOPOLY, CONTRACTS, AND DISCRETION (2003); Joseph P. Tomain, *networkindustries.gov.reg*, 48 U. KAN. L. REV. 829 (2000) (discussing the parallel historical development of the transportation, communications, financial, and energy industries).

28. *See* Joseph D. Kearney & Thomas W. Merrill, *The Great Transformation of Regulated Industries Law*, 98 COLUM. L. REV. 1323, 1383-1403 (1998).

structure and regulatory regime,[29] and public utilities, including electricity, have been a part of that system.

In this section, we briefly describe the technological, commercial, and legal developments that gave rise to the Traditional Model and the changes in these elements that have spurred the current effort to restructure electricity markets. We find that the current focus is on creating competitive generation markets and the capacity to move electricity generated in those markets around the country. Much less attention is being paid to taking advantage of the disintegration of the Traditional Model to adopt more environmentally friendly methods of electricity generation and consumption.

A. *Brief History*

The story of electricity is a particularly interesting one, involving colorful characters from the very inception of the industry right up until today's headlines. Imagine the classic American inventor Thomas Edison toiling at his workshop in Menlo Park, New Jersey, inventing the incandescent light bulb. While this picture of Edison is an accurate one, it is also a partial one. Edison was a remarkable inventor; he was also quite a business genius. Once the incandescent light bulb was invented, it was necessary to illuminate that bulb with electricity. Edison's plan to use the dynamo,[30] a

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29. *See* Joseph P. Tomain, *The Dominant Model of United States Energy Policy*, 61 U. COLO. L. REV. 355 (1990).

30. The most literary description of the machine that creates electricity is in a chapter called "The Dynamo and the Virgin" in HENRY ADAMS, THE EDUCATION OF HENRY ADAMS: AN AUTOBIOGRAPHY (1907), *reprinted in* HENRY ADAMS, NOVELS, MONT SAINT MICHEL; THE EDUCATION: DEMOCRACY: AN AMERICAN NOVEL, ESTHER: A NOVEL, MONT SAINT MICHEL AND CHARTRES, THE EDUCATION OF HENRY ADAMS, POEMS, at 1067 (Library of America ed., 1983):

> To him, the dynamo itself was but an ingenious channel for conveying somewhere the heat latent in a few tons of poor coal hidden in a dirty engine-house carefully kept out of sight; but to Adams the dynamo became a symbol of infinity. As he grew accustomed to the great gallery of machines, he began to feel the forty-foot dynamos as a moral force, much as the early Christians felt the Cross. The planet itself seemed less impressive, in its old-fashioned, deliberate, annual or daily revolution, than this huge wheel, revolving within arm's length, at some vertiginous speed, and barely murmuring,—scarcely humming an audible warning to stand a hair's-breadth further for respect of power,—while it would not wake the baby lying close against its frame. Before the end, one began to pray to it; inherited instinct taught the natural expression of man before silent and infinite force. Among the thousand symbols of ultimate energy, the dynamo was not so human as some, but it was the most expressive.

Id. at 1067.

turbine motor, to generate electricity, came to fruition on September 4, 1882 in Lower Manhattan at Pearl Street Station.[31] On that day, the electric industry was born. Edison flipped the switch on the country's first central power station thus serving eighty-five customers with four hundred electric lamps.[32]

While it is the case that Edison did not invent either the electric light or electricity, it was his particular genius to develop product distribution.[33] Edison's business genius was the construction of the distribution system to deliver the electricity to light the lights. More specifically, Edison favored direct current ("DC") electricity because of its safer low voltage. Edison's commitment to direct current, ironically, could have ended his career because that commitment created serious competitors who recognized that DC electricity had severe technological limitations.[34] Specifically, DC could be used to transmit low voltage electricity only for short distances.[35]

In order to transmit higher-voltage electricity longer distances, a technological fix was necessary. High-voltage electricity had to be converted to lower voltages so that it could be distributed to end users. This change in voltage was mediated through a transformer which depended upon alternating current ("AC"). Nicola Tesla invented just such an AC system. Tesla, fired by Edison, went to work for George Westinghouse, a keen Pittsburgh inventor and entrepreneur, who saw the value in AC.[36] As the story goes, Edison was so enamored with DC that he hired somebody to develop an AC electric chair as to prove how dangerous and undesirable AC electricity was.[37]

The AC/DC battle is more than a story of rival technologies; it involves the development of the electricity industry. In short, at the turn of the nineteenth century, the electric industry was competitive and highly localized. Since electricity could be transmitted longer distances, however, the economics of competition changed dramatically. The most significant person to recognize the changing

31 JILL JONNES, EMPIRES OF LIGHT: EDISON, TESLA, WESTINGHOUSE, AND THE RACE TO ELECTRIFY THE WORLD 84-85 (2003).

32. LEONARD S. HYMAN ET AL., AMERICA'S ELECTRIC UTILITIES: PAST, PRESENT, AND FUTURE 117 (7th ed. 2000).

33. *Id.* at 115-17.

34. *See* JONNES, *supra* note 31, at 144-46, 150-63, 179-83.

35. Ironically, as today's electricity policy discussions focus on more localized generation, there is renewed interest in DC electricity connections to the grid. *See* PETER VAN DOREN & JERRY TAYLOR, CATO INST., POLICY ANALYSIS NO. 530: RETHINKING ELECTRICITY RESTRUCTURING 10 (2004), *available at* http://www.cato.org/pubs/pas/pa530.pdf; *infra* notes 79-80 & accompanying text.

36. JONNES, *supra* note 31, at 153-63.

37. *Id.* at 197-98.

economics of the electric industry at the time was Samuel Insull, who had also once worked for Thomas Edison. Insull recognized that profits could be made in the electric industry once two fundamental costs were recouped: fixed costs and operating costs.[38]

The electric industry, like other network industries, has high front-end capital costs. Significant investment must be made in plants and equipment before production can begin. These capital costs are particularly sensitive in the electric industry because it is difficult to store electricity in any significant quantity. You need only think of the battery on your laptop computer to realize how frequently it must be charged. Because end users for manufacturing purposes or home convenience need a reliable supply of electricity, it became necessary to build sufficient generation plants so that service could be delivered without interruption. Additionally, generation plants are expensive, costing millions of dollars at the beginning of the twentieth century and hundreds of millions of dollars today. Thus, there are high fixed costs. By comparison, there are comparatively low operating costs, including costs for fuel, labor and the like. Nevertheless, both of these costs need to be recouped in order to have a profitable firm.

Insull recognized that by charging users relatively higher prices at the beginning of a use period and then lowering prices with more consumption, he could capture both fixed and operating costs. Such a pricing scheme also induces consumption. Insull was a remarkably successful businessman, perhaps too successful. As his electricity conglomerate grew, he created a series of holding companies along a pyramid scheme. Those holding companies created enormous profits right up until the Great Crash of 1929, after which time Insull was accused of stock manipulation and fraud. Insull fled the country only to return to face trial. Insull was acquitted of all charges but never recovered his good name, and he died a pauper. Today, Insull's legacy is that the industry operates under holding company restrictions.[39] However, the scandal *du jour*—Kenneth Lay and Enron—bears remarkable similarities to Insull's empire.[40]

The point of this brief history is a simple one. The electric industry started competitively. However, technological change gave rise to a change in corporate form primarily through concentration, which led to manipulation. And with manipulation came cries for

38. HYMAN ET AL., *supra* note 32, at 122.

39. As a result of Insull's market manipulation, Congress passed the Public Utility Holding Company Act of 1935, 15 U.S.C. §§ 79-79z (2000).

40. *See* Richard D. Cudahy, *Insull and Enron: Is There a Parallel?* (pts. 1-3), INFRASTRUCTURE, Spring 2003, at 3, Summer 2003, at 1, Fall 2003, at 7.

government regulation.[41] It is at this point in the electricity story that economic theory takes the stage, for economic theory justified government regulation.

Insull's economic instincts were not wrong. Concentration is more efficient for certain industries according to the economic theory of natural monopoly. Natural monopoly can be most simply defined as a situation in which, for some period of time, product costs "will be lower if they consist in a single supplier."[42] While there are more technical definitions of natural monopoly,[43] the simple, fundamental idea is that a single firm can realize economies of scale throughout a range of production, thus continually lowering product cost. The idea is straightforward: It is wasteful for a firm to make large capital investments in facilities that will duplicate another firm's facilities. There is no need to have multiple sets of telephone lines, electric lines, or natural gas pipelines serving the same geographic area because the duplicate sets are inefficient and will go to waste.[44] It is fair to note that the concept of natural monopoly is hardly universally accepted,[45] although it has been accepted in law.

41. Historically, there has been debate about whether public utility regulation was undertaken for the benefit of the public along a public interest model of regulation or was undertaken at the behest of the utilities themselves along a capture theory model. *See* WERNER TROESKEN, WHY REGULATE UTILITIES?: THE NEW INSTITUTIONAL ECONOMICS AND THE CHICAGO GAS INDUSTRY, 1849-1924, at 3-4 (1996); Steven P. Croley, *Theories of Regulation: Incorporating the Administrative Process*, 98 COLUM. L. REV. 1, 65-66 (1998); George L. Priest, *The Origins of Utility Regulation and the "Theories of Regulation" Debate*, 36 J. L. & ECON. 289, 289-90 (1993); Thomas P. Lyon, Capture or Contract?: The Early Years of Electric Utility Regulation 1-3 (Jan. 30, 2003) (working paper), *available at* http://papers.ssrn.com/sol3/papers.cfm?abstract_id=375628.

42. 1 ALFRED E. KAHN, THE ECONOMICS OF REGULATION: PRINCIPLES AND INSTITUTIONS 11 (1970).

43. *See generally* SANFORD V. BERG & JOHN TSCHIRHART, NATURAL MONOPOLY REGULATION: PRINCIPLES AND PRACTICE 21-24 (1988); WILLIAM W. SHARKEY, THE THEORY OF NATURAL MONOPOLY 2-4 (1982); ROGER SHERMAN, THE REGULATION OF MONOPOLY 81 (1989); W. KIP VISCUSI ET AL., ECONOMICS OF REGULATION AND ANTITRUST 80-81 (2d ed. 1995); Paul L. Joskow, *Regulation of Natural Monopolies*, *in* HANDBOOK OF LAW AND ECONOMICS 1, 7-8 (A.M. Polinsky & S. Shavell eds., forthcoming 2005), *available at* http://econ-www.mit.edu/faculty/download_pdf.php?id=1086.

44. *See, e.g.*, Omega Satellite Prods. Co. v. City of Indianapolis, 694 F.2d 119, 126 (7th Cir. 1982) (Posner, J.) (describing the "wasteful duplication of facilities" created by the "competitive free-for-all" that exists before a single provider emerges from the struggle to serve the whole market).

45. For a critique of natural monopoly, see Peter Z. Grossman, *Is Anything a Natural Monopoly?*, *in* THE END OF A NATURAL MONOPOLY: DEREGULATION AND COMPETITION IN THE ELECTRIC POWER INDUSTRY 11-39 (Peter Z. Grossman & Daniel H. Cole eds., 2003); Harold Demsetz, *Why Regulate Utilities?*, 11 J. L. &

The United States Supreme Court, drawing on earlier English precedent, accepted the idea of natural monopoly in the case of *Munn v. Illinois*,[46] in which the Court upheld the constitutionality of an Illinois statute regulating the prices charged by grain elevator operators against a takings challenge.[47] Grain elevators would purchase and store farmers' grain and then resell it for a profit.[48] Because the grain elevators were an effective oligopoly, the farmers argued that they were being overcharged for storage. In response, the Illinois legislature decided to regulate the prices charged by the operators. *Munn* stands for the proposition that there are certain industries "affected with a public interest"[49] whose prices can be regulated for the public good. To satisfy the test in *Munn*, a proposed price regulation must show first that the industry exhibits monopolistic tendencies and second that the industry is affected with a public interest. Electricity clearly satisfies both tests: Insull's consolidated electricity empire demonstrated that it could exercise monopoly power, and legislators around the country found that the public enjoyed the comforts of the product. Regulation, then, was not far behind.

Thus far, we have shown how technological innovation and economic theory contributed to the development of the electricity industry. We now look at how government regulation responded to those developments and how it has contributed to our current industrial structure.

Again, we can turn to Insull for the central insight into how and why the government regulated the electric industry the way that it did. It is the case that a single producer of electricity can produce electricity at a lower cost than multiple producers. However, that single producer most likely will become a monopolist. The regulatory response to this exercise of monopoly power may seem counterintuitive. The regulatory response was to impose a government-sanctioned monopoly on that single provider through what has come to be known as the regulatory compact.[50] The terms of the compact are fairly simple. An electric utility is given an exclusive franchise area and is obligated to provide service within that franchise area. The government, to counteract monopolistic

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ECON. 55, 56-59 (1968).

46. 94 U.S. 113 (1876).

47. *Id.* at 135-36.

48. *Id.* at 117-18.

49. *Id.* at 126.

50. *See* Jersey Cent. Power & Light Co. v. FERC, 810 F.2d 1168, 1189 (D.C. Cir. 1987) (Starr, J. concurring); J. GREGORY SIDAK & DANIEL F. SPULBER, DEREGULATORY TAKINGS AND THE REGULATORY CONTRACT: THE COMPETITIVE TRANSFORMATION OF NETWORK INDUSTRIES IN THE UNITED STATES 4 (1997).

pricing, is then given ratemaking authority over the electric utility. Ratemaking is a shorthand way of saying that the government controls utility prices and profits. Recall Insull's understanding of utility economics as encompassing the need to cover both fixed and operating costs and doing so through high charges at the beginning of a user's consumption. Government regulators bought this theory wholesale in the ratemaking process.

To encourage continued investment in utilities, regulators designed what we refer to as the traditional rate formula that allowed utilities to recover operating costs and a return on investment on all capital costs. Such ratemaking is a form of cost-plus pricing. Known as cost-of-service ("COS") ratemaking, the traditional formula functioned in such a way that as long as a public utility operated prudently and, for the most part, as long as customers received service, then a utility would stay in business.[51] COS ratemaking had another feature which favored industrial growth and expansion: declining block rate design. Utility customers are charged for the amount of electricity that they consume and for the cost of providing the service. However, as we will develop in much more detail in Part V, customers do not pay for exactly the electricity that they consume at the time that they consume it. Rather, they pay an average cost and do so in "blocks." Again, Insull had the central insight. Customers, under the declining block rate design, pay more for the first block of electricity that they consume and less for additional blocks.[52] In this way, the utility has the opportunity to recover the more expensive capital costs in the beginning of the consumption period before going on to recover operating costs.

For an investor, COS ratemaking may look too good to be true. Although there was no *guarantee* that a profit would be made, rarely were profits lost. For many years the market reflected this low risk

51. *See generally* J. BONBRIGHT ET AL., PRINCIPLES OF PUBLIC UTILITY RATES (2d ed. 1988); CHARLES F. PHILLIPS, JR., THE REGULATION OF PUBLIC UTILITIES: THEORY AND PRACTICE 435-36 (3d ed. 1993); SIDNEY A. SHAPIRO & JOSEPH P. TOMAIN, REGULATORY LAW AND POLICY: CASES AND MATERIALS 107-15 (3d ed. 2003).

52. By way of example, assume that a consumer uses 2000 kilowatt-hours ("kWh") in a month. Under a declining block rate design, they would then pay:

1st 650 kWh	4.782¢
Next 350 kWh	4.104¢
Over 1,000 kWh	4.040¢
Total $85.847	

Combined, the average rate is $0.0427 per kWh. This rate design is such that the more a user consumes, the less costly the electricity becomes, thus encouraging consumption. HYMAN ET AL., *supra* note 32, at 289.

investment with low, although reliable, rates of return to utility investors, and every diversified portfolio contained some utility stocks or bonds.[53]

The situation of reliable utility returns existed for most of the twentieth century, and utilities were considered safe investments as electricity rates stayed flat or even declined as the industry expanded. In the mid-1960s, however, the industry experienced another transformation, a transformation with which we continue to wrestle.[54] Until that time, particularly after World War II, electricity production and consumption increased at a predictable seven percent annual rate. After the mid-1960s, however, the industry and the world changed. The electricity demand growth rate slowed, energy costs increased, world energy prices were thrown into disarray for various political reasons, and regulators began to question COS ratemaking and the prevailing declining block rate design. A simple way of understanding the cataclysm that the electric industry was experiencing is to realize that one cannot continue to invest capital forever. There will come a point at which further investment is unwise because it is inefficient. The limit of utility investments was modeled by two economists, Harvey Averch and Leland Johnson.[55]

In the mid-1960s and early 1970s, the suspicion was that the electric industry had over-built and that it had significant excess capacity. Historically, because of the need to provide electricity on demand and because of an obligation for reliable service, the industry would over-build and have its excess capacity accounted for in what is known as a reserve margin. In other words, a utility invested in an excess plant so that it could satisfy demand. That excess plant constituted the reserve margin. Historic reserve margins during the decades of the 1960s, 1970s, and 1980s ranged from 23.8% to 31.8% and fell to 19.9% during the 1990s.[56] The question then became: Were the reserve margins too high, and could they be lowered? The suspicion was that they were too high and that the possibility existed for lower cost electricity. The problem, however, was that utilities were granted government protected franchises, thus discouraging new entrants. The electric industry was surprised by the reaction to a piece of legislation known as the

53. BENJAMIN GRAHAM ET AL., SECURITY ANALYSIS: PRINCIPLES AND TECHNIQUE 1-20, 264-307 (1962).

54. HYMAN ET AL., *supra* note 32, at 163-79.

55. Harvey Averch & Leland L. Johnson, *Behavior of the Firm Under Regulatory Constraint,* 52 AM. ECON. REV. 1052 (1962).

56. HYMAN ET AL., *supra* note 32, at 33 tbl.3-1. Reserve margins peaked in the early 1980s and have been declining ever since. *Id.* at 63 fig.6-1.

Public Utility Regulatory Policies Act ("PURPA"),[57] which was part of President Jimmy Carter's National Energy Act legislation of 1978.[58]

The National Energy Act was intended to be comprehensive and to respond to the energy crises that affected energy prices and the economy more generally during the 1970s.[59] President Carter's legislation had several purposes, including responding to growing dependence on foreign oil, finding alternative sources of energy, and engaging in resource conservation and energy preservation measures. PURPA was intended to experiment with innovative ratemaking and rate designs.

PURPA was intended to move away from COS ratemaking and to try market-based rate strategies. As part of the rate regulation reform, PURPA encouraged new forms of electricity generation, including the promotion of small power producers and co-generators.[60] Co-generation is the situation in which the manufacturer generates excess heat from its manufacturing activity, which can then be converted into electricity. Small power producers, generators of eighty megawatts ("MW") and less, and co-generators were encouraged to enter the market and to connect to the local public utility with a guarantee that the local public utility would pay for the electricity generated by these two "qualifying facilities" at the utilities' own avoided cost. In other words, these new producers would produce electricity more cheaply than that produced by the local utility, but the local utility would pay the producers the utilities' production cost, not the production cost of the new producers.[61]

What has been referred to as "PURPA's surprise"[62] is that

57. Public Utilities Regulatory Policies Act of 1978, Pub. L. No. 95-617, 92 Stat. 3117 (codified as amended in scattered sections of 5, 15, 16, 26, 30, 42, & 43 U.S.C.).

58. *Id.*; Energy Tax Act of 1978, Pub. L. No. 95-618, 92 Stat. 3174-3205 (codified as amended in scattered sections of 26 & 42 U.S.C.); National Energy Conservation Policy Act, Pub. L. No. 95-619, 92 Stat. 3206-88 (1978); Natural Gas Policy Act, Pub. L. No. 95-621, 92 Stat. 3350-3411 (1978); Powerplant and Industrial Fuel Use Act of 1978, Pub. L. No. 95-620, 92 Stat. 3289-3349.

59. The key events were the Arab Oil Embargo in 1973 and the Iranian Embargo in 1979. *See, e.g.*, PAUL ROBERTS, THE END OF OIL 100 (2004).

60. "Co-generation facility" is defined in 16 U.S.C. § 796(18)(A) (2000); "small power production facility" is defined in 16 U.S.C. § 796(17)(A). *See also* Michael J. Zimmer, *Cogeneration and Independent Power Production*, *in* 3 ENERGY LAW AND TRANSACTIONS § 70.01-.16 (David J. Muchow & William A. Mogel eds., 2003).

61. *See, e.g.*, Am. Paper Inst., Inc. v. Am. Elec. Power Serv. Corp., 461 U.S. 402, 406 (1983).

62. Joseph P. Tomain, *The Past and Future of Electricity Regulation*, 32

suspicions about excess capacity were real, new entrants desired to enter the market, and the industry was more competitive than was assumed. As a result, electricity "deregulation" began in earnest. We put the word deregulation in quotation marks to emphasize the fact that the industry is experiencing a restructuring rather than deregulation. What is being deregulated or what is attempting to be deregulated is the pricing of electricity at the wholesale and retail levels. To date, the restructuring is continuing at the wholesale level and has been largely discontinued at the retail level. Through a series of FERC rule-makings, the industry is indeed being restructured at the wholesale and at the interstate levels.[63] The restructuring activities in the states have come to something of a halt as a result of the crisis in California in the summer of 2000.[64] You may notice that until this point of electricity history, most of the effort has been on production. This production focus has operated under the belief that a strong pattern of energy consumption indicates a strong economy.[65] Nevertheless, the industry cannot

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ENVTL. L. 435, 451-53 (2002) [hereinafter Tomain, *Past and Future*]; Joseph P. Tomain, *The Persistence of Natural Monopoly*, 16 NAT. RESOURCES & ENV'T 242, 244 (2002) [hereinafter Tomain, *Persistence*].

63. The key regulations are F.E.R.C. Order No. 888; Order No. 889; and Order 2000. F.E.R.C. Order 888, 18 C.F.R. §§ 35 & 385 (1996); F.E.R.C. Order 889-A, 18 C.F.R. § 37 (1997); F.E.R.C. Order 889-B, 18 C.F.R. § 37 (1997); F.E.R.C. Order 2000, 18 C.F.R. § 35 (1999). For discussions on how these orders operate, see Reinier H.J.H. Lock & Marlene L. Stein, *Electricity Transmission, in* 3 ENERGY LAW & TRANSACTIONS §§ 81.01-.05 (David J. Muchow & William A. Mogel eds., 1996); Floyd L. Norton IV & Gregory W. Camet, *Electricity: Open Access, Transmission & Comparability, in* 4 ENERGY LAW & TRANSACTIONS §§ 82.02-.05 (David J. Muchow & William A. Mogel eds., 2004).

64. Mike Stenglein, *The Causes of California's Energy Crisis,* 16 NAT. RESOURCES & ENV'T 237, 273 (2002); Tomain, *Past and Future*, *supra* note 62, at 439-42; James F. Wilson, *Restructuring the Electric Power Industry: Past Problems, Future Directions,* 16 NAT. RESOURCES & ENV'T 232, 232 (2002).

65. *See generally* AMORY B. LOVINS, SOFT ENERGY PATHS: TOWARD A DURABLE PEACE 3-24 (1977) (describing and critiquing the claim that there is a positive correspondence between energy consumption and economic growth). Today there is increasing interest in promoting strong economies through the consumption of less energy. *See, e.g.*, CTR. FOR AM. PROGRESS, THE PROGRESSIVE PRIORITIES SERIES: SECURING OUR ENERGY FUTURE (2004) [hereinafter CAP, SECURING ENERGY FUTURE], *available at* http://www.americanprogress.org/atf/cf/{E9245FE4-9A2B-43C7-A521-5D6FF2E06E03}/ENERGYCHAPTER.pdf; ENERGY FUTURE COALITION, CHALLENGE AND OPPORTUNITY: CHARTING A NEW ENERGY FUTURE 27-29, 86-100 (2003) [hereinafter EFC, CHALLENGE AND OPPORTUNITY], *available at* http://www.energyfuture coalition.org/pubs/EFC %20Report.pdf; NAT'L COMM'N ON ENERGY POLICY, ENDING THE ENERGY STALEMATE: A BIPARTISAN STRATEGY TO MEET AMERICA'S ENERGY CHALLENGES (2004) [hereinafter NCEP, STALEMATE], *available at* http://www.energycommission.org/ewebeditpro/items/O82F4682.pdf; JAMES

function without transmission and distribution, which means that the consumption end of the fuel cycle comes into play.

B. *Traditional Electric Utility Regulation*

Physics, firm structure, and markets combined to create what we all know as the standard local public utility. Two physical characteristics are key here. First, as mentioned earlier, electricity cannot be stored effectively. Next, electricity follows the path of least resistance rather than the shortest path. Because electrons travel literally near the speed of light, once a switch is turned on the electricity that is used can come from anywhere on the grid. Consequently, electricity lacks the property characteristics that make it amenable to bilateral contract sales. In other words, most purchasers do not buy specific electricity from a specific producer. Instead, consumers purchase from the grid, and the grid, in turn, has the property characteristics of a commons.[66] These two physical characteristics, then, require that sufficient electricity is available to satisfy demand instantaneously.

The firm structure that is consistent with those physical characteristics, for most of the twentieth century, was the vertically-integrated electric utility.' The local public utility, until relatively recently, functioned as a vertically-integrated, investor-owned business, known in the industry as an "IOU." IOU's engaged in functions of generation, transmission, and distribution. In other words, the public utility produced the electricity and delivered it to end-use customers.

Natural monopoly theory neatly complemented both the physical characteristics and the structure of the electric industry. Local public utilities, as noted above, were in fact state-protected monopolies that were regulated with the traditional COS rate formula enabling them to continue to invest capital to provide reliable and universal service. Most notably, capital investments were encouraged so that utilities had sufficient capacity to provide electricity during periods of peak demand. The world of the traditional public utility was a satisfying one for all actors for a good part of last century.[67] Shareholders were happy because they were

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BARRETT ET AL., NATURAL RES. DEF. COUNCIL, JOBS AND THE CLIMATE STEWARDSHIP ACT: HOW CURBING GLOBAL WARMING CAN INCREASE EMPLOYMENT (2005), *available at* http://www.nrdc.org/golobalwarming/csa/csajobs.pdf; U.S. PIRG EDUC. FUND, REDIRECTING AMERICA'S ENERGY: THE ECONOMIC AND CONSUMER BENEFITS OF CLEAN ENERGY POLICIES 10-16 (2005), *available at* http://newenergy future.com/reports/redirectingamericasenergy.pdf.

66. VAN DOREN & TAYLOR, *supra* note 35, at 6-7.

67. HYMAN ET AL., *supra* note 32, at 151-61.

earning reliable returns on their investment; managers were happy as the plant continued to be built and managed; consumers were happy because rates were reasonable, stayed flat, and on occasion declined; and regulators were happy because there was both little to do and what business they had was not politically controversial.[68] This happy situation changed when costs (and rates) began to rise in the mid-1960s due to a number of factors.[69] The steady growth in demand began to vary downward. Many utilities were faced with nuclear power plants that were much more expensive than anticipated.[70] Given the traditional rate formula, utility executives were faced with quite a problem. Should they throw good money after bad and complete the nuclear plant, convert it to a coal generation unit, or cancel construction entirely?[71] The energy crises of the 1970s exacerbated the problem of rising costs as the country experienced double digit inflation. Environmental regulations also added to a utility's costs. As a direct consequence of inflation and additional regulations, capital costs rose as well. And, as rates rose, consumers complained.

As noted, the electric industry, as traditionally structured and regulated, works well as long as the industry is expanding. Once, however, costs rise because of either reaching a technological plateau or reaching capacity, then the market can become distorted and inefficient. Consumers can consequently suffer because they are paying higher than efficient rates for electricity. The electricity industry experienced exactly this confluence of events. In brief, utilities had accumulated excess capacity, had built expensive plants, and under the COS formula, were charging customers for those additional costs. These events combined to put significant pressures on politicians and regulators to address rising electricity rates.

In the mid-1970s, after a period of significant inflation and two energy crises, industry deregulation generally, and electric industry deregulation in particular, became a significant matter for

68. WILLIAM GORMLEY, THE POLITICS OF PUBLIC UTILITY REGULATION 7 (1983).

69. HYMAN ET AL., *supra* note 32, at 163-79.

70. *See* JOSEPH P. TOMAIN, NUCLEAR POWER TRANSFORMATION 29-54 (1987); Roger D. Colton, *Excess Capacity: Who Gets the Charge from the Power Plant?*, 34 HASTINGS L.J. 1133, 1141-43 (1983); Richard J. Pierce, Jr., *The Regulatory Treatment of Mistakes in Retrospect: Cancelled Plants and Excess Capacity*, 132 U. PA. L. REV. 497, 504 (1984).

71. *See* Richard J. Pierce, *Public Utility Regulatory Takings: Should the Judiciary Attempt to Police the Political Institutions?*, 77 GEO. L.J. 2031, 2049 (1989).

legislative attention.[72] The deregulation of telecommunications, railroads, banking, and trucking, as well as energy industries, was looked on as the way to improve markets and improve consumer choice.[73] In some of those markets, deregulation was seen to have exactly those effects. Airline deregulation, for example, increased consumer choice, increased the number of flights, and introduced various discount plans. Telecommunications deregulation witnessed a "revolution" in innovation, choice, and lower rates. In other markets, most notably for our purposes electricity, deregulation has not been as smooth.

Deregulation in the electricity industry as a result of FERC initiatives, both on the electric and natural gas sides of its docket, began at the wholesale level and has moved to the distribution segment of the industry. In order to have a completely deregulated electricity market, of course, it is necessary that the retail segment of the market be deregulated as well, and retail deregulation is a story that is yet to develop, let alone conclude.[74]

Deregulation across the electricity industry presents problems. It is fair to say that electricity deregulation at the wholesale level can proceed. PURPA and experiments with alternative energy sources such as renewable energy indicate that there are additional electricity suppliers. The significant amount of merger and acquisition activity in the industry shows that the market is viable,[75]

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72. TOMAIN, *supra* note 70, at 11-12, 102-34; *see also* Bernard S. Black & Richard J. Pierce, Jr., *The Choice Between Markets and Central Planning in Regulating the U.S. Electricity Industry*, 93 COLUM. L. REV. 1339, 1343-50 (1993) (describing changes to electricity markets and the enactment of legislation in the 1970s); Alfred E. Kahn, *Electric Deregulation: Defining and Ensuring Fair Competition,* ELECTRICITY J. (April 1998); Richard J. Pierce, Jr., *The State of the Transition to Competitive Markets in Natural Gas and Electricity*, 15 ENERGY L.J. 323, 324 (1994).

73. *See generally* ALFRED E. KAHN, LESSONS FROM DEREGULATION: TELECOMMUNICATIONS AND AIRLINES AFTER THE CRUNCH (2004) (comparing the relative effectiveness of the deregulation and regulatory policies in the airline and telecommunications industries); DEREGULATION OF NETWORK INDUSTRIES: WHAT'S NEXT? (Sam Peltzman & Clifford Winston eds., 2000) (analyzing the deregulation and remaining regulation of the airline, railroad, telecommunications, and energy industries).

74. KENNETH ROSE, 2004 PERFORMANCE REVIEW OF ELECTRIC POWER MARKETS I-2 to -4 (Aug. 25, 2004), *available at* http://www.ksg.harvard.edu/hepg/Papers/Rose.2004.perf.review.elec.mkts.0804.pdf.

75. *See, e.g.*, Dennis K. Berman & John R. Emshwiller, *For Exelon, PSEG Might Be Big Boost,* WALL ST. J., Dec. 20, 2004, at A3; Eric Dash, *Exelon Plans to Buy New Jersey Utility*, N.Y. TIMES, Dec. 21, 2004, at C2; Jad Mouawad & Andrew Ross Sorkin, *Biggest Utility in New Jersey Seen as Target of Acquisition*, N.Y. TIMES, Dec. 18, 2004, at C1 (reporting the potential acquisition of New Jersey's largest utility, P.S.E.&G., by the Exelon Corporation, an owner

and even with the collapse of Enron, energy futures trading continues and should continue to be healthy.[76]

All of this activity pertains to the generation segment of the industry. Deregulation of transmission (and distribution) and retail segments, including consumption, remains problematic. Transmission is problematic as it continues to be a natural monopoly.[77] Nevertheless, FERC initiatives are attempting to organize reliable and accessible grids as will be described immediately below. Distribution is problematic as states' and the federal government's experiment with "unbundling" vehicles affects the corporate structure of distribution companies. The California energy crisis has given retail reformers pause, and there can be no effective retail deregulation without unfettered access to the grid.

The consumption end of the fuel cycle presents difficulties because all customers are not similarly situated. There are some consumers, particularly large industrial customers, who would like to have access to various suppliers and can negotiate adequate contracts for themselves. Large suppliers and consumers can use long-term contracts, spot markets, and futures markets to provide for their electricity needs. Small customers and residential consumers, however, run into problems of pricing and reliability. Under the traditional rate formula, these smaller consumers were the beneficiaries of cross-subsidization, which lowers their real rates. In a completely deregulated market all consumers will pay their full electricity costs.

C. *Summary*

A safe assumption about the electricity future is that the Traditional Model will continue for some time. Nuclear power accounts for twenty percent of the electricity produced in the country, and coal reserves are sufficient to last for 250, 500, or even 1,000 years depending on who is making the reserve estimates. In addition, the national electricity grid is necessary for transmission and distribution, and large producers can produce more cheaply.

Nevertheless, the conversation has moved on to what will replace the Traditional Model, and this question involves a number

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of a number of electric utilities and an experienced manager of nuclear plants);. *see also* VIJAY V. VAITHEESWARAN, POWER TO THE PEOPLE 280 (2003).

76. *See, e.g.*, DTE Energy Trading, *at* http://www.dteenergytrading.com (last visited Apr. 3, 2005) (advertising its services as an "active physical gas and power marketing company").

77. Joseph P. Tomain, *Whither Natural Monopoly? The Case of Electricity*, *in* THE END OF A NATURAL MONOPOLY: DEREGULATION AND COMPETITION IN THE ELECTRIC POWER INDUSTRY 111 (Peter Z. Grossman & Daniel H. Cole eds., 2003).

of important issues. Indeed, contemporary energy policy discussions involve fundamental concerns of a different kind from those that occupied most of the twentieth century. Today, energy policy discussions involve growing concern about the availability and the price of oil,[78] global climate change,[79] terrorism,[80] and international markets as well as a healthy energy economy.[81] By way of shorthand, energy policy today must address energy, the environment, and security.[82] Most significantly, today's policy discussions must address how interconnected these variables have become. Clearly, continuing the Traditional Model presents difficulties in each area. The Traditional Model has become too costly, the United States is a net importer of oil, the Traditional Model especially relative to coal-fired generation has contributed to environment harms, and the Traditional Model is prone to energy and national security threats.

Our aim is to contribute to the discussion about the future of energy policy by focusing on what a Smart Model of electricity generation and consumption can contribute to national well-being. In the next part, we discuss how a Smart Model would change the

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78. *See, e.g.*, AMORY B. LOVINS ET AL., WINNING THE OIL ENDGAME: INNOVATION FOR PROFITS, JOBS, AND SECURITY (2005), *available at* http://www.oilendgame/org/pdfs/WtOEg_72dpi.pdf; PAUL ROBERTS, THE END OF OIL: ON THE EDGE OF A PERILOUS NEW WORLD (2004).

79. *See, e.g.*, INT'L CLIMATE CHANGE TASKFORCE, MEETING THE CLIMATE CHALLENGE: RECOMMENDATIONS OF THE INTERNATIONAL CLIMATE CHANGE TASKFORCE (2005), *available at* http://www.americanprogress.org/atf/cf/%7bE9245FE4-9A2B-43C7-A521-5D6FF2E06E03%7d/CLIMATECHALLENGE.PDF; *see also* Press Release, Int'l Climate Change Taskforce, G8-Plus Group Needed to Tackle Climate Change, *at* http://www.ippr.org.uk/pressreleases/archive.asp?id=1264&fID=62 (Jan. 24, 2005) (urging G8 leaders to make greenhouse gas reduction a top priority).

80. GRAHAM ALLISON, NUCLEAR TERRORISM 55-56 (2004).

81. *See generally* CAP, SECURING ENERGY FUTURE, *supra* note 65; EFC, CHALLENGE AND OPPORTUNITY, *supra* note 65; NCEP, STALEMATE, *supra* note 65; *see also* New Thinking on Energy Policy: Meeting the Challenges of Security, Development, and Climate Change, Conference Proceedings of a William J. Clinton Presidential Foundation Conference (Dec. 6, 2004). A video of the forum can be found at http://www.clintonpresidentialcenter.org/feature-energy-120604.htm (last visited Apr. 3, 2005). Of increasing concern is the demand for energy, particularly oil and natural gas, by China and India. *See, e.g.*, Keith Bradsher, *2 Big Appetites Take Seats at the Oil Table*, N.Y. TIMES, Feb. 18, 2005, at C1; *see also* Simon Romero & Jad Mouwad, *Saudis in Strategy to Export More Oil to India and China*, N.Y. TIMES, Feb. 18, 2005, at C4.

82. We use "security" in two senses. First, the energy policy is concerned with reliable energy supplies to keep the nation independent, particularly from imported oil. Second, the country's energy system must be secure from terrorist activities.

way in which we generate and distribute electricity. Part V discusses how a Smart Model would change the way in which we consume electricity.

IV. THE SMART GENERATION MODEL

In this Part, we discuss four prominent examples of generation of electricity under a Smart Model: distributed generation, renewable energy, renewable portfolio standards, and the Smart Grid. All of these options are potential improvements in the generation and delivery of electricity that respond to the concerns about energy, the environment, and security. While these ideas have been part of energy policy discussions for many years, they have stayed at the periphery of those discussions, mostly because they have been too costly and have not passed a market test. To date, investors have been reluctant to invest in these alternatives because they have not been promised a sufficient return on their investment.

One reason, we believe, for the limited attractiveness of Smart Model generation options is the lack of accurate price signals in electricity markets. Through greater price accuracy, which we discuss in the next Part of the article, consumers can make smarter consumption choices, producers can make smarter investment decisions, and the industry can perform more efficiently. Simply, COS ratemaking can no longer be relied upon to continue to regulate the industry. Instead, we examine marginal cost pricing and real time pricing models that are intended to bring prices closer to the market and are intended to give consumers more accurate price signals.

One other preliminary observation is pertinent. Each of the alternatives that we discuss must connect with the transmission and distribution grid to greater or lesser degrees. Distributed generation needs backup access to backup power. Renewable resources need to connect with the market. Renewable energy portfolios have the same needs. And, the Smart Grid is an improved grid. In other words, as much as we might like to get away from the Traditional Model, the grid remains central to the electricity industry, and the grid retains its natural monopoly characteristic, thus necessitating regulation in one form or another.[83] The grid will remain a necessary component until electricity production and distribution become localized, and that decentralization is starting through distributed generation.[84]

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83. *See supra* notes 42-45 and accompanying text; *see also* VAN DOREN & TAYLOR, *supra* note 35, at 10.

84. *See, e.g*, John D. Kueck et al., *Tapping Distributed Energy Resources,*

A. *Distributed Generation*[85]

Distributed generation ("DG") is an alternative source of electricity generation that focuses on small-scale power production.[86] The core concept behind DG is that power will be produced locally, instead of relying on large regional grids for transmission and distribution. DG power producers will be much smaller and will rely on a variety of energy sources and technologies such as solar cells and wind turbines.

DG technologies include gas or diesel-fired engines, small turbines, fuel cells, and photovoltaic cells.[87] While some of these fuel sources are fossil fuels, it is contemplated that DG technologies will capture both heat and power, thereby increasing energy efficiency. Other fuel sources are renewable and therefore cleaner than the fossil fuels burned in large-scale plants.

DG and micropower are dependent upon significant technological improvements throughout electricity production, transmission, distribution, storage, and consumption. Most simply, the scale of generation units is reduced significantly, and they are widely dispersed.[88] "Smart energy" technologies are intended to reduce the size of power generation units, to be closer to the source of consumption, to utilize "Smart Grids" which will transmit power more efficiently, and to use "smart meters" which will provide consumers with more information about their consumption patterns and about their choice of providers.[89]

Another term for DG is micropower, which also involves new technologies including microturbines, hydrogen fuels, solar cells,

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PUB. UTIL. FORT., Sept. 2004, at 46, 47.

85. Portions of this subpart of the Article also appear in Joseph P. Tomain, *Nuclear Futures*, 15 DUKE ENVTL. L. & POL'Y F. (forthcoming Spring 2005).

86. The International Energy Agency defines "distributed generation" as:

> generating plant serving a customer on-site or providing support to a distribution network, connected to the grid at distribution-level voltages. The technologies generally include engines, small (and micro) turbines, fuel cells, and photovoltaic systems. It generally excludes wind power, since that is mostly produced on wind farms rather than for on-site power requirements.

INT'L ENERGY AGENCY, DISTRIBUTED GENERATION IN LIBERALISED ELECTRICITY MARKETS 19 (2002), *available at* http://www.iea.org/textbase/nppdf/free/2000/distributed2002.pdf [hereinafter IEA, DISTRIBUTED GENERATION]; *see also* SETH DUNN, WORLDWATCH INST., MICROPOWER: THE NEXT ELECTRICAL ERA; WORLDWATCH PAPER 151 (Jane A. Peterson ed., 2000), *available at* http://www.worldwatch.org/pubs/paper/151l.html.

87. INT'L ENERGY AGENCY, *supra* note 86, at 25-26 tbl.1; VAITHEESWARAN, *supra* note 75, at 35-37.

88. VAITHEESWARAN, *supra* note 75, at 40-43.

89. EFC, CHALLENGE AND OPPORTUNITY, *supra* note 65, app.A4, at 74-85.

landfill gases, and the like. In this regard, micropower is touted as a clean energy alternative. According to the International Energy Agency, these technologies are increasing in importance. For example, "[w]orldwide, more DG capacity was ordered in 2000 than [the capacity ordered] for new nuclear power."[90] Not too much should be taken from that statement because of the decrease in orders for new nuclear plants. Still, it is fair to assert that we are witnessing a worldwide rise in DG and micropower.[91]

Smart electricity policy is a return to the electricity future. When Edison flipped the switch at Pearl Street Station in New York City in 1882, the first electricity company went into operation and did so on a small scale.[92] Technological advances enabled the effective nationalization of the electricity grid in the early part of the twentieth century.[93] Today, we find ourselves contemplating a return to small scale because it promises economic efficiencies by removing producers from the grid, environmental benefits through greater energy efficiencies and increased use of renewable energy resources, and energy security advantages from terrorist attack, international supply disruptions, or catastrophic accidents.

B. *Renewable Energy*[94]

The discussion of renewable energy policy and resources can trace its history to the environmental movement in the 1960s and early 1970s. At that time, books such as *A Sand County Almanac*[95] and *Silent Spring*[96] created popular awareness of threats posed by man to our natural environment. Around that time, scientists and economists completed an influential empirical study which raised an alarm about the irreversible consequences of continued energy resource consumption.[97]

Those concerns became imbedded in law in the United States

90. IEA, DISTRIBUTED GENERATION, *supra* note 86, at 7.

91. There is also an increase in the number of smart energy providers of information and products. *See, e.g.*, Climate Solutions, *at* http://www.climatesolutions.org (last visited Mar. 15, 2005); Environmental Law and Policy Ctr., Smart Energy, *at* http://www.elpc.org/energy (last visited Mar. 15, 2005); Smart-Energy, *at* http://www.smart-nrg.com (last visited Mar. 15, 2005); SmartPower, *at* http://www.smartpower.org (last visited Mar. 15, 2005).

92. HYMAN ET AL., *supra* note 32, at 115-17.

93. JONNES, *supra* note 31, at 367-70.

94. *See generally*, Richard L. Ottinger & Rebecca Williams, *Renewable Energy Sources for Development*, 32 ENVT. L. 331 (2002).

95. ALDO LEOPOLD, A SAND COUNTY ALMANAC (1949).

96. RACHAEL CARSON, SILENT SPRING (1962).

97. DONELLA H. MEADOWS ET AL., THE LIMITS TO GROWTH (1972).

through the National Environmental Policy Act ("NEPA") signed into law by President Nixon on January 1, 1970,[98] and through associated legislation. While NEPA made the country aware of environmental issues, the connection between energy and the environment did not become part of the policy landscape until the passage of President Carter's Energy Security Act of 1980.[99] The 1980 Act promoted the development of alternatives to traditional fossil fuels in two ways. First, the government provided financial incentives to producers of synthetic fuels, such as oil shale and tar sands. Although they were fossil fuel resources, these synthetic fuels provided increased independence from foreign oil sources.[100] The Act also promoted the development of more environmentally benign energy sources, such as bio-mass and alcohol fuels; various renewable energy resources; solar energy; conservation; and geothermal energy.[101] Even with the impetus of major legislation, neither the synfuels industry nor the renewable energy industry was able to sustain itself financially.

The 1970s were a volatile time for our energy economy, particularly given the OPEC Oil Embargo of 1973, the latter Iranian embargo in 1978, and the nuclear accident at Three Mile Island in 1979. Heightened energy awareness began to generate a series of studies of our energy future including predictions that would make renewable energy a major part of our energy economy.[102] In fact, it was predicted that solar power would account for twenty percent of the electricity generated by the year 2000.[103] The year 2000 has

98. National Environmental Policy Act, 42 U.S.C. §§ 4321-4370 (2000).

99. Energy Security Act, Pub. L. No. 96-294, 94 Stat. 611 (codified as amended in scattered sections of Titles 7, 10, 12, 15, 16, 30, 42, and 50 U.S.C.) (1980). The Energy Security Act was comprised of several statutes including: the Defense Production Act Amendments of 1980, 94 Stat. 617; the United States Synthetic Fuels Corporation Act of 1980, 94 Stat. 633; the Biomass Energy and Alcohol Fuels Act of 1980, 94 Stat. 683; the Renewable Energy Resources Act of 1980, 94 Stat. 715; the Solar Energy and Energy Conservation Act of 1980, 94 Stat. 719; and the Geothermal Energy Act of 1980, 94 Stat. 763.

100. United States Synthetic Fuels Corporation Act of 1980, Pub. L. No. 96-294, 94 Stat. 633.

101. Geothermal Act of 1980, Pub. L. No. 96-294, 94 Stat. 763; Solar Energy and Energy Conservation Act of 1980, Pub. L. No. 96-294, 94 Stat. 719 (1980).

102. *See, e.g.*, Paul L. Joskow, *Energy Policies and Their Consequences After 25 Years*, ENERGY J., Nov. 4, 2003, at 17, 17.

103. Modesto A. Maidique, *Solar America, in* ENERGY FUTURE: REPORT OF THE ENERGY PROJECT AT THE HARVARD BUSINESS SCHOOL, 231, 231 (Robert Stobaugh & Daniel Yergin eds., Ballentine Books 1980) (1979); SAM H. SCHURR ET AL., ENERGY IN AMERICA'S FUTURE: THE CHOICES BEFORE US 32 (1979) (noting that sunlight "carries more potential than any other renewable resource for going beyond mere local or regional importance within the United States").; *c.f.*

come and past and solar has not moved even a notch on the dial. To date, solar power provides about one percent of the nation's energy.[104]

Regardless of the dire predictions, perhaps best captured by the book title *The End of Nature*,[105] the country is not running out of energy,[106] nor have we run out of traditional fossil fuels. It is also the case that we have not sustained any significant renewable energy policy.[107] This is true despite continued calls for a greater reliance on renewable resources.[108] What is significantly different this time around, however, is that the triple concerns of energy, environment, and security are starting to coalesce with energy policy thinkers, and renewable energy does play a significant role in those new policy discussions.

When we talk about renewable energy, any number of resources can be discussed, including hydro-power, geothermal, bio-mass and alcohol fuels, wave power, hydrogen, and the like. Below we discuss two particular renewable resources—solar power and wind power—because both present particular issues for electricity supply. In particular, both are attractive because they are decentralized; yet, both have two significant problems. First, anyone relying on one of these options will want to also have a connection to the grid. Solar energy users need the connection as a backup source of energy. Those producing electricity using wind turbines need the connection to be able to sell the power that they generate. In both cases, the need to connect to the grid raises policy issues concerning interconnection and pricing.[109] Second, although this is less true for

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FORD FOUND., ENERGY: THE NEXT 20 YEARS 467 (1979) (giving an optimistic view of solar energy in the future but noting that it was impossible at that time to quantify its likely impact).

104. ENERGY INFO. ADMIN., RENEWABLE ENERGY TRENDS WITH PRELIMINARY DATA FOR 2003, at 1 (2004), *available at* http://www.eia.doe.gov/cneaf/solar.renewables/page/trends/trends.pdf.

105. BILL MCKIBBEN, THE END OF NATURE (Penguin Books ed., Viking 1990) (1990).

106. PETER W. HUBER & MARK P. MILLS, THE BOTTOMLESS WELL: THE TWILIGHT OF FUEL, THE VIRTUE OF WASTE, AND WHY WE WILL NEVER RUN OUT OF ENERGY, at xv (2005).

107. Joskow, *supra* note 102, at 41.

108. *See* DANIEL LASHOF & PATRICIO SILVA, NATURAL RES. DEF. COUNCIL, A RESPONSIBLE ENERGY POLICY FOR THE 21ST CENTURY, at vi (2001), *available at* http://www.nrdc.org/air/energy/rep/rep.pdf.

109. *See* Larry Prete, *Transmission Pricing Issues for Electricity Generation from Renewable Resources, in* RENEWABLE ENERGY 1998: ISSUES AND TRENDS 45, 50 (Energy Info. Admin. ed. 1999), *available at* http://tonto.eia.doe.gov/FTPROOT/renewables/062898.pdf (explaining that wind and solar power have "lower and more highly variable capacity factors, intermittent availability,

wind power, both are not as cost effective as traditionally produced electricity.[110] These issues must be addressed as we consider the design of new energy policy and the reformation of the regulatory structure of the electric industry.

1. *Solar Power*

There are basically two types of solar energy. First, passive solar energy, used principally for water and space heating, is a matter of architectural design more than anything else.[111] Through movable or immovable parts, the sun's heat is captured and stored for the purposes listed above. Second, through the use of photovoltaic cells and other large solar collectors, electricity can be generated and stored.[112]

As noted earlier, solar power, despite a once promising future,[113] now provides almost none of the electricity currently used in the United States.[114] Government regulation of solar energy to date has involved the stimulation of markets through demonstration projects and favorable tax rates and credits.[115] Nevertheless, the market has been static,[116] and the industry is yet to be cost competitive.[117] One reason may simply be a matter of scale. The largest solar collector generates about fifty-five MW of electricity, which can be contrasted with a large nuclear coal plant that generates over a thousand MW.

Nevertheless, given the ubiquity of this power source, one would

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and longer distances for existing transmission lines and/or load centers").

110. Suedeen G. Kelly, *Alternative Energy Sources*, *in* ENERGY LAW AND POLICY FOR THE 21ST CENTURY 13-1, 13-2 (James E. Hickey et al. eds., The Energy Law Group ed., 2000).

111. *Id.* at 13-6.

112. *Id.* at 13-3 to -4.

113. MARK GIELECKI ET AL., ENERGY INFO. ADMIN., INCENTIVES, MANDATES, AND GOVERNMENT PROGRAMS FOR PROMOTING RENEWABLE ENERGY (2001), *available at* http://www.eia.doe.gov/cneaf/solar.renewables/rea_issues/incent.html.

114. *See supra* notes 102-04 and accompanying text.

115. *See, e.g.*, Solar Photovoltaic Energy Research, Development, and Demonstration Act of 1978, 42 U.S.C. §§ 5581-5594 (2000); Solar Energy and Energy Conservation Act of 1980, Pub. L. No. 96-294, 94 Stat. 719 (2000) (codified as amended in scattered sections of 12 and 42 U.S.C.); Solar Energy Research Development and Demonstration Act of 1974, 42 U.S.C. §§ 5551-5566 (2000). According to MIT Professor Paul Joskow, "[i]n the last 25 years there has been a plethora of federal policies to encourage alternative fuels and fuel-use technologies with little to show for the efforts." Joskow, *supra* note 102, at 31.

116. *See, e.g*, ENERGY INFO. ADMIN., RENEWABLE ENERGY ANNUAL 2000, at 11-14 (2001), *available at* http://tonto.eia.doe.gov/FTPROOT/renewables/060300.pdf.

117. *See* Kelly, *supra* note 110, at 13-4.

think that we could use the resource better than we do. It has been estimated, for example, that "[i]f all the energy from the sun that reaches the United States were harnessed . . . it would provide about 500 times the nation's present energy demands."[118] Moreover, not only is solar energy safe and inexhaustible, it is not subject to cartelization. Therefore, it provides energy security and national security as well as providing clean electricity.

2. *Wind Energy*

Wind energy is considered among the fastest growing sources of energy today.[119] As costs decline, wind is attractive because it produces no air or water pollution and involves no toxic or hazardous waste. It is estimated that wind energy in the United States provides enough electricity to serve nearly one million households.[120] Wind does, however, present two significant environmental issues. The location of wind turbines can be seen as aesthetically unattractive, and windmills pose a danger to birds.

The government currently encourages wind projects through tax credits.[121] Most of the wind energy is currently generated in California, and a joint industry and government organization called the National Wind Coordinating Committee has formed to develop a commercial market. In 1999, the Secretary of the Department of Energy ("DOE") announced a Wind Powering America initiative that set a goal of wind energy providing five percent of U.S. electric power by 2020.[122]

3. *Summary*

The United States so far has made very little use of renewable energy sources. While there are several forms of renewable energy resources, combined they contribute little to the country's overall energy needs, satisfying only about two percent of the energy supply.

Nevertheless, given the new demands on energy policy,

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118. *Id.* at 13-3.

119. *See id.* at 13-20 to -22; AM. WIND ENERGY ASS'N, FAIR TRANSMISSION ACCESS FOR WIND: A BRIEF DISCUSSION OF PRIORITY ISSUES 1 (2000), *available at* http://www.awea.org/policy/documents/transmission.PDF; Matthew L. Wald, *Wind Power Is Becoming a Better Bargain: No Fuel Cost or Pollution, but Production Is Not Always Reliable,* N.Y. TIMES, Feb. 13, 2005, at A27; DOE, Energy Efficiency and Renewable Energy: FEMP Focus—Jan./Feb. 2002, *at* http://www.eere.energy.gov/femp/newsevents/fempfocus_article.cfm/news_id=7169 (last visited Apr. 3, 2005) [hereinafter DOE, FEMP Focus].

120 DOE, FEMP Focus, *supra* note 119.

121. *See* 42 U.S.C. § 13317 (2000).

122. AM. WIND ENERGY ASS'N, *supra* note 119, at 1.

renewable resources are again coming to the fore in policy discussions. Such resources are attractive insofar as they are non-carbon and therefore do not contribute to climate change. They are also small-scale, dispersed, and local. Consequently, they go counter to the Traditional Model, and they present fewer security risks.

The troubling aspect of wind power and solar power deals is reliability.[123] Because of the vagaries of weather, neither resource will be continually producing electricity. Consequently, consumers may not be availed of reliable electricity from those sources. More problematic is that connections to the grid[124] become difficult and may even pose threats to wind turbines. These issues will have to be resolved if we are to increase our reliance on renewable sources of energy.

At the moment, however, the huge stumbling block is that many renewable resources are not close to being cost competitive with fossil fuels. Still, their attractions are considerable, and they are part of contemporary energy thought.[125]

C. *Renewable Portfolio Standards*

According to the federal government, a renewable portfolio standard ("RPS") is a "market-based strategy to ensure that renewable energy constitutes a certain percentage of total energy generation or consumption."[126] The government creates a RPS when it requires electricity generators or sellers to supply a percentage of their electricity generation or sales with electricity from renewable resources or technologies. Although there are no federal RPS programs to date,[127] they are operating in various states. As of 2004, eighteen states had programs in place.[128]

Acknowledging that the renewable resources are often not cost

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123. Lovins argues to the contrary, however, that reliability is less of a problem than the critics make it. LOVINS, *supra* note 65, § 2.5, at 44-45.

124. *See* FERC, Interconnection for Wind Energy and Other Alternative Technologies, 70 Fed. Reg. 4791, 4793-94 (proposed Jan. 24, 2005) (to be codified at 18 C.F.R. pt. 35).

125. *See* CAP, SECURING ENERGY FUTURE, *supra* note 65, at 12; EFC, CHALLENGE AND OPPORTUNITY, *supra* note 65, at 16; NCEP, STALEMATE, *supra* note 65, at 62.

126. ENERGY INFO. ADMIN., THE CHALLENGES OF ELECTRIC POWER INDUSTRY RESTRUCTURING FOR FUEL SUPPLIERS 73 (1998), *available at* http://www.eia.doe.gov/pub/electricity/chg_str_fuel.pdf.

127. There is, however, a federal RPS proposal that would require 5.5% of electricity to be generated from renewable sources by 2010. Sellers would be able to meet the RPS requirement either by generating renewable electricity themselves or by purchasing tradable renewable electricity credits. *Id.*; *see also* Exec. Order No. 13,123, 64 Fed. Reg. 30,851 (June 3, 1999).

128. ENERGY INFO. ADMIN., *supra* note 104, at 3.

competitive with traditional resources does not end consideration of them in our energy future. Rather, the question becomes how to encourage the development and deployment of smaller, cleaner renewable energy resources and technologies. A standard regulatory response is through subsidies, financial incentives, standards, and other regulatory devices.[129] State governments have developed a different response through standard setting. In particular, several state governments now require that electricity producers must provide specified percentages of generation from renewable energy sources by specified dates. As examples, California has set a target portfolio requirement of twenty percent by 2017, and Maine set a thirty percent goal to be achieved by 2000.[130] Hydroelectricity, however, is included in Maine's definition of renewable resources. Often, RPS programs include a trading provision through which regulated firms can trade renewable energy credits, thus creating a market like the emissions trading market. This market gives producers more flexibility in meeting the standards imposed upon them because a generator that cannot meet its requirement can purchase credits, while generators that can exceed the goal will sell credits.

RPS programs can be designed such as to encourage the development and use of particular technologies. Nevada, for example, encourages the use of photovoltaic cells by giving literally extra credits for electricity produced by those cells.[131]

D. Smart Electricity Grids

Each of the previous smart energy activities depends on a reliable distribution system, and the grid is in need of improvement as attested to by the August 2003 Blackout.[132] New technologies, under the rubric "Smart Grid," promise to improve the grid and enable it to move electricity more efficiently and more effectively.

The Smart Grid promises "important economic, security, and environmental benefits by promoting substantial upgrades to the performance of the transmission and distribution network that

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129. *See* Mark Gielecki et al., *Incentives, Mandates, and Government Programs for Promoting Renewable Energy*, *in* ENERGY INFO. ADMIN., RENEWABLE ENERGY 2000: ISSUES AND TRENDS 1-17 (2001), *available at* http://www.eia.doe.gov/cneaf/solar.renewables/rea_issues/062800.pdf.

130. *See* Everett Britt, *Renewable Electric Generation 2004: Incentives, Obligations, and Concerns*, NAT. RESOURCES. & ENV'T, Winter 2005, at 34, 35.

131. *Id.* at 35.

132. *See* U.S.-CAN. POWER SYSTEM OUTAGE TASK FORCE, FINAL REPORT ON THE AUGUST 14, 2003 BLACKOUT IN THE UNITED STATES AND CANADA: CAUSES AND RECOMMENDATIONS (2004), *available at* https://reports.energy.gov/Blackout Final-Web.pdf.

connects electricity generators and consumers."[133] Contemporary thinking, then, integrates energy, environment, and security into the distribution and transmission system by incorporating "sophisticated sensing and monitoring technology, information technology, and communications to provide better grid performance and to support a wide array of additional services to consumers."[134]

There is a general consensus that investment in the electricity infrastructure is lagging behind our electricity needs[135] and that additional, more reliable, transmission and distribution capacity is necessary. Given the need for a system upgrade, there is no reason not to improve upon the technology while simultaneously addressing environmental and security needs. Such improvements can occur through the so-called Smart Grid that involves:

- Infrastructure with "smarter" controls to support robust market activity; rapid recovery from cascading outages, natural disasters and potential terrorist attacks;[136]

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133. EFC, CHALLENGE AND OPPORTUNITY, *supra* note 65, at 75.

134. *Id.*; *see also* ELEC. POWER RES. INST., ELECTRICITY TECHNOLOGY ROADMAP: MEETING THE CRITICAL CHALLENGES OF THE 21ST CENTURY: 2003 SUMMARY AND SYNTHESIS 1-4 (2003) [hereinafter ELEC. POWER RES. INST., ROADMAP], *available at* http://www.epri.com/roadmap/viewpdfs.asp. The Electric Power Research Institute claims:

> [a] truly "smart" power delivery system will include automated capabilities to anticipate problems, find solutions, and optimize performance ... The basic building blocks include advanced sensors for wide-area system monitoring and control, faster-than-real-time data processing and pattern recognition software, solid-state power flow controllers, and two-way energy/information consumer access portals.

Id.; see also NAT'L COMM'N ON ENERGY POLICY, REVIVING THE ELECTRICITY SECTOR: FINDINGS OF THE NATIONAL COMMISSION ON ENERGY POLICY 4-5, 8 (2003), *available at* http://www.pewtrusts.com/pdf/environment_energy_policy_0903.pdf.

135. ELEC. POWER RES. INST., ROADMAP, *supra* note 134, at 1-1; Kueck, *supra* note 84, at 48; Joskow, *supra* note 102, at 23; EFC, CHALLENGE AND OPPORTUNITY, *supra* note 65, at 76; ERIC HIRST, EDISON ELEC. INST., U.S. TRANSMISSION CAPACITY: PRESENT STATUS AND FUTURE PROSPECTS 1 (2004), *available at* http://www.eei.org/industry_issues/energy_infrastructure/transmission/USTransCapacity10-18-04.pdf; U.S. DEP'T OF ENERGY, NATIONAL TRANSMISSION GRID STUDY 25 (2002), *available at* http://www.eh.doe.gov/ntgs/gridstudy /main_print.pdf; *see also* PAUL J. HIBBARD, ANALYSIS GROUP, INC., U.S. ENERGY INFRASTRUCTURE: DEMAND, SUPPLY AND FACILITY SITING: REPORT TO THE NATIONAL COMMISSION ON ENERGY POLICY 2 (2004), *available at* http://64.70. 252.93/O82F4698.pdf.

136. This capacity is also know as a "self-healing" grid. "A self-healing grid integrates real-time information from embedded sensors with distributed intelligence and automated control, enabling the system to respond automatically to disruptive events and attacks to the system." EFC, CHALLENGE AND OPPORTUNITY, *supra* note 65, at 77.

- High quality and highly reliable electricity for our digital economy;
- An infrastructure connected with advanced communications to form an energy web;
- An energy web which increases economic productivity;
- "Clean . . . power generation technologies" and "universal access to affordable electricity."[137]

Smart Grid technologies are attractive not only because they are responsive to the increasing environmental sensitivity of progressive electricity policies but also because they increase grid security and contribute to greater demand sensitivities. Security is heightened as the grid operates more rapidly to recognize and isolate problem areas. The Smart Grid will also be one that can easily accommodate distributed and small-scale generation technologies, which, by their size alone, make less attractive targets. The Smart Grid is intended to be consumer friendly in other ways as well by providing communications and power to "smart" buildings to make the most intelligent use of equipment.[138] Such portals enable residential, commercial and industrial customers to "manage electricity use in a manner that improves efficiency and reduces consumer energy costs, while at the same time enhancing customer control of electrical equipment."[139] In the next sub-part, we address electricity pricing and the Smart Grid together with smart metering. Together these technologies facilitate real-time pricing thus giving consumers more accurate price signals.

To be sure, the Smart Grid is a matter of our electricity future, not a current reality. To become a reality certain recommendations have been made including:

- The DOE should be charged with establishing a clear vision and set of goals for the development of the Smart Grid through a program of regional and local demonstrations projects.

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137. ELEC. POWER RES. INST., ROADMAP, *supra* note 134, at 2-2; *see* EFC, CHALLENGE AND OPPORTUNITY, *supra* note 65, at 78-79; NCEP, STALEMATE, *supra* note 65, at 94.

138. "The GridWise Alliance is a consortium of public and private stakeholders," whose mission it is to "provide real-world technology solutions to support the U.S. Department of Energy's vision of a transformed national electric system." *See* Gridwise Alliance, The Gridwise Alliance, *at* http://www.gridwise.org/index.htm (last visited Mar. 17, 2005). The alliance envisions an electric system that will "employ new distributed 'plug and play' technologies using advanced telecommunications, information and control approaches to create a society of devices that functions as an integrated transactive system." *Id.*

139. EFC, CHALLENGE AND OPPORTUNITY, *supra* note 65, at 78.

- Appropriate technical and reliability standards must be devised and adopted (the North American Electric Reliability Council can be tasked with this recommendation).
- A Twenty-First Century Electricity System Security and Modernization Fund should be created to fund the necessary investment in research and development.[140]

To the end of modernizing the electric grid, the DOE has announced its support of technological innovations in transmission, communications and information, and siting.[141] The DOE proposes a National Electric Delivery Technologies Roadmap,[142] which will be a combined government and industry undertaking to improve electricity transmission.

V. THE SMART CONSUMPTION MODEL

A smart electricity generation policy will not displace the Traditional Model. It is, however, responsive to protecting the environment and serving other important national interests. The evaluative test for the success of the smart generation alternatives will come in the market, and, for this reason as well as others, the market must contain a pricing mechanism that is cost sensitive. We therefore turn next to new thinking about electricity pricing.

More specifically, this section investigates the potential of marginal cost pricing to promote energy conservation. Our analysis reveals that marginal cost pricing requires the installation of new meters that should result in significant energy conservation, which in turn will reduce some of the environment harm associated with electricity generation, and that the benefits of reduced consumption should outweigh the problems of achieving it.

A. *Meters and Prices*

Most retail consumers purchase electricity according to how much electricity they consume over some period of time, usually a month.[143] The price usually does not vary, except possibly for fuel costs,[144] even if the cost of producing the electricity goes up because

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140. These last three recommendations are those of the Energy Future Coalition. *Id.* at 80-84.

141. U.S. DEP'T OF ENERGY, "GRID 2030": A NATIONAL VISION FOR ELECTRICITY'S SECOND 100 YEARS 27-28 (2003), *available at* http://www.electricity.doe.gov/documents/Electric_Vision_Document.pdf; *see also* Michael T. Burr, *The Digitized Grid: Data Gathering and Controllability Offer the Quickest Path to Reliability*, PUB. UTIL. FORT., Jan. 2005, at 26, 27.

142. *See, e.g.*, ELEC. POWER RES. INST., ROADMAP, *supra* note 134, at vii.

143. Moot, *supra* note 4, at 315.

144. *See, e.g*, MIDAMERICAN ENERGY CO., SCHEDULE OF RATES FOR ELECTRIC SERVICE IN ILLINOIS, RIDER NO. 2 ELECTRIC FUEL ADJUSTMENT CLAUSE 17 (1995),

retail prices are based on the average cost of producing and delivering electricity. By comparison, electricity production costs vary significantly by hour in almost all systems across the country.[145]

Average cost pricing is used in large part because marginal cost pricing requires the use of meters that measure the time of day that electricity is consumed.[146] If electricity prices are based on marginal costs, consumers will have an incentive to reduce electricity use during periods of peak demand or to switch to less expensive sources of energy because the cost of generating and delivering electricity is normally greater during such peaks.[147] There is little marginal cost pricing in both regulated and unregulated generation markets because neither market generally employs meters that measure time-of-day demand.[148]

1. *Regulated Markets*

Consumers do not pay any more for electricity when the costs of generating and delivering it increase in regulated markets (except for fuel costs) because the normal method of setting utility prices uses average cost. Regulators, however, could adopt marginal cost pricing if they required utilities to install time-of-use meters.

a. *Traditional Regulation*. Under cost-of-service ratemaking, regulators first determine the revenue requirement of a utility.[149] Regulators calculate the revenue requirement by estimating the cost of producing electricity and how much money the utility must earn to provide a sufficient rate of return for stockholders and bondholders who invest in the company.[150] Once the revenue requirement is determined, regulators determine the price that the utility can charge for each unit of electricity. Regulators can do this by dividing the revenue requirement by the quantity of electricity that they estimate the utility will sell, but regulators may also make adjustments to reflect differences in the cost of producing and transmitting electricity.[151] For example, a commission will set a lower price for large industrial users because it is less expensive for a utility to deliver a large volume of electricity to one location than

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available at http://www.midamericanenergy.com/pdf/rates/elecrates/ilelectric/17-17.30.pdf.

145. *See* David Nichols & John Stutz, *Load Response: New, or Déjà Vu?*, ELECTRICITY J., May 2001, at 73, 74.

146. Moot, *supra* note 4, at 315.

147. *See infra* notes 176-205 and accompanying text.

148. Moot, *supra* note 4, at 315.

149. *See* SHAPIRO & TOMAIN, *supra* note 51, at 109.

150. *Id.*

151. *Id.* at 113.

much smaller amounts to thousands of households. None of these prices reflect actual marginal costs since they are based on regulators' estimates of the differences in cost of providing service to different classes of customers. More importantly, once a price is established for a class of customers, it does not change over the period of time in which it is in effect.[152] In other words, price is the average cost of producing electricity for that class of customers. Thus, even after these adjustments, other than the actual fixed price paid, there is no further incentive for any class of consumers under this regulatory system to use less electricity when the cost of producing it rises.

The current method of structuring prices does not take into account that the cost of producing electricity normally increases during periods of peak demand. The cost goes up for several reasons. During periods of peak demand, electrical utilities typically include older, more inefficient generation plants in their portfolio of generators, which are not normally used because they are more expensive to operate and because they cause more air pollution than other generation units.[153] In restructured electricity markets, local utilities can purchase additional supplies of electricity from other generators, but the cost of electricity purchased from other suppliers can be expected to rise as demand increases unless there is sufficient excess efficient generation. Furthermore, the marginal transportation costs rise according to the distance over which electricity is transported because megawatts are lost in the act of transmitting electricity.[154] In addition, the cost of transmission increases because high demand for electricity creates transmission congestion.[155]

The cost differences between peak and non-peak demand can be substantial as the following table illustrates:

152. John C. Hilke, *A Consumer Self-Defense Perspective on Electricity Markets*, 33 LOY. U. CHI. L.J. 805, 808-09 (2002).

153. Darren Bush & Carrie Mayne, *In (Reluctant) Defense of Enron: Why Bad Regulation Is to Blame for California's Power Woes (or Why Antitrust Law Fails to Protect Us Against Market Power When the Market Rules Encourage Its Use)*, 83 OR. L. REV. 207, 236-38 (2004).

154. Moot, *supra* note 4, at 315.

155. *Id.* at 314.

TYPICAL COSTS OF POWER: COMMERCIAL AND INDUSTRIAL USERS, DOLLARS PER MEGAWATT-HOUR ("MWH")[156]

	Average Cost	*Off-Peak*	*Highest 1,000 to 2,000 Hours*
Generation	30-50	20	100-160
Distribution	20-40	10	40-60
Total	$50-90	$30	$140-220

b. *Regulatory Reform.* If regulators decided to employ marginal cost pricing, there are a number of difficult issues that they will have to overcome. These include the choice of a pricing method, the scope of the marginal cost pricing, and methods to protect consumers who still purchase electricity from monopoly suppliers.

i. *Pricing Method.* Regulators have two general options to adopt marginal cost pricing: consumers receive rebates for reducing electricity usage during periods of peak demand or retail prices are actually based on the marginal cost of producing electricity.

a. *Rebates.* Under this approach, consumers are rewarded for reducing electricity use during periods of high demand. Thus, in this approach, consumers reduce their electricity loads in response to actual or forecasted demand.[157] In return, they are entitled to rebates based on the amount that they reduce their electricity use during these periods of high demand. For example, a consumer might receive fifty percent of the amount of money a utility saves because the consumer reduced its electricity use during a period of high demand. The utility saves money because it does not have to generate (or buy) electricity for that customer at a time when the cost of producing the electricity (or buying it) has increased.

As compared to marginal cost pricing, this approach creates less incentive for consumers to reduce their electricity use because consumers capture only some percentage of the amount of money that the utility saves because it does not have to pay higher marginal costs to generate and deliver electricity. If, by comparison, marginal cost pricing is used, the consumer can save the full amount of the increase in cost. For example, if the marginal cost of producing electricity during a period of high demand is 50¢ per

156. This table is from Tobey Winters, *Retail Electricity Markets Require Marginal Cost Real-Time Pricing*, ELECTRICITY. J., Nov. 2001, at 74, 76; *see also* Moot, *supra* note 4, at 315 (finding that marginal cost of producing electricity on a hot summer day can be $50/MWh as compared to $20/MWh on a cool day).

157. Thomas et al., *supra* note 3, at 56.

kilowatt ("kW") and the consumer is entitled to fifty percent of that amount, the consumer is entitled to a 25¢ rebate per kW. If, however, the consumer will have to pay the entire 50¢ per kW for any electricity used during a peak period, the consumer can save 50¢ for each kW that electricity usage is reduced or deferred to a period when prices are lower. Marginal cost pricing therefore provides more incentive for consumer to engage in conservation efforts. Nevertheless, this plan may be attractive to regulators because it protects consumers from a run-up in prices during periods of peak demand while still providing an incentive for consumers to reduce their electricity usage.[158]

b. *Variable prices.* Regulators can also pursue marginal cost pricing through use of "time-of-use" or "real-time" pricing. In time-of-use pricing, meters record when consumption occurs (for example, hourly), and rates are assigned to time blocks much like monthly rates are presently assigned.[159] For example, Florida Gulf Power normally charges customers three different rates (low cost, medium, and high cost) depending when the electricity is used.[160] Real-time pricing, in contrast, uses an even smarter meter than the time-of-use meter to communicate the actual price of electricity in real time.[161]

The biggest advantage of time-of-use pricing is that it is easier for consumers to understand and therefore for utilities and their regulators to embrace. Nevertheless, the incremental benefits of real-time pricing over time-of-use pricing may be significant relative to the small incremental cost of a real time meter over a time-of-use meter. Unlike real-time pricing, time-of-use pricing does not distinguish between hot days and cool days because the rate for blocks of time is set in advance. In addition, a key issue is how consumers will react to each type of pricing. Assuming that the time periods are designed such that the average customer consumes half of his demand during peak hours at 10¢ per kilowatt-hour ("kWh") and half during off-peak hours at 4¢ per kWh, consumers may behave as if they are charged 7¢ per kWh regardless of when power is consumed. By comparison, real time pricing seems more likely to cause consumers to engage in conservation efforts since

158. *See id.*

159. Wolfgang Orasch et al., Efficient Load-Management Tools in Competitive Electricity Markets: Time-Of-Use Rates and Real-Time-Pricing, Presented at the Conference on Domestic Use of Energy, Cape Technikon, Cape Town (1998), *available at* http://www.ctech.ac.za/conf/due/SOURCE/Web/Orasch/Orasch. html.

160. Thomas et al., *supra* note 3, at 56.

161. *Id.*

they are immediately aware of the costs of not doing so.

Nevertheless, some critics claim real-time pricing will not work unless consumers have smart devices that shut off appliances when electricity costs rise or reduce the amount of electricity that they use.[162] There are, however, a number of studies that indicate residential and small business consumers are able to shift their electricity demand in response to prices that vary by time.[163]

Moreover, consumer response can be enhanced if utilities and regulators alert consumers to potential price increases. This would be similar to efforts to inform people about the quality of air during periods of potentially unhealthy smog. Most morning newspapers and television broadcasts convey this information to consumers. Similarly, the news media can warn consumers about weather conditions that will result in high demand for electricity and therefore higher electrical prices. Regulators could require utilities to maintain websites that indicate current prices, or even send email alerts, which may make it easier for consumers to keep abreast of changes in price.

The adoption of real-time pricing would also create a market demand for devices to assist consumers in reducing their energy costs. Utilizing a Smart Grid, as discussed earlier,[164] real-time pricing meters can be designed to give consumers immediate information on the rate of consumption and the current cost per hour.[165] It will also be possible to automate some consumer responses. For example, the meter can be connected to "smart" appliances that shut off or cut back on electricity use when they receive a signal of higher prices.[166]

ii. *Consumer Protection.* When marginal cost pricing is used in monopoly electricity markets, regulation of prices will remain necessary to protect consumer interests. Regulators face three general challenges.

First, regulators will have to use ratemaking to establish a revenue requirement for a utility's costs other than the cost of producing electricity. The retail price would be composed of the marginal cost of producing and delivering the electricity plus the price set by regulators to permit the utility to recoup its other costs.

162. *See* Lisa Kosavanic & Dan Engel, *Meeting the Nation's Demand for Power: A New Take on Demand Programs,* ENERGY USER NEWS, May 2004, at 11, 12.

163. Borenstein et al., *supra* note 5, at 28.

164. *See supra* notes 133-39 and accompanying text.

165. *See* Chris King & Dan Delurey, *Efficiency & Demand Response: Twins, Siblings, or Cousins?,* 54 PUB. UTIL. FORT., March 2005, at 54, 56.

166. *See* Kosavanic & Engel, *supra* note 162, at 12 (discussing "smart" appliances).

Regulators would also need to verify that the marginal costs a utility charged were its actual marginal costs. For this purpose, regulators would need to establish in advance how marginal costs were to be calculated.

Second, regulators will have to address the problem that marginal cost pricing creates economic risks for consumers that did not exist previously because retail rates will vary, sometimes by substantial amounts.[167] Economic theory would dictate that prices should be based on marginal costs regardless of volatility, but this result may not be consistent with a regulator's legal obligation to design regulation in a manner that protects the public. Moreover, the adoption of marginal cost pricing may not be politically feasible if consumers are exposed to price spikes and market volatility.[168] At the same time, efforts to protect consumers against price spikes will reduce the extent to which marginal cost pricing creates an incentive to engage in conservation.

Regulators have a number of options to address this issue. They can make marginal cost pricing voluntary. Or, as noted earlier, they can adopt a rebate plan.[169] Under this approach, consumers are protected against price spikes because they pay regulated rates for electricity. At the same time, they receive rebates for reducing the electricity load during peak periods, which encourages conservation or deferral. Regulators can also adopt a price ban that limits the amount that prices can be increased or decreased based on the marginal cost of producing the electricity, protecting consumers and utility investors. Whichever approach is adopted, regulators ought to make the ultimate objective to move as many consumers as politically and legally possible to marginal cost pricing.

Finally, regulators will need to consider the potential burden on low-income electrical consumers, who will be less able to afford to install energy saving products, such as better insulation, as compared to wealthier consumers. More accurately, these consumers would not be in a position to pay higher rents for housing if landlords took additional conservation measures and passed the costs on to their tenants. This reality suggests that low-income consumers will end up paying higher electrical bills. However, because low-income consumers generally live in small housing units, the amount of the increase may not be very great. Moreover, low-income consumers can avoid higher prices to the extent that they

167. Phil Hanser et al., *Real-Time Pricing—Restructuring's Big Bang?*, PUB. UTIL. FORT., Mar. 1, 1997, at 22, 28.

168. Kosavanic & Engel, *supra* note 162, at 12.

169. *See supra* notes 157-58 and accompanying text.

conserve electricity during periods of high demand. Nevertheless, even a small increase in price may be highly detrimental to low-income consumers. Some low-income consumers may not be able to reduce electrical use because, for example, they are unable to work and, therefore, are not in a position to conserve on air conditioning during the middle of the day, as compared to persons who leave for work.

There are a number of potential solutions to this problem. Regulators could exempt low-income consumers from installing more expensive meters, low-income consumers could be entitled to purchase electricity at lower rates, or they could receive a discount when they paid their bills. All of these methods, however, would require a subsidy from either other ratepayers, which could be part of the regulated portion of the price that utilities would charge, or taxpayers in the form of direct subsidies. Since welfare reform seems unlikely, regulators should attempt to address the issue of low-income consumers during regulatory reform.

2. *Unregulated Markets*

In competitive markets, sellers will continue to sell a product or service as its marginal revenue exceeds its marginal costs.[170] Thus, short-run prices in competitive markets reflect marginal costs.[171] In competitive generation markets for electricity, however, sellers cannot always charge consumers for electricity according to the time of day that electricity is produced. As in regulated markets, many consumers still have meters that measure only the total electricity consumed, but not the time during which it was consumed.[172]

As a result, the market price does not fully reflect the marginal cost of producing electricity for consumers who lack new meters. Instead, they purchase electricity at a fixed price for some period of time, such as one month. A utility will calculate this fixed price based on an estimate of its average marginal costs for that month. While this approach is closer to marginal cost pricing than occurs under traditional cost-of-service ratemaking, it still does not reflect changes in the cost of producing electricity at different times of day or on different days within the billing period.

B. *Prices and Conservation*

Economic theory predicts that consumer demand will fall as the price of a product or service goes up. Thus, if consumers pay higher prices for electricity during periods of higher demand, the demand

170. SHAPIRO & TOMAIN, *supra* note 51, at 49.
171. *Id.* at 48.
172. *See supra* notes 52 ,143-48 and accompanying text.

for electricity should fall. This "economic law," however, is subject to some important caveats. The extent to which consumers will reduce demand depends on the elasticity of demand. If consumers do not have a readily available substitute for a product or service, demand will not fall as rapidly as when less expensive substitutes are available.[173] Consumers have three potential substitutes for purchasing electricity: They can reduce demand during peak periods when prices are higher, invest in products that reduce energy use, or switch to lower cost sources of energy. According to economic theory, consumers will choose these options only if they cost less than paying for more electricity, and the consumer will choose among these options based on their comparative costs.

While all three of these options will reduce the demand for electricity, the last may not produce an environmental improvement if consumers switch to an alternative source of energy that creates as much or more pollution.[174] For example, some consumers may switch to a diesel unit that produces pollution emissions that greatly exceed those produced by the plant whose electricity the consumer is replacing.[175] Most households, however, are unlikely to keep a generator in the backyard, and most industrial users will likely rely on less expensive sources of energy, such as natural gas, to fuel self-generation.

Since marginal cost pricing is not widely used, there is only limited evidence concerning the extent to which consumers will reduce demand in response to higher prices. The results of voluntary programs, however, suggest that it will be possible to obtain significant reductions of demand during periods of peak usage. A program offered to industrial users by the Georgia Power Company, for example, has produced as much as a 500 MW reduction in the utility's load, which represents about ten percent of the utility's total industrial demand.[176] When the utility charges its highest prices, it gets an eighteen percent reduction in demand.[177] Similarly, a voluntary program for industrial users in New York

173. SHAPIRO & TOMAIN, *supra* note 51, at 49.

174. Nichols & Stutz, *supra* note 145, at 77.

175. *Id.*

176. Kosavanic & Engel, *supra* note 162, at 12. The company offers industrial users a two-part fee composed of standard rates for a baseline level of consumption and hourly market-based rates for consumption above the baseline amount. Firms can also receive a credit (at market rates) for reducing consumption below the baseline amount. *Id.*

177. John Wilson et al., USING DEMAND RESPONSIVE LOADS TO MEET CALIFORNIA'S RELIABILITY NEEDS 8, *available at* http://www.westgov.org/wieb/electric/demand%20response/background%20documents/wilson_paper.pdf (last visited Apr. 3, 2005).

took an average of 668 MW in load off the grid during the hottest summer days, which is the equivalent of the generating capacity of a large turbine power plant.[178]

There have also been positive results concerning residential consumers. Residential consumers who volunteered for a variable rate program offered by Gulf Power in Florida consumed only 20% of the power they purchased during high-cost periods, producing an annual average 14% savings in their electricity bills.[179] An experimental plan in California that used marginal cost pricing including a very high price for critical peak periods resulted in a reduction of over 12% in peak demand.[180] A marginal price plan that did not include a critical rate produced a 4% decrease in demand during peak periods.[181] Prices during the peak period were about three times higher under the plan with the higher prices.[182]

These results suggest that at least some industrial and residential consumers will reduce demand in response to price increases or rebates. The critical issue is how many consumers are sensitive to price and how they will act when prices go up (or when there is an opportunity to earn a rebate). Some commentators predict that many residential consumers will not react to high prices by reducing electrical use during peak periods of demand, at least in the short run.[183] This will happen if the purchase of more energy-efficient appliances or of more insulation costs more than paying higher electricity bills, which may be the situation for persons who do not consume much electricity, even during periods of peak demand. Since, however, the benefits of lower demand are benefits for everyone using electricity, these commentators argue regulators may be justified in using additional financial incentives to

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178. Thomas et al., *supra* note 3, at 55.

179. *Id.* at 58. Under the program, Gulf Power customers pay four different rates (low, medium, high, and extraordinary) for electricity depending on when it is used. *Id.*

180. CHARLES RIVER ASSOCS., STATEWIDE PRICING PILOT SUMMER 2003 IMPACT ANALYSIS 7, 9 (2004), *available at* http://www.energy.ca.gov/demandresponse/documents/group3_final_reports/2004-10-29_SPP_REPORT.PDF. Under this plan, demand increased 3% during non-peak hours as consumers shifted their use from expensive peak power to less expensive off-peak power. *Id.* The total demand for peak periods was decreased by 1.4%. *Id.* at 8 tbl.1-3.

181. *Id.* at 9-10. Total demand for peak periods under this plan had an increase of 0.1%. *Id.* at 10.

182. *Id.* at 2.

183. Nichols & Stutz, *supra* note 145, at 77-78; *see also* Fereidoon Sioshansi & Ali Vojdani, *What Could Possibly Be Better Than Real-Time Pricing? Demand Response*, ELECTRICITY J., June 2001, at 39, 40 (observing that "[m]ost consumers are totally oblivious to the *actual* costs they impose on the system as they use power").

encourage conservation. This argument anticipates that the cost of the incentives will be substantially less than the benefits of protecting the environment and having a more reliable and less expensive generation and delivery system.[184] Fifteen states currently have established benefit funds for this purpose funded by a small charge of all kWh flowing through the transmission and distribution grids.[185]

C. *Capital Costs*

There are good reasons to believe that marginal cost pricing (or some variation of it) will lead to conservation efforts by at least some consumers. Marginal cost pricing will cause consumers to use less electricity during periods of high demand and, to the extent that such use cannot be rescheduled to periods of lower cost, to purchase energy saving products. Nevertheless, for this reform to succeed, regulators will need to require utilities to install new meters in millions of homes and small businesses. Although this is by no means an inexpensive proposition, it does appear to be cost-effective.

There is limited information about the cost of real time meters. However, the utility in Ontario, Canada is contemplating installing meters and estimates the cost to be C$150 to C$450 per meter initially, decreasing to C$150 (about US$120 to US $362).[186] As the number of meters in use increases, the cost of meters should decline over time. There were 116 million residential customers and an additional fifteen million commercial customers in the United States in 2002.[187] Conservatively assuming a cost of $200 per meter for 130 million residential and commercial consumers, the total installation cost would be about $26 billion. The cost could be lower or higher if meter costs were more or less than $200 each.[188]

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184. At an earlier point in time, utilities funded programs to encourage more efficient energy use and to assist low-income consumers with home weatherization, among other expenditures. Steven Nadel, *Smart Energy Policies Through Greater Energy Efficiency*, 16 NAT. RESOURCES & ENV'T 226, 227 (2002). The value of energy savings gained by consumers was about double the cost of producing the savings. *Id.* at 228.

185. *Id.*

186. *Ontario Ponders Smart v. Not So Smart*, THE ELECTRICITY DAILY, Nov. 3, 2004.

187. ENERGY INFO. ADMIN., ELECTRIC POWER ANNUAL 2002, at 6 tbl.ES (2003), *available at* http://tonto.eia.doe.gov/FTPROOT/electricity/034802.pdf.

188. The 2,000 meters installed in the California SPP cost an average of $5,000 to install according to The Utility Reform Network ("TURN"). Marcel Hawiger & Jeff Nahigian, *Letters to the Editor*, PUB. UTIL. FORT., Oct. 15, 2003, at 10, 10. A high cost-per-meter in a pilot is not indicative, however, of the cost that will be experienced in a wide-scale rollout. Nevertheless, we are cognizant of TURN's admonition to consider the impact on the smaller consumers before

The actual total cost, however, would be less since it would be offset by the amount of money that consumers would save by decreasing peak purchases in favor of cheaper power during non-peak periods. While it is difficult to estimate how much money people will save, rudimentary calculations suggest consumers should quickly recoup the cost of the new meter. For a ballpark estimate, assume that the capital markets require a 10% internal rate of return on the investment in metering over a ten year period. Annual savings of about $4 billion per year would be necessary to generate such a return on investment. Since residential consumers spent over $100 billion on power in 2002,[189] a 4% reduction in energy costs would be sufficient to amortize the investment in metering.

An alternative analysis is to consider the average customer. According to the study commissioned by the DOE, the average residential customer in 2002 consumed about 10,880 kWh per year at an average cost of 8.46¢ per kWh, or a total of $920 for the year.[190] The California time-of-day pricing tariff deemed 1,500 hours per year to be "peak" periods and 7,260 hours per year to be "off-peak" and assigned prices to the peak periods that were 153% higher than off-peak prices.[191] If the California parameters are applied to the DOE data, there is a peak price of 16.960¢ per kWh and off-peak price of 6.704¢ per kWh.[192] Assuming a meter cost of $200, an annual savings of about $32.50 would be required to amortize the cost of the meter.[193] To generate $32.50 in savings, about 316 kWh of consumption (about 3% of the annual consumption of the average residential consumer) would have to be switched from peak prices to off-peak prices.

This analysis suggests that large electricity consumers should be able to recoup the cost of the meters without much difficulty. For example, the Marriott Hotel in New York saved more than $200,000 in the first summer of experimental testing of Consolidated Edison's real time pricing by reducing its use of energy during peak periods

installing a meter that will never be paid out. *See supra* notes 143-48 and accompanying text.

189. ENERGY INFO. ADMIN., *supra* note 187, at 7 tbl.ES.

190. *Id.* at 6-7 tbl.ES. (demonstrating that retail sales of 1,266,959,000 MWh to 116,448,000 residential customers in 2002, or approximately 10,880 kWh per customer).

191. CAL. ENERGY COMM'N, STATEWIDE PRICING PILOT (SPP): OVERVIEW AND DESIGN FEATURES 7 (2004), *available at* http://www.energy.ca.gov/demandresponse/documents/2004-09-30_workshop/2004-09-30_SPP_ OVERVIEW.PDF.

192. The weighted average of 16.960¢ per kWh for 1,500 hours and 6.704¢ per kWh for 7,260 hours equals the 8.46¢ per kWh in the EIA data.

193. A $32.50 annual savings for ten years has a present value of $200 using a 10% discount rate.

of demand.[194] The experience of residential consumers, however, indicates that they also will be able to recoup the cost of a new meter through decreased demand or shifts in the use of electricity. Customers of Gulf Power in Florida who purchased electricity under a voluntary variable rate plan saved, on average, 14% on their annual electricity costs.[195]

There are additional savings. Capital costs will be saved as peak day loads grow less rapidly than total demand due to consumption switching away from peak periods. It is difficult to know how much money will be saved by additional conservation by consumers, but the United States is facing a very large bill for construction of new generation and transmission facilities in the next decade. A study commissioned by Edison Electric Institute estimates that $56 billion of transmission investments will be required during the current decade.[196] The Energy Information Agency, an arm of the U.S. DOE, estimates that 88 gigawatts ("gW") of generation will be required by the year 2010.[197] Using industry rules of thumb, 88 gW of capacity would require an investment of between $26 billion[198] and $44 billion.[199]

Moreover, the potential to save money is substantial because this household use of electricity in the residential segment is the largest consumer of power,[200] and more importantly, it has the

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194. Hanser et al., *supra* note 167, at 26.

195. Thomas et al., *supra* note 3, at 56. For details of the program, see *supra* notes 157 , 179 and accompanying text.

196. *See* ERIC HIRST & BRENDAN KIRBY, EDISON ELEC. INST., TRANSMISSION PLANNING FOR A RESTRUCTURING U.S. ELECTRICITY INDUSTRY 9 (2001), *available at* http://www.eei.org/industry_issues/energy_infrastructure/transmission/transmission_hirst.pdf. *But see* Steve Huntoon & Alexandra Metzner, *The Myth of the Transmission Deficit*, PUB. UTIL. FORT., Nov. 1, 2003, at 28, 30 (arguing that transmission investment needs are overstated and that the actual investment requirement is $56 billion over the next ten years—$35 billion of which utilities already plan to spend).

197. ENERGY INFO. ADMIN., ANNUAL ENERGY OUTLOOK 2004 WITH PROJECTIONS TO 2025, at 81 (2004), *available at* http://www.eia.doe.gov/oiaf/archive/aeo04/pdf/0383(2004).pdf.

198. Based upon a rule of thumb of $300 per kW of capacity. Edward N. Krapels, *What Is a Power Plant Worth?*, PUB. UTIL. FORT., Jan. 2004, at 31, 31 (misstating the capital cost rule of thumb in terms of "per-megawatt" rather than kW, but having calculations consistent with $300 per kW).

199. Based upon a rule of thumb of $500 per kW. HIRST & KIRBY, *supra* note 196, at 10.

200. The EIA breaks down power demand into four segments: residential (1,267 million megawatt hours ("MM MWh") of consumption in 2002); commercial (1,116 MM MWh); industrial (972 MM MWh); and other (107 MM MWh). ENERGY INFO. ADMIN., *supra* note 187, at 4.

lowest load factor of the three major market segments.[201] The residential segment accounts for about 37% of annual electricity consumption, while the commercial and industrial segments represent 32% and 28%, respectively, of demand.[202] The amount of electricity consumed, however, understates the true burden that the residential segment places on the power grid. Since power cannot be stored, each utility must have the ability to generate or purchase enough power to meet peak day demand; therefore, peak usage is a better indicator of the demand that a segment makes upon the power grid. Assuming 40%, 60%, and 80% load factors for residential, commercial, and industrial consumers, respectively, residential consumers represent 51% of peak day demand, while commercial and industrial consumers represent 30% and 19%, respectively.[203]

Experimental programs appear to confirm the previous analysis. A pilot program in Little Rock, Arkansas found that each new real-time pricing customer helped to avoid the installation of 1.5 kW of electricity, saving $1,200 in capital costs.[204] The net savings was $350 per customer after paying $850 to install the necessary metering.[205] Similarly, program participants in a voluntary New York program, which reduced peak load by an

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201. Reliable data on customer load factors are difficult to get, but there seems to be a consensus among industry analysts that large industrial consumers have load factors (calculated by dividing average demand by peak demand) in the range of 80%, commercial consumers have load factors in the vicinity of 60%, and residential consumers have load factors of 40% or less. *See* Robert McCullough & Ruben Brown, *Electric Industry Restructuring: The Effect on Rates Nationwide*, FORTNIGHTLY, July 15, 1994, at 20, 21 (conducting an analysis using load factors of 80%, 60%, and 40%, respectively, for industrial, commercial, and residential consumers).

202. ENERGY INFO. ADMIN., *supra* note 187, at 4. In addition to residential, commercial, and industrial demand, "other" demand (primarily street lighting and other sales to government entities) represents about 3% of annual demand. *Id.* at 4, 78.

203. *See* McCullough & Brown, *supra* note 201, at 21. Since load factor equals annual demand divided by peak demand, peak demand is calculated by dividing annual demand by the load factor (expressed as a decimal). This analysis simplifies a complex issue, since not every peak load occurs simultaneously (that is, residential users may use the most power on a hot day, while a factory may peak as a function of its production scheduling). Therefore, since peaks are non-coincidental, system peak demand will be less than the sum of each user's peak demand. The simple analysis demonstrates that residential consumers account for a higher percentage of peak demand than they do of average demand.

204. Albert L. Danielsen & Nainish K. Gupta, *Seven Myths of Real-Time Pricing*, PUB. UTIL. FORT., Mar. 1 1997, at 23, 23.

205. *Id.*

amount equivalent to the generating capacity of a large gas turbine power plant, received $3.3 million in rebates, which is less than 1% of how much such a plant would cost.

VI. CONCLUSIONS

The valuable effort to restructure and reform electricity markets is not addressed to reducing the pollution and other environmental problems caused by relying on fossil fuels, particularly coal, to generate electricity. This failure has generated interest in a new Smart Model of electricity regulation that would increase reliance on renewable energy sources and would make the electrical grid more efficient and more reliable.

We believe the Smart Model should also address the demand for electricity by basing the price of electricity on the marginal cost of producing it. This is necessary for two reasons. First, the adoption of smart generation and delivery methods is going slowly, primarily because these alternatives are more costly than traditional forms of generation and delivery. Second, one of the reasons for the limited demand is that consumers are not currently paying for the actual cost of the electricity that they purchase, particularly during periods of peak demand.

Marginal cost pricing will lead to greater conservation of energy and thereby reduce some of the adverse environmental impacts associated with the production of electricity. Moreover, it will also reduce the amount of money that the country will have to invest in additional generation and transmission capacity. While we are uncertain of the magnitude of these positive effects, we are confident that consumption side reform should be pursued on the basis of the information we have and present in this paper.

We would not ignore the opportunity to pursue smart generation alternatives. The government has a role to play here. It can do so by fostering technological development and promoting smart generation methods and a Smart Grid. Governmental efforts are justified because they address the environmental hazards associated with traditional electricity generation. Nevertheless, the widespread adoption of smart generation options will require them to attract private investment. Until this happens, the government should require the installation of electricity meters that permit the use of marginal cost pricing, a reform whose time has come.

There has been some movement in the direction of adopting marginal cost pricing. It is used in some markets for large industrial customers,[206] and it has been offered to some residential

206. *See supra* notes 176-78 and accompanying text.

consumers in experimental programs.[207] At the same time, even the biggest supporters of marginal cost pricing recognize that there is little political will in most regulatory jurisdictions to expose consumers to price spikes and market volatility.[208] This dynamic might change, however, if environmental advocates recognize the advantages of adopting marginal cost pricing for protecting the environment. Environmental organizations and citizens might provide the missing political constituency. In light of the opportunity to reduce demand, particularly peak demand, for electricity, they should take on this cause.

Furthermore, it should be possible to design rate programs that shield vulnerable consumers from assuming the entire economic risks of price fluctuations.[209] While such approaches could reduce the impact of marginal cost pricing in terms of reducing demand, they would still be desirable as compared to current reliance on average cost pricing.

207. *See supra* notes 179-82 and accompanying text.
208. Kosavanic & Engel, *supra* note 162, at 12.
209. *See supra* notes 167-69 and accompanying text.

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